JPRS L/9086

12 May 1980

USSR Report

ECONOMIC AFFAIRS

(FOUO 9/80)

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INDUSTRIAL DEVELOPMENT AND PERFORMANCE

PROCEDURES FOR REEQUIPMENT OF INDUSTRIAL PLANTS EXAMINED

Moscow VOPROSY EKONOMIKI in Russian No 2, Feb 80 pp 105-114

[Article by V. Dubrovskiy: "The Technical Reequipment of Operating Enterprises"]

[Text] In the decisions of the 25th CPSU Congress and subsequent Plenums of the party it was noted that there are serious shortcomings in capital construction, which significantly lower the effectiveness of capital investments. The basic reasons for the lowering of the efficiency of capital investments were reviewed in the course of a discussion which has opened in the pages of this journal.[1] Among the reasons that have been noted is the failure to make requisite use of the possibilities of the technical reequipment and reconstruction of enterprises now in operation.

In the decree adopted by the CPSU Central Committee and the USSR Council of Ministers on the improvement of planning, a system of measures has been set forth to eliminate these shortcomings. It is aimed at the further increase in the effectiveness of capital investments and, above all, the entire technical reequipment and reconstruction of operating enterprises. The intensification of production is one of the basic objects of investment policy. Now, as is noted in the decree, means for the new construction and expansion of operating enterprises will be allotted if the requirements of the national economy cannot be met by operating enterprises, taking into account their reconstruction and technical reequipment.

The decree makes it mandatory to put into operation all reserves and economic levers, and to speed up the fulfillment of this important national-economic task. In our view, in order to achieve high efficiency in the reconstruction and technical reequipment of operating enterprises, basic attention must be focused, above all, on the further elaboration of methodological and organizational questions.

In the preparation of "Basic Directions for the Development of the National Economy of the USSR in the Years 1976-1980" with a view to increasing the productivity of the work with regard to the composition of planning

estimates and the technical-economic substantiation of projects of technical reequipment, reconstruction and expansion of operating enterprises, and with a view to the realistic determination of deadlines for operations to be carried out, these concepts were more precisely defined in a joint decision of the USSR State Planning Commission (Gosplan) and the USSR State Committee for Construction (Gosstroy). However, as the experience of the intensification of production has shown, the existing definitions of technical reequipment and reconstruction of operating enterprises do not allow their clear delimitation in practice. The technical reequipment of operating enterprises constitutes a complex of measures (without expansion of the available production areas) envisaging the increase of the technical level of individual sectors of production, integrated sets of machinery and installations via the introduction of new technology, the mechanization and automation of production processes, the modernization and replacement of obsolete and physically worn equipment with new, more productive equipment. Reconstruction is complete or partial (with regard to a single project) reequipment and reconstruction of production (without the construction of new and the expansion of operating plants of basic production function, but with the installation, if necessary, of new and the expansion of operating projects of auxiliary and service functions) with the replacement of obsolescent and physcially worn equipment, the mechanization and automation of production, the elimination of disproportions in technological links and auxiliary services, which guarantee an increase in the volume of production on the basis of new, more modern technology, the expansion of the assortment or the increase in the quality of products and other indicators with lower expenditures and shorter deadlines than in the case of the construction or the expansion of operating enterprises.[2]

The principal difference between technical reequipment of operating enterprises and reconstruction consists in the fact that reconstruction is carried out in accordance with a single plan for the entire enterprise, while technical reequipment, as a rule, is realized on the basis of individual local plans and estimates. However, in the sectorial plans for capital investments the difference between technical reequipment and reconstruction is frequently relative, not always do the proposals of the enterprises with regard to the technical perfection of production agree with the position of the ministry in the determination of the concrete composition of operations. Probably, this is one of the reasons for the fact that in the 10th Five-Year-Plan the share of capital investments aimed at the technical reequipment and reconstruction of enterprises increased insignificantly for industry as a whole--to 23.6 percent by comparison with 20.2 percent in the 9th Five-Year-Plan.[3]

The measures being realized in practice with regard to the technical reequipment and reconstruction of operation enterprises differ little from new construction. Let us refer to the experience of work in this direction of a number of Moscow enterprises, and above all such large enterprises as

the Moscow Automobile Plant imeni Likhachev (ZIL), the Automobile Plant imeni Leninskiy Komsomol (AZLK), the First State Bearing Plant (GPZ-1). In these plants a great deal of work has been done during the last few years with regard to the technical reequipment and reconstruction of operating factories. At ZIL more than 90 automated lines have been introduced and 70 all-round mechanized sections. At AZLK 28 all-round mechanized sectors, 135 technological flow-lines, and 45 automated lines have been established, 92 percent of the machine tools operate in an automated mode. At GPZ-1, in the course of technical reequipment and reconstruction, 3 fully automated plants, turning out more the 40 percent of the total number of bearings manufactured by the plant, have been put into service, as well as 74 mechanized lines.

A significant growth of capacities by virtue of technical reequipment and reconstruction of operating factories in these plants is envisaged for the long term. Thus, in the leading plant of the association ZIL the old buildings will be demolished and a building complex for the production of automobile bodies, a building complex for light automobiles, a welding and assembly complex, a motor transport plant, power management projects and everyday service facilities will be built. Significant construction work will be carried out at the branch plants: at the Moscow Carburetor Plant a new production complex will be built, at the Moscow Motor Assembly Plant--storage and everyday service facilities.

At the AZLK a new pressing complex, a die shop, a block of mechanical shops will be built, and press and accessories production will be expanded. Significant volumes of work will be carried out on new territory in the course of the technical reequipment and reconstruction of the First State Bearing Plant (GPZ-1). During the first phase, the capacities of the first section of the starting complex (40,000 square meters of new territory) will be introduced. The second phases envisages the construction of a wood processing plant on a new industrial area and the construction of a profile rolled metal plant on operating territory. During the third phase the capacities of the second section of the starting complex on new territory will be introduced (almost 50,000 square meters), the construction of the thermal plant will be completed, as well as the reconstruction of the foundry on the operating industrial area.

The replacement of obsolete equipment as a basic element of the intensification of production, in accordance with the decision adopted by Gosplan and Gosstroy of the USSR, is a distinctive sign of the technical reequipment, as well as the reconstruction of operating enterprises. In practice this means freedom in the selection of reproduction forms if we are talking about increasing the technical level of production by virtue of the introduction of new technology. The experience accumulated during the years of the 8th and 9th Five-Year-Plans with regard to the carrying out of reconstruction of enterprises aimed at increasing the technical level of production testifies to the fact that under conditions of the multi-

purpose character of reconstruction measures, the priority of expenditures for equipment, in particular for replacement, is by far not always observed. As a result of the non-objective assessment of the technical level of enterprises, the economic effect of the replacement of obsolescent and physically worn equipment frequently is absorbed by significant volumes of non-productive expenditures for the construction of secondary projects, and in a number of cases by expenditures called forth by the proportional participation of enterprises in the construction of city purification installations included in the combined financial calculations of the reconstruction projects. Thus, of the total volume of capital investments expended during the first phase of the reconstruction of the Benderskiy Silk Combine (1971-1974), only 17 percent of all funds were directed toward the replacement of obsolete equipment, almost 25 percent constituted expenditures for the construction of auxiliary and service-type projects, transport management and communication.

According to the new plan for the reconstruction of the Benderskiy Silk Combine at a total price of 41 million rubles, the expenditures for basic production are projected in an amount of only 24.4 million rubles. Meanwhile the reconstruction of the combine presupposes, above all, meeting the Moldavian Soviet Socialist Republic's needs in regard to silk cloths and the expansion of their production from 24.3 million to 59.7 million linear meters. This is why the main task is the reequipment and the increase of the machine park with highly-productive equipment.

For the national economy as a whole, of the total volume of capital investments directed toward the reconstruction and expansion during the last years, only 9 percent went for reconstruction without the construction of buildings and installations.[4] Without a doubt, the social results of the intensification of production (the installation of service and educational building complexes, dining halls, professional and technical schools, plant clinics, etc.) can now already no longer be regarded as something secondary, but nevertheless the technical reequipment of sectors of the national economy is a basic task, since an increase in the share of equipment in the volume of capital investments of 1 percent leads to a growth in the output of production of approximately 7-8 billion rubles.[5] Probably it is necessary to strengthen the priority of expenditures for the replacement of obsolete technology in one of the reproduction forms so as to increase control over their use and to draw a clear distinction between such expenditures and expenditures incurred as a result of a change in the profile of the products turned out, as a result of the expansion of production, the achievement of social results of the intensification of production, and other particular motives for undertaking reconstruction.

The expediency of such a measure is confirmed by the existing practice of renovating the production apparatus. The growth of expenditures for the expansion, reconstruction and technical reequipment of operating enterprises according to the five-year-plans does not reflect the real expendi-

tures for the intensification of production. Thus, the proportion of capital investments for the expansion, reconstruction and technical re-equipment of operating enterprises in 1965 equalled 61 percent of the total volume of capital investments on projects of a production character, in 1977 it increased to 69 percent.[6] The share of expenditures for the replacement of obsolete equipment in the total volume of capital investments in equipment in the 8th Five-Year-Plan amounted to 13.2 percent.[7] In the subsectors of machine building, 7-8 percent of the total sum of capital investments directed toward the development of the entire industry were allotted for the renovation of fixed capital in the 9th Five-Year-Plan.[8] For the national economy as a whole, the share of equipment directed toward replacement amounts to approximately 14 percent of the total volume of its consumption.[9]

The average annual rates of growth of the equipment park in the national economy have decreased by an insignificant amount in recent years. The expanded reproduction of the machine park is realized basically to the detriment of the real removal of the assets. Thus, in 1976 the coefficient of the introduction of machines and equipment in industry amounted to 9.6, while the coefficient of equipment removal was only 2.3,[10] in machine building and metal-working--13.3 and 2 respectively, i. e., the expansion of the functioning equipment park proceeds more than 6 times as intensive than the replacement of its obsolete part.

In our view, the replacement of obsolete equipment could be excluded from the structure of reconstruction operations and be regarded only as "the technical reequipment of operating enterprises." The definition of the structure of reconstruction operations in relation to the specific character of industries is also in need of refinement. The existing definition of reconstruction does not reflect the whole diversity of reconstruction measures. Thus, at the present time there has been a sharp increase in expenditures for the preservation of the environment. For example, the plan for the reconstruction and technical reequipment of the Kuznetskiy Metallurgical Combine imeni V. I. Lenin involving a total cost of 905 million rubles projects expenditures for the preservation of air and water basins in the amount of almost 168 million rubles. An important peculiarity of the investment policy of technical reequipment of operating enterprises in the current period lies in the fact that it has the character of special purpose economic programs. Such, for example, are the programs of technical reequipment of the coal industry, the textile enterprises of Moscow and Leningrad. The technical reequipment and reconstruction of the enterprises of Sverdlovsk Oblast made it possible to obtain 1 billion rubles in additional production while saving 460 million rubles in capital investments.

One of the basic tasks of special purpose economic programs is the putting into operation of all reserves and the exposure of the reserves of all spheres of material production.[11] In relation to the programs of technical

reequipment, this is linked to the elaboration of plans of technical re-equipment of enterprises on the scale of industries and within the limits of large investment projects. Positive experience of such work in industry exists in the chemical and petroleum machine building sector. During the 9th Five-Year-Plan the development and introduction of such plans were completed in 15 plants in the sector. At the present time, plans for the technical reequipment of 62 enterprises of the sector are being developed.

However, to date there is no single approach to the development of plans for technical reequipment. The selective investigation we have conducted of enterprises of the Main Administration for the Manufacture of Excavators and Cranes (Glavekskavator), the Main Administration for the Manufacture of Construction Machinery (Glavstroymash), the Main Administration of Road Machinery Manufacture (Glavdormash), industrial enterprises of the Moldavian Soviet Socialist Republic and a number of Moscow enterprises shows that these plans are cumbersome, contain a number of sections which have no direct relationship to the task of the technical reequipment of production. In their composition the developing technology of the elaboration of the technical, industrial and financial plans is practically copied, and they represent, in essence, plans for the technical development of enterprises in which no difference is made between technical reequipment, properly speaking, and reconstruction projects.

An analysis of methodological materials also demonstrates the oversaturation of the technical reequipment plans of enterprises with measures concerning the perfection of the organization of production. Thus, the plan for the technical reequipment of the enterprises of the Ministry of Machine Building for Light and Food Industry and Household Appliances consists of 15 parts. Along with basic measures concerning the technical perfection of production, it has also such sections as the scientific organization of labor, the increase of qualifications and training of workers, proposals with regard to shipments of products under subcontracting arrangements, planning work. The plans for the technical reequipment of the enterprises of the food industry of the Moldavian Soviet Socialist Republic include measures regarding the rational use of material and natural resources, the preservation of the environment, the perfection of the organization of production. The plan for the technical reequipment of enterprises of the machine tool and tool building industry (stankoinstrumental'naya promyshlennost') encompasses 37 different directions of the technical perfection of production.

Undoubtedly, the technical development of the enterprises presupposes the overall improvement of production taking into account its specific character. At the same time, it is necessary for the plan of the technical reequipment of enterprises to be more concrete. It is thought that this is, first of all, the plan for the replacement of obsolete technology with new technology, with highly-productive equipment, by virtue of which it must be a component part of the plan for the technical development of the

enterprise and not substitute for it. Apparently, a directive interrelationship between the plans for technical reequipment and the standards for mandatory annual depreciation of obsolescent and physically worn equipment, differentiated by sectors of industry, is expedient. This makes the plan of technical reequipment effective and, what is the main thing, reinforces control over its fulfillment.

In the drafts of the five-year-plans a new decree by the CPSU Central Committee and the USSR Council of Ministers envisages the development of balances and calculations of the use of available production capacities and summary plans of reconstruction and technical reequipment. The delivery of finished projects is now the main criterion for assessing the activity of the contracting organizations. Under conditions of planning effective production and new construction as a single whole, these measures must increase the level of technical-economic grounds in the selection of the paths of intensification of production and supply with material resources and capacities those enterprises which have come forward with the initiative of technical reequipment or reconstruction of production now in operation. Nevertheless, given the mass character of operations with regard to the technical reequipment and reconstruction of operating enterprises in regions and large industrial regions, where the development of large construction programs is envisaged in the long run, strains may arise in the balance of specialized capacities. The construction and assembly organizations must determine the priority of projects included in the plan of operations.

The solution of the problem of the formation of new specialized capacities requires the careful substantiation of the contemplated variants of reconstruction and technical reequipment, the selection of the most optimal and least capital intensive among them. The necessity arises to compare, for each region and industrial complex, the expenditures for the creation of construction-assembly organizations with the losses that may be caused to the national economy because of a shortage of available capacities. Therefore, in order not to divert additional capital investments for the formation of new capacities, the enlargement of already existing contracting organizations and, first of all, of the repair and building subdivisions is expedient, in our view. For example, in the Moldavian Soviet Socialist Republic the repair and building organizations attached to the ministries are given the rights of a general contractor, themselves carry out construction work within the limits established for them, engage subcontracting organizations for the assembly, the setting in motion and adjustment of equipment and keep accounts with them for work that has been completed. It must be noted that these organizations are active participants in the investment process of the republic--which significantly reduces the time periods required for the technical reequipment of operating factories.

The experience of the Territorial Main Administration for Construction in the Western Regions of the RSFSR (Glavzapstroy) of the USSR Ministry of

Construction, where correction factors were introduced for contracting organizations, taking into account the specific nature of the work in operating enterprises, produced positive results. However, as became clear in the course of the experiment, it is inexpedient to entrust large specialized organizations with small volumes of work in regard to the reconstruction and technical reequipment of operating enterprises. The question is not that the basic volume of work in the program of technical reequipment of operating enterprises be carried out in an economic manner, but that in a number of cases it is much more advantageous and must not be refused. The widely disseminated practice of the technical reequipment of operating enterprises in the Moldavian Soviet Socialist Republic revealed a number of new organizational forms. For example, in the Moldavian Bread Industry (Moldkhlebprom) Association of the Ministry of Food Industry of the Republic, the department for new technology of the leading enterprise, which determined the function of each of the subdivisions, was in charge of the development of the program of technical reequipment of the bread-baking plants. All necessary documentation was worked out by the design office of the enterprise. A specialized section, consisting of the construction group of the department of capital construction, metal workers and repairmen, and fitters, carried out the introduction of new technology. The starting and adjustment operations were carried out by the engineers and automation specialists of the department of the chief mechanic.

At the Benderskiy Silk Combine the start-up and adjustment work in textile production was carried out by assistants to the foremen of operating plants, responsible for the daily operation of the equipment. In other factories of the combine metal workers and repairmen with high qualifications were involved in this work. Work completed on schedule and the assessment "good" in accordance with a specially developed scale entitled workers to receive an increase in the amount of 30 percent of their wages. This resulted in a sharp reduction of the time periods required for jobs and guaranteed their proper quality.

It must be noted that the territorial specialized organizations do not always do the best job in carrying out the assembly and the start-up and admustment work of equipment. Frequently they do not know the specific character of the equipment at the enterprises to be serviced, do not bear responsibility for the quality of work, and drag out excessively the time required for completing the work. At the large enterprises, the services of the department of the chief mechanical engineer are staffed with qualified specialists who are able to solve complex technical tasks, and, what is important, they are interested in reducing the time period required for completing the work. For this reason, sometimes the technical reequipment of production is more advantageously carried out by the efforts of the enterprises themselves--where there is no unique equipment requiring the participation of chief fitters.

In large associations it is expedient to give the specialized sections en-

gaging in the technical reequipment of production the character of visiting brigades. Having acquired skills and accumulated a certain work experience, these brigades, together with the metal-workers and repairmen and the service of the department of the chief engineer on the local scene, can significantly speed up the execution of such work. It is very important that at the decisive moment of the technical reequipment of production in one enterprise--for the period of the withdrawal of operating capacities --compensating possibilities can be prepared within the limits of the association in another. In the associations the planning and design office needs to be involved more broadly in the development of the planning estimates. For example, at the First State Bearing Plant the designers created approximately 20 models of automatic machines for the control and grading of components of bearings. On the basis of such models automatic control devices are manufactured for the entire bearing industry of the country in tool-making plants. Moreover, there is the possibility, not having fully completed the draft and manufacturing plans, to carry out necessary adjustments with the manufacturing engineers in all phases, to conduct control tests and to introduce changes, having already realistically determined time periods for the execution of technical reequipment work, and at the same time to work up the details of the plan for every complex under construction.

Planning and design offices in associations and large enterprises that have taken the initiative of the technical reequipment of production through their own efforts must be given the rights of a responsible developer of documentation and must be placed on the same footing by statute as the planning organizations. This is especially important in industries where the course toward the technical reequipment of production through the efforts of enterprises is conditioned by their specific characteristics.

The creation of large design offices in a number of industries, which take questions having to do with the planning of the technical reequipment of production, may be conducive to the solution of the problem. The experience of such work is available in the machine-tool industry of Moscow, where special design offices were created. For example, on the basis of the manufacturing instructions provided by the Moscow Special Design Office for Automated and Integrated Machine-Tools, complexes of automated lines were manufactured for the technical reequipment of Moscow plants and, first of all, such large plants as ZIL, AZLK, Dynamo and Kompressor.

Practice shows that the development of progressive plans for technical reequipment by design institutes is impossible without the active assistance of the leading specialists of the enterprises. Their participation helps to find solutions which most fully take into account contemporary directions of development of the plant and industry.

Since 1977 all financial resources of capital investments have been concentrated in the USSR Stroybank (All-Union Bank for the Financing of

Capital Investments). For the financing of the technical reequipment and reconstruction of operating factories, the enterprises use the means of the fund for the development of production and credit. The role of the fund for the development of production in the financing of expenditures for the intensification of production is increasing especially with the publication of a new decree of the CPSU Central Committee and the USSR Council of Ministers. Now the expenditures for the technical reequipment of production are included in the plan of capital construction of the ministries and departments.

The effectiveness of expenditures for the intensification of production, to be determined along the line "fund for the development of production--credit", in many respects depends on the real magnitude of the fund for development and the level of its utilization, since the credits received in the first place must be paid off with means from the fund. Unfortunately, in practice the strictly purposeful expenditure of means from the fund for the development of production is not observed. In the enterprises of the majority of industries there exists, as a long-established tradition, a procedure for the expenditure of the means of the fund, in which--along with the liquidation of indebtedness in terms of bank loans and deductions going into the centralized fund of the ministries--deductions for the repair and construction of motor highways are mandatory.

The selective investigation which we conducted into the use of the means of the fund for the development of production in the largest sectors of the industry of the Moldavian Soviet Socialist Republic showed that a significant portion of the means of the fund are expended for the construction and repair of roads. Thus, according to the Ministry of Light Industry of the Moldavian Soviet Socialist Republic, deductions for the repair and construction of motor highways made from means of the fund for the development of production during 1971-1976 almost equalled the expenditures for production. In this case the expenditures for the acquisition of equipment at the expense of means from the fund for the development of production amounted to 26 percent of the total extra-charge fund and exceeded the volume of credit received for these purposes by only 17 percent. For the 9th Five-Year-Plan as a whole, the deductions for motor highway repair and construction from the means of the fund for the development of production exceeded the dimensions of centralized capital investments directed toward the replacement of obsolete equipment by a factor of 1.9 and non-centralized capital investments by a factor of 1.6, and constituted 74 percent of their total volume.

According to the Ministry of Furniture and Wood-Processing Industry of the Moldavian SSR, of the total fund for the development of production set down during 1972-1976 only 15 percent were expended for the acquisition of equipment. At the same time, the deductions for the repair and construction of motor highways, made during this period at the expense of the means of the fund for the development of production by the enterprises of the ministry, exceeded the volume of centralized capital investments directed

toward the replacement of obsolete equipment by 9 percent and the volume of non-centralized capital investments by a factor of 2.1, having amounted to 75 percent of their total volume. The same kind of correlations between the deductions for repair and construction of motor highways and the expenditures for the replacement of obsolete equipment are characteristic also for the enterprises of the Ministry of Food Industry of the republic. Here such deductions during 1974-1976 exceeded centralized capital investments for the replacement of obsolete equipment by 8 percent and non-centralized capital investments by a factor of 2.5.

A striking contrast can be observed when contrasting deductions for the repair and construction of motor highways made by enterprises at the expense of means from the fund for the development of production with the dimensions of credit drawn. For example, in the case of the Ministry of Light Industry of the Moldavian SSR such deductions during 1971-1976 exceeded the credits obtained for the acquisition of equipment by a factor of 5.5 and the total volume of credits obtained for production needs by a factor of 2.2. In the case of the Ministry of Furniture and Wood-Processing Industry of the Moldavian SSR these deductions during 1972-1976 were 2 times larger than the credit expended for the acquisition of equipment.

The norm of expenditures for local needs, projected in the amount of 0.2 percent of the sales volume, obligates enterprises to make such deductions regularly. According to the existing situation, expenditures for the repair and construction of motor highways must be made from several sources. However, in practice the only real source is the fund for the development of production. Thus, of the total volume of deductions for local needs in the case of the Ministry of Light Industry of the Moldavian SSR the means from the fund for the development of production constitute 92 percent, in the case of the Ministry of Furniture and Wood-Processing Industry of the Moldavian SSR--94 percent, in the case of the Ministry of Food Industry of the Moldavian SSR--88 percent. Thus, on the one hand, the means of the fund for the development of production are inadequate for the financing of the technical reequipment of operating enterprises and the enterprises are forced to obtain credits, and on the other they are expended for goals which have no direct relationship to the increase in the technical level of production. Thus, during the 9th Five-Year-Plan, industrial enterprises of union-republic, republic and local subordination of the Moldavian SSR transferred 41 percent of all means directed toward the replacement of obsolete equipment for production-oriented projects from the fund for the development of production to the repair and construction of motor highways. This is approximately 1.2 times larger than expenditures for the technical reequipment and reconstruction of enterprises in the sectors of industry for which capital investments were allotted directly by the Council of Ministers of the Moldavian SSR. It suffices to say that only by virtue of the means from the fund for the development of production transferred by the enterprises of the Ministry of Light Industry of the Moldavian SSR for local needs during 1971-1976 was it possible to replace the obsolete means of work, retired during this period,

by 62 percent.

Under the new conditions of financing the technical reequipment and reconstruction of operating enterprises it is impossible to accept such a procedure of expending means from the fund for the development of production. Of course, expenditures for the repair and construction of motor highways are necessary; however, in our view, the means from the fund for the development of production must be excluded from the composition of the sources of financing expenditures for local needs. Apparently it is expedient to create a special source of expenditures for these purposes.

The improvement in the amortization policy and the termination of the financing of expenditures for the repair and construction of motor highways from means coming from the fund for the development of production does not deny the necessity for credits. Precisely now the enterprises will more often resort to credit services for the needs of technical reequipment since under the new conditions of financing credit is unlimited, and the potential possibilities of the fund in terms of the liquidation of the credits obtained will be significantly higher. Particularly advantageous is the liquidation of credits by means of the fund for the development of production when the work in regard to the technical reequipment of enterprises are completed ahead of schedule, since in this case the rate of interest is reduced.

At present the All-Union Bank for the Financing of Capital Investments (Stroybank SSSR) grants credits, taking into account the total volume of the proposed expenditures. According to the new state of affairs, if the fund for the development of production turns out to be inadequate for the repayment of the credit, the enterprise may direct a portion of its profit toward the repayment of the credit--the portion which remains after deductions to economic incentive funds, payments for credits obtained earlier, and payments into the budget. Evidently, this point must be more precisely defined, i. e., a procedure must be set down for the repayment of a credit in those cases where work in regard to the technical reequipment of plants and sections and the reconstruction of individual factories, called forth by a change of technology, the expansion of production or the necessity of improving working conditions, is carried out simultaneously and the enterprise obtained credits, since the means of the fund for the development of production did not suffice. In our view, measures of the technical reequipment of production based on credit must, first of all, be repaid by means from the fund for the development of production. Loans for the reconstruction of production units called forth by significant capital investments and the time periods required for such work, in these cases must be repaid from profit. This makes it possible to control the the use of capital investments and to speed up the time period required for the execution of reconstruction work, since a material interest on the part of the collectives will be created in the timely completion of the work.

The All-Union Bank for the Financing of Capital Investments has issued instructions obligating all institutions of the bank to give all possible assistance to enterprises in the matter of the technical reequipment of production. However, to rely only on the indicator of credit efficiency is impossible alone for the reason that the practice of its calculation now in operation does little to encourage the strengthening of bank control. The essence lies in the fact that the average indicator of credit effectiveness calculated by the institutions of the bank often times does not take into consideration the specific characteristics of the subsectors of the industry and thus does not always reliably reflect the effectiveness of the loans obtained. It is inferred not from factual data concerning the output of production for the past period, but from accounting data, and for this reason it has an exceedingly provisional character.

The existing system of measures envisaging strict bank control over the character of the use of loans must be supplemented with special statutes allowing the institutions of the All-Union Bank for the Financing of Capital Investments not to accept the plans submitted by the ministries for capital construction with an insufficiently effective structure of capital investments and to require the priority of expenditures for the replacement of obsolete technology, and then to control the credits expended.

The problem of the effectiveness of the technical reequipment of operating enterprises during the current stage of development encompasses a wide range of questions. The task consists in the acceleration of the process of the technical reequipment of production--having perfected the organizational forms of the realization of such work, the forms of stimulating the economic initiative of the enterprises and having utilized all possible sources of financing.

FOOTNOTES

1. See, in particular, Academician T. Khachaturov, "Puti povysheniya effektivnosti kapital'nykh vlozheniy" [Ways of Increasing the Effectiveness of Capital Investments], VOPROSY EKONOMIKI, No 7, 1979.

2. See "Novostroyka, rekonstruktsiya, rasshireniye" [New Construction, Reconstruction, Expansion], EKONOMICHESKAYA GAZETA, No 15, 1975, p 9.

3. See EKONOMIKA STROITEL'STVA, No 11, 1976, p 68.

4. See V. K. Fal'tsman, "Intensifikatsiya razvitiya proizvodstvennogo apparata" [The Intensification of the Development of the Production Apparatus], VOPROSY EKONOMIKI, No 1, 1978, p 10.

5. See M. G. Chentemirov, "Povysheniye effektivnosti kapital'nykh vlozheniy--zadacha kompleksnaya" [The Increase of the Effectiveness of Capital Investments Is a Complex Task], EKONOMIKA STROITEL'STVA, No 4, 1977, p 5.

6. See NARODNOYE KHOZYAYSTVO SSSR V 1977 G. STATISTICHESKIY EZHEGODNIK. [The National Economy of the USSR in 1977. A Statistical Yearbook], Izdatel'stvo Statistika, 1978, p 355.

7. See N. V. Ivanov, N. A. Zelenskiy, "Puti obnovleniya parka oborudovaniya" [Ways of Renovating the Equipment Park], VESTNIK MASHINOSTROENIYA, No 6, 1975, p 88.

8. See A. P. Bulkin, "Rol' mashinostroyeniya v investitsionnykh programmakh narodnokhozyaystvennykh kompleksov" [The Role of Machine Building in the Investment Programs of National-Economic Complexes], INVESTITSIONNYE PROBLEMY NARODNOKHOZYAYSTVENNYKH KOMPLEKSOV, Moscow, 1976, p 256.

9. See IZVESTIYA AKADEMII NAUK SSSR. Seriya ekonomicheskaya, No 2, 1975, p 53.

10. See "Narodnoye khozyaystvo SSSR za 60 let" [The National Economy of the USSR After 60 Years], Izdatel'stvo Statistika, 1977, p 190.

11. See V. P. Krasovskiy, "Effektivnost' tselevykh ekonomicheskikh programm" [The Effectiveness of Special Purpose Economic Programs], VOPROSY EKONOMIKI, No 12, 1976, p 39.

8970
CSO: 1820

ECONOMIC MODELING AND COMPUTER TECHNOLOGY APPLICATION

INSTITUTE ACTIVE IN ECONOMIC MODELING

Moscow VOPROSY EKONOMIKI in Russian No 3, Mar 80 pp 3-5

[Unsigned article: "Scientific and Scientific-Organizational Activity of the Central Mathematical Economics Institute of the USSR Academy of Sciences"]

[Text] The decree of the Presidium of the USSR Academy of Sciences entitled "On the Scientific and Scientific-Organizational Activity of the Central Mathematical Economics Institute of the USSR Academy of Sciences in the Period 1970-1978" notes that the institute, guided by the tasks outlined in the 24th and 25th CPSU congresses and plenums of the CPSU Central Committee related to improvement of management of the national economy and to more thorough intensification of social production, has carried on a definite effort to develop and deepen that direction in economic science known as mathematical economics.

The institute has made a substantial contribution to development of a new field of economic science--mathematical economic modeling--and has been energetic in helping to set down the procedural foundations for effective use of electronic computers in managing the national economy and its constituent entities and also creation of the methods of systems analysis and improvement of the economic mechanism for management of the planned economy. The institute has done research on the following topics: the theory of optimum functioning of a socialist economy; the economic and social problems of long-range development of the USSR national economy; theoretical and methodological problems of long-range economic planning and creation of the computerized system of planning computations (ASPR); methodological underpinning and experimental construction of systems of models of optimum planning of the national economy, sectors and industries and multisector complexes.

In recent years TsEMI [Central Mathematical Economics Institute of the USSR Academy of Sciences] has brought out such publications as "Problems of Optimum Functioning of the Socialist Economy," "Economic Laws of Socialism and Optimum Solutions," "Integrated National Economic Planning," "Optimization of the Economy," "Forecasting the Growth of a Socialist Economy,"

"Modeling National Economic Processes," "System of Models of Optimum Planning," "Economic Problems of Conservation of Resources," "Basic Principles in Methods of Optimalizing Development and Location of Production," "Needs, Income, Consumption. Methodology for Analyzing and Forecasting the Prosperity of the People," etc.

The institute made a contribution to the drafting of the Comprehensive Program of Scientific-Technical Progress and Its Long-Range Socioeconomic Consequences.

Various models of the planning and management of enterprises and industries in the context of ASU [computerized management system] have been put through experimental verification and delivered for practical use. ASU's have been set up in a number of large enterprises, ministries and departments with the guidance of the institute as to methods and with its direct participation. Jointly with other organizations the institute developed models for optimalization of the production program and capital investments, for location of production, for optimum utilization of productive resources, and for optimalization of relations between suppliers and consumers for the chemical, cement, coal and other industries. With the institute's participation preplan optimalization computations were made on the basis of these models for a number of branches and subbranches of material production.

The "Recommendations on Methods of Drafting Comprehensive National Economic Programs" were prepared by the institute and approved by the Council for Examination of Major Social and Economic Problems of USSR Gosplan. With the institute's participation methods were also created for determining the efficiency of utilization of new technology, inventions and production innovations in the national economy, of economic assessment of mineral deposits, of calculating the optimum sequence for compiling price books, etc.

Measures have been adopted to improve the planning of scientific research and to make the activity of graduate study more orderly.

But there are still substantial shortcomings in the institute's work. Work is going slowly on the most urgent problems of the national economy. In theoretical and applied research little attention is being paid to studying strategies for the transition of the socialist economy from the extensive to the intensive type of reproduction, for speeding up scientific-technical progress and for increasing production efficiency.

There is a lag in developing the methodological foundations of applying the methods and models of mathematical economics in planning and management and of optimum utilization of all opportunities for expanded socialist reproduction. A number of materials prepared by the institute are in need of more thorough substantiation in the field of political economy.

Research on the problems of the optimum functioning of the economic system are not always up-to-date and purposive. Due attention is not being paid

to the problems of the quantitative determinacy of socially necessary costs, social utility, and creation of methods of measuring it.

The methods of national economic forecasts and practical projects in the forecasting field still are not comprehensive in nature. The theory and methods being used as the basis for research on problems of long-range forecasting are incomplete. Up to the present no one has succeeded in overcoming the difficulties in correlating the scientific-technical forecasts and the socioeconomic forecasts. Research on setting up information systems has not been coordinated.

Among the institute's publications there are poor examples which have been rightly criticized.

Some of the institute's subdivisions are not oriented toward solving the principal problems they have been set. There is a shortage of specialists with education in the field of political economy, especially people with high qualifications who have mastered the methods of mathematical economics. Some of the staff members are superficial in their understanding of the problems of the national economy.

Many methods and models of mathematical economics that have been developed and tested experimentally are still not being sufficiently used in the practice of planning and managing the national economy.

The Presidium of the USSR Academy of Sciences has approved on the whole the results of the scientific research effort of TsEMI in the period 1970-1978.

It has been deemed indispensable to concentrate the efforts of the institute's staff on study of the problems of planned management of the economy and of raising its efficiency. The first-order problems are a further rise in the theoretical level and strengthening of the practical orientation of research, preparation of recommendations on scientific methods of improving planning and management of the national economy and its individual entities on the basis of extensive use of the methods of mathematical economics and electronic computers. There is a corresponding need to further intensify research in the following fields and make it more effective:

i. development of a methodology of long-range and medium-term forecasting of economic development, including justification of growth rates and the structure of social production, development of the most important intersector national economic complexes;

ii. creation of a methodology for integrated national economic planning and construction of systems of mathematical economic models of economic development of the country as a whole, of intersector complexes, of sectors and industries, of union republics and of economic regions, as well as of incorporating them into the ASPR, including solution of the problems of correlating mathematical economic models with the technological scheme for

drafting national economic plans and linkage of the different sections of plans;

iii. work on the theory of systems for management of sectors and industries, associations and enterprises using computer equipment to perfect the economic mechanism and organizational structures;

iv. study of the problems of perfecting the planned economic mechanism for managing the socialist economy, including the problems of planned price setting, economic assessment of national economic resources, optimalization of conservation of resources, organic combination of physical and value proportions of the plan;

v. development of new methods of modeling economic processes and their software, including creation of algorithms and packages of applied programs for linear, nonlinear and discrete optimalization and for solving statistical and stochastic problems.

The Presidium of the USSR Academy of Sciences has ordered the institute to take an active part in preparing materials for the 11th Five-Year Plan for Development of the National Economy and for compiling the long-range plan of the country's socioeconomic development; to see to the further development and comprehensiveness of studies of the political-economic foundations of the system of optimum functioning of the socialist economy and comprehensive mathematical economic models for planned management of the national economy; to devise a methodology for constructing computerized management systems; to raise the level of research on scientific methods related to the Comprehensive Program of Scientific-Technical Progress and Its Long-Range Socioeconomic Consequences; to adopt measures toward a further rise in the scientific and theoretical level and practical significance of the institute's publications and recommendations; and to see that the problems are posed in concrete terms and thoroughly elucidated.

The Presidium of the USSR Academy of Sciences has assigned the institute's directors the following duties: in order to increase the effectiveness and practical significance of the results of scientific research, to take steps to strengthen relations with USSR Gosplan, ministries, departments, associations (enterprises), and subdivisions of academies of sciences of the union republics developing mathematical economic models of planning and management; to be more persistent in implementing measures to introduce the methods and models of mathematical economics into the practice of planning and managing the national economy and to prepare specific recommendations in this area; to improve the organizational structure and scientific-organizational activity of the institute with a view to concentrating energies on the main lines of research and improvement of their planning; to take effective steps to increase the number of specialists with education in the field of political economy; to enroll in specialized graduate study primarily persons who have education in political economy and mathematical economics.

The decree recommends that the institute's directors and academic council take a more exacting stance in evaluating the results of the creative activity of scientists when they are being reappointed to a new term and when scientific-technical personnel are being certified.

The Presidium of the USSR Academy of Sciences has ordered the institute to prepare recommendations on raising the scientific and theoretical level and practical significance of publications in the journal EKONOMIKA I MATEMATICHESKIYE METODY.

7045
CSO: 1820

INTRODUCTION OF NEW TECHNOLOGY

ECONOMIC, LEGAL PROBLEMS OF SCIENTIFIC-TECHNICAL R&D NOTED

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 1, Jan 80 pp 31-40

[Article by P. A. Sedlov, candidate of economic sciences]

[Text] The system of integrated planning, financing and stimulation of scientific-technical progress was first created and successfully applied in our country. We draft plans for new technology and utilize specific methods of financing and material incentives aimed at speeding up the rates of scientific-technical development. But now because of the strengthening of economic methods of managing production and the development of economic legislation there is a need to make the system for planning and stimulating scientific-technical progress more comprehensive, to improve the interrelatedness of the individual parts of this economic mechanism.

Within industries this system is called upon to perform a whole range of tasks. They include planning the creation, production and application of new technology (at the manufacturing enterprises they plan both the output of series-produced products and also organization of production of new technology; the distribution of resources between these two principal types of operation, as well as production capacities, needs to be done on a normative basis); improvement of the method of setting prices on new types of products so as to take into account that distribution of the economic benefit to the national economy which would give an incentive for new technology both to manufacturers and consumers; compensation for the higher costs related to putting new technology into production; reimbursement in the incentive funds of enterprises of the losses resulting from those same causes; material incentives of collectives for advances in scientific-technical progress financed from funds earmarked for the awarding of bonuses for economic performance, and finally, specific incentives for workers of enterprises and organizations for developing new technology and for putting it into production.

It is a question, consequently, of creating those economic conditions (and not merely incentive methods) which "fully correspond to very rapid passage

of new ideas along the entire chain--from the invention to large-scale production and set up a dependable economic barrier to the manufacture of outdated products."*

The specific solution to the economic problems enumerated above is provided for by means of law, set forth in the relative normative documents, which should contain a strict set of rules governing the operation of the individual elements of the system. At the same time.efficient operation of the economic system must be achieved by using the motivation of enterprises, organizations and individual workers.

Under present conditions it is frequently unprofitable for enterprises to put new technology into production. During the period of its being put into production the higher costs and higher labor intensiveness have an adverse effect on the indicators of enterprises' economic performance. Collectives are working intensively, expenditures are rising, but the size of the incentive may be smaller.

According to statistical data for the industrial sector as a whole, during the Ninth Five-Year Plan the profitability of the manufacture of all new products was lower during the first 2 years than the average profitability of marketed products. Thereafter, beginning in the third or fourth year of production depending on the type of product, the profitablity of products increases and begins to exceed the average. In surveys conducted by the Central Statistical Administration of 1,900 enterprises in 10 machinebuilding ministries the profitability of marketed output was 17 percent in 1974 and 17.3 percent in 1975. At those same enterprises the profitability of new products put into production was 14.4 percent in 1974 and 14.3 percent in 1975 (that is, 2.6 and 3 points lower, respectively).

At enterprises in the machinebuilding sector the size of the fund from which financial incentives are paid for economic performance is as a rule 10-12-fold larger than the fund from which bonuses are paid for new technology, and the amount by which incentive funds are reduced for underfulfillment of the fund-regulating indicators (rise of labor productivity, level of profitability and growth in the volume of marketed output) by just 1 percentage point can exceed the entire amount of funds used to pay bonuses for creation and application of new technology.

When fund-regulating indicators are underfulfilled by just 1 percentage point, the material incentive fund of the Ministry of Machine Tool and Tool Building Industry (according to the rates established for that industry) would decrease by an amount approximately equal to the size of the fund from which bonuses are awarded for new technology. In light industry,

* L. I. Brezhnev, "Report of the CPSU Central Committee and the Next Tasks of the Party in the Domain of Domestic and Foreign Policy," in the book "Materialy XXV s"yezda KPSS" [Proceedings of the 25th CPSU Congress], Moscow, 1976, pp 48-49.

where the rate of the deductions for new technology is lower than in machinebuilding, the total amount of the reduction of the material incentive fund would be threefold greater than the fund from which bonuses are paid for creation and application of new technology.

Figures on the industrial sector as a whole, on individual industries and on enterprises confirm the need to adopt special effective measures aimed at strengthening the motivation of enterprises and their workers to put new technology into production. The decree of the CPSU Central Committee and USSR Council of Ministers entitled "On Improving Planning and Increasing the Impact of Economic Instruments on Production Efficiency and the Quality of Performance," adopted in July 1979, is aimed at improving economic methods of managing the process of putting new technology into production.

The basis of the system of economic incentives to encourage scientific-technical progress, as indeed for managing the socialist economy as a whole--is planning. The list and scope of projects related to new technology, standards pertaining to outlays to put it into production and the economic benefit from its application should be set forth within the framework of a unified plan. Planning targets for current production, especially with respect to the rise of labor productivity, the volume of sales, profit and profitability should be assigned so as to take into account the impact which the processes of putting new technology into production has on enterprise performance. And finally, enhancing the role of planning in economic stimulation of scientific-technical progress consists of developing and applying sound norms pertaining to the higher costs of putting new technology into production, to reimburseable losses in incentive funds, to the time during which reimbursement is to be made, and so on; without this the entire system cannot function normally.

Until recently only targets for application of new technology financed with capital investments were assigned to the enterprise in the technical, industrial and financial plan (in the group of indicators pertaining to capital construction): that is, targets whose purpose is the retooling and reconstruction of capital. The actual introduction of the new product in physical terms would be calculated and approved at the enterprise itself. It is clear, however, that the target for putting a new product into production will have the force of a directive only if it is included in the principal products list whose nonfulfillment has an effect on formation of incentive funds.

Nor until recently have specific rates and standards that take into account the peculiarities of the period in which new technology is being put into production been applied to planning and supporting the output of new products with the necessary production capacities, manpower and financial resources, wage fund and economic incentive funds. In the chapter entitled "Drafting of Norms and Standards" of "Tipovaya metodika razrabotki pyatiletnogo plana proizvodstvennogo ob"yedineniya (kombinata), predpriyatiya" [Standard Method of Drafting the Five-Year Plan of the Production

Association (Combine), Enterprise] (Moscow, 1975) norms and standards were not envisioned pertaining to the consumption of raw materials and supplies, labor intensiveness nor the need for equipment concerning the conditions for putting new technology into production.

The method for drafting these norms and standards should take into account the complexity of putting new products into production and variation of the norms and standards according to the periods for putting new technology into production. The general methodological approach to determining standard costs could in this case be the following one.

An item-by-item costing is done for the products to be put into production. Necessary additional expenditures are determined for each item by recording and analyzing actual costs of analogous projects under similar conditions, and then they are totaled. The costs of standardized (standard) parts and operations are determined precisely, while costs and additional expenditures for the production of components and assemblies pertaining only to the new product are calculated on the basis of similar examples and so as to take into account the experience in the most efficient manufacture of models already being produced of the given form of technology. After this has been done, a calculation needs to be made on the basis of the data obtained of the cost increase coefficients for each item and the overall coefficient for the entire product. Then, taking into account variation of profitability from year to year during organization of the production of the new product, the standard period for reimbursement of the higher cost is determined and the degree of reduction of the cost increase coefficients is determined by calendar periods (this kind of work should be done by the head scientific research institutes for subindustries for each product type). Drafting these standards will make it possible to determine more accurately the rates used in forming the industrywide Unified Fund for Development of Science and Technology (YeFRNT), which has been provided for in the decree of the CPSU Central Committee and USSR Council of Ministers.

An intensive search is being conducted in our country for new forms and methods of planning and stimulating scientific-technical progress.

In the electrical equipment industry and certain other industries the planning of new technology is based on the principle of project continuity--from scientific research to organization of the production of new products or adoption of progressive manufacturing processes. Intraministerial job orders are used as a planning instrument; they call for fulfillment of all the phases of the projects, they designate those responsible, they specify the technical-and-economic parameters of the subjects of the projects, sources of financing and other data indispensable to successful creation and introduction of new technology. The job orders are in turn used as the basis for compiling annual topic plans of scientific research institutes and design bureaus and enterprise plans for putting new technology into production. This procedure eliminates the gap between R&D projects and the effort to put the result into production and makes it possible to

monitor the entire group of projects phase by phase as they are being carried out. The new planning procedure has made it possible to reduce the time required to create new technology and put it into production by approximately one-third and in certain cases even more.

The decree of the CPSU Central Committee and USSR Council of Ministers entitled "On Improving Planning and Increasing the Impact of Economic Instruments on Production Efficiency and the Quality of Performance" called for completion in 1980 of the conversion of enterprises and organizations of industrial ministries to the cost-accounting system of organizing efforts to create, put into production and apply new technology on the basis of job orders. It is important to generalize the experience of using job orders in various industries and to standardize both the planning method and also its forms. This experience should also be used in organizing and planning efforts that lie outside the framework of intraindustry relations, specifically in fulfillment of comprehensive scientific-technical programs.

We should note that the new planning procedure in the electrical equipment industry has not touched upon the system of indicators which should reflect more fully the task of increasing efficiency in developing new technology and putting it into production. When the "start-to-finish" method of planning is used, "start-to-finish" indicators should also be used in our opinion. For the level of the scientific research institute (design bureau)--pilot operation--industrial enterprise such indicators might be the list of projects governed by completion dates, the economic benefit to the national economy from application of the new products or manufacturing processes, the technical level of the latter (group of quality indicators), the standard project cost or cost justified by technical-and-economic computations, and an indicator related to cost-accounting motivation (cost-accounting benefit, the size of transfers to economic incentive funds that depend on the economic benefit to the national economy).

The bonus system now in effect for creation and application of new technology calls for the size of bonuses to be dependent to a certain extent on the calculated economic benefit of the new development, though the size of the bonus fund depends on another indicator--the wage fund. In the economic incentive system used in the electrical equipment industry the size of the incentive fund has already been linked to the economic benefit, but the benefit itself is the ultimate result of effort in the domain of scientific-technical progress--so far it is not assigned in the plan.

The CPSU Central Committee and USSR Council of Ministers have decreed that the economic benefit from performance of scientific-technical measures is to be assigned in 5-year plans in a breakdown by years. In our opinion, to put it concretely, one ought to plan the national economic benefit, which would be determined from imputed costs and would serve as the basis for choosing the best variant of what is to be used in production.

But the way matters often stand in practice at the present time is this. Having selected the best version on the basis of the calculated benefit, people then seem to forget about the calculated benefit. When the result of the effort is applied, the benefit obtained may be less than was anticipated, but the size of the incentive is determined from uniform standards in effect. It therefore seems to us expedient to plan the national economic benefit as an indicator which will serve as the principal criterion in settling the question of use of the particular result in production. But then the size of the incentive should be differentiated. If the plan and calculated benefit is attained, then incentive funds should be paid in the planned amount. If the benefit is greater than that calculated, then it makes sense to raise the rate. Yet if the benefit proves to be less than that calculated--meaning that perhaps the best version was not chosen, the rate of the incentive must be reduced.

Moreover, it is indispensable to work out a method of determining the cost-accounting benefit of new technology. Using such a method one would be able to plan specific assignments for enterprises as to the actual economic benefit to be derived from applying scientific-technical advances.

Fulfillment of the assignments of superior organizations concerning new technology that arise out of the tasks in development of the subindustry, the industry and the industrial sector as a whole and which are aimed at ensuring development of the national economy is no less important than manufacturing the products on the principal products list. For that reason nonfulfillment of these assignments should be reflected in the assessment of enterprise performance, in the formation of incentive funds, and in the size of bonuses paid to supervisory personnel and persons responsible for the failure of these efforts.

Up to now fulfillment or nonfulfillment of assignments for new technology has not in practice been linked to the evaluation of economic performance and formation of enterprise incentive funds. In accordance with the decree of the CPSU Central Committee and USSR Council of Ministers on improving the economic mechanism, the cost of jobs of an industrial nature related to putting new technology into production and to its application and financed with the funds of the unified fund for development of science and technology will be included in the total volume of output, and standard profit will be credited on the relevant groups of products. This is an important step forward toward unification in the unified system of evaluation of the results of economic performance and of putting new technology into production.

As this principle is implemented, we propose that certain measures be taken which would incorporate proposals that would make for a further convergence of the planning and evaluation of enterprise performance.

Every measure planned in the domain of technical progress, not only those related to organizing the production of new products, should be evaluated

in value terms (applying the relevant standards) and should be included in the total volume of sales (both in the assignment and in the report). The value of all jobs of an industrial nature, which would also include general overhauls, modernization of an enterprise's equipment and vehicles done by the given enterprise's production personnel proper, would be included in the volume of sales in accordance with the procedure now adopted. We propose that the range of jobs of an industrial nature whose cost is included in commodity output (sales) be expanded so as to include the cost of performing all assignments for new technology. If we include the cost of efforts to modernize equipment, why not include in the volume of sales the cost of creating a new manufacturing process whose application in subsequent years will make it possible for the enterprise to obtain a considerably greater profit than use of the equipment that has been overhauled or modernized? The cost of projects related to each item of the plan for new technology should moreover be taken into account independently, and not merely as part of the sum total of plantwide or shopwide expenditures. Then the actual volume of commodity output could be determined so as to take into account performance of assignments for scientific-technical progress, in just the same way as fulfillment of assignments for deliveries in accordance with contracts and job orders. Nonfulfillment of an assignment arising out of the plan for technical progress, analogous to any delivery unfulfilled, means nonfulfillment of the plan for the volume of commodity output. Thus assignments for product deliveries and for technical progress in effect come together within the framework of the unified economic plan, and the plan of scientific-technical progress is the most important section of the technical, industrial and financial plan and of plans of other types and at other levels.

The volume of commodity output should include the cost of new products, experimental prototypes, efforts to retool the production operation and to assimilate new manufacturing processes, pilot and experimental operations after deduction of the cost of the equipment purchased which is used to fulfill assignments for application of new technology, which are envisaged in the group of indicators for capital construction and in new manufacturing processes to be assimilated. Thus the volume of sales will no longer be an expression of gross output, but of fulfillment of the plan for the specific products list.

If any job related to new technology is not performed, it is deducted in quantitative value terms from the planned assignment for the volume of sales, and then nonfulfillment of the assignment for any item on the list (one of which is new technology) will signify nonfulfillment of the plan in general and will have an impact on indicators of labor productivity, profitability, and so on.

It would be wise to include the cost of all these efforts in the volume of sales, not limiting this group to a single source of financing--the Unified Fund for Development of Science and Technology.

The process of setting prices on new technology has great importance to economic stimulation of scientific-technical progress.

The price of a new product should be advantageous both to the manufacturer and to the consumer. The specific cost per unit of the useful benefit must decrease--that is one of the basic requirements which new technology must meet. This requirement was reflected in the decisions of the CPSU 25th Congress and has been put in practical terms in documents on methods. But its fulfillment is not always being monitored by legal services as yet. The requirements of policymaking bodies are not always being followed out in the normative documents of ministries and departments. If the use of prices to stimulate scientific-technical progress is to be made more effective, certain changes must also be made in the methodology for price determination; to be specific, the present procedure for determining the size of incentive supplements and ceiling prices needs to be improved.

In determination of the size of the incentive supplement, which is calculated in fractions of profitability, preference has so far been given not to the most efficient products, but to products with high production cost, since in practice profitability of a particular product is determined by the ratio of the profit to its production cost. It would be advisable to determine the size of the premium in percentages of the economic benefit to the national economy. Proposals to that effect have been worked out in the Economics Institute of the USSR Academy of Sciences.

Calculation of the ceiling price on a new product now takes into account the upper limit of that price, but this creates conditions for manufacturing a product which is not advantageous to the consumer. What do we have in mind? As we know, the price's upper limit signifies that level of the price where the new product is equal in efficiency to the one being replaced from the consumer's standpoint. If we take into account the additional costs of preparing the production of the new technology for acceptance, then actually the upper limit of the price makes the new product disadvantageous for the consumer.

The method of determining the ceiling price must be improved in such a way as to guarantee that an appropriate share of the benefit to the national economy is obtained both by the manufacturer and also by the consumer and so as to prevent the creation and production of inefficient technology. The ceiling price therefore should be determined not on the basis of the upper limit of the price, but on the basis of its lower limit, which takes into account reimbursement of justified costs of producing the product and affords standard profit to cover formation of economic incentive funds. If the maximum possible fraction of the benefit to the national economy which can go to the manufacturer (the minimum fraction of the benefit necessary to the consumer will remain) is added to the lower limit of the price, then we will obtain the size of the ceiling price.

Compensation of the higher costs of new technology should even now be made out of the Unified Fund for Development of Science and Technology. But if we are to provide a sound solution to the question of full compensation of enterprise costs from the YeFRNT, we must be able to determine the level of those costs that was actually necessary. We cannot make reimbursement with the funds of the YeFRNT for losses resulting from bad management. For that reason the list of costs for industries and for specific types of technology should be revised, standard times and amounts of compensation should be established for products and manufacturing processes that ensure achievement of equal profitability between the new technology and the technology being replaced (methodological bases for calculation of the norms are given above).

Reduction of profit, the drop in profitability, and consequently the related losses on incentive funds should be restored for each unit of the new product through compensation of higher costs from the YeFRNT, which is formed at sound rates. Enterprises which have compensated the higher costs will obtain standard profit for each new product (established in the price for the period of large-scale manufacture), and the incentive premium will create certain advantages for them during the period of putting the new technology into production.

Putting new technology into production reduces the volume of sales, and this means losses on incentive funds. The higher labor intensiveness of new products and preparation of production for output of the new technology reduce the number of new products as compared to the volume of output of the products being replaced which could have been obtained using the available capacities of the machine tool, the shop or the enterprise.

Higher labor expenditures should be taken into account in the production plan and in planning the wage fund, and losses on incentive funds are reimbursed to the enterprise from funds earmarked for this purpose--from the YeFRNT or the centralized incentive fund. In this connection it is necessary to know precisely in what amount and over what period enterprises should be reimbursed losses on incentive funds. This also requires having a method for determining losses and the standard rate at which they are to be reimbursed.

The possibility which has now been provided for of reimbursing losses on incentive funds of enterprises which successfully put new technology into production from reserves of economic incentive funds cannot be successfully realized because these reserves perform the task of a compensatory mechanism regulating formation of funds as a function of the performance of the industry as a whole.

We must look favorably on replacement of previous sources for financing new technology with the YeFRNT. Financing has now become more orderly. Payment for completed projects or major phases instead of allocating funds to support scientific research organizations has had a substantial impact toward

improving the results of R&D projects and toward shortening the time it takes to complete them. At the same time certain shortcomings have turned up in the actual practice of forming and using the YeFRNT.

First, this fund is not formed on the basis of stable rates nor in a planned volume. The rate of transfers to the YeFRNT of the electrical equipment industry has varied as follows from year to year: 13 percent of profit in 1969, 16.6 percent in 1972, and 32 percent in 1975. Enterprises have also had an unequal share in creating this fund: the transfers have been made at different rates ranging from 3 to 87 percent.

Second, both in heavy industry and also in the electrical equipment industry the share of the YeFRNT used for the costs of putting new technology into production is decreasing, and the relative share of outlays for R&D projects is increasing. In the Ninth Five-Year Plan the share of unfinished R&D projects financed from the YeFRNT increased 2.6-fold in the electrical equipment industry, while at the same time the volume of completed projects increased only 1.4-fold over that period.

It would seem wise to make a strict division of the resources of the YeFRNT on planning principles with respect to their purpose and to separate reporting into two parts: funds used for R&D and funds earmarked for putting new technology into production. The ratio between these parts should be determined by the tasks in developing the industry. Moreover, there is a need to improve the method of using the YeFRNT.

The decree of the CPSU Central Committee and USSR Council of Ministers on improving the economic mechanism calls for formation of an YeFRNT in all industrial ministries and departments conducting efforts to create new products and manufacturing processes. Implementation of this principle requires economic substantiation of the procedure for formation of this fund, the drafting of norms and standards and legal regulation of the expenditure of funds so as to take into account the experience of using the YeFRNT in certain industries.

Full compensation of higher costs and reimbursement of the enterprise for losses on incentive funds related to putting new technology into production merely place it in equal economic conditions with those manufacturing products put into production previously. But additional efforts are always required to put new technology into production. In order to motivate the production collective to develop new technology and put it into production after compensation of the higher costs and reimbursement of losses on incentive funds, this collective must be additionally rewarded both from the material incentive fund and also from special funds.

As a function of the complexity and technical level of the product and the capital-worker ratio of the enterprise, between 10 and 25 percent of the material incentive fund is now spent in connection with development and application of new technology. Engineers and technicians of design and

process engineering subdivisions, of mechanization and automation divisions involved in developing new products and manufacturing processes and in perfecting equipment are paid bonuses on the basis of the overall indicators of the enterprise's economic performance, though they perform the same work as staff members of scientific research institutes and design bureaus who are paid incentives from special bonus funds for new technology. Indicators of technical progress ought to be used in awarding bonuses to these and other specialists: the economic benefit and the technical level of new products and manufacturing processes.

The special system of incentives for advances in the domain of scientific-technical progress should remain solely for efforts performed in the interest of the entire industry or the entire national economy. Material incentives paid to personnel of industrywide scientific research and design organizations are part of this system. The experience of the electrical equipment industry will prove useful in working out such a system. Formation of incentive funds in this industry is related to the application of new technology. Profit has become the principal source of incentive funds in this industry, and the rates of the transfers are linked to the economic benefit of the new technology.

The procedure for awarding incentives is the most finished element of the new system for planning, financing and economic stimulation of the efforts related to the creation of new technology and to putting it into production. But for all the common principles governing application of this system in various industries, we note a certain difference in the procedure for forming incentive funds. These differences are moreover to be explained, in our opinion, mainly by the poor legal preparation of the documents. Certain experiments in this area conducted on an experimental basis and without proper legal regulation are acquiring permanent status at the end of the experiment on a nonauthorized basis, but this is neither economically nor legally justified, and it has no normative basis.

We need a unified normative act for all industries which are undergoing conversion to the cost-accounting system for organizing projects to create new technology, put it into production and apply it on the basis of job orders. Such a document is being drafted, and its content should strictly regulate the conditions for formation of economic incentive funds.

We will sum up what we have said.

Enterprises and organizations can be motivated to perform projects related to new technology rapidly and competently only by interrelated application of all economic levers and the entire integrated system of planning and economic incentives that uses the methods of planning, price setting, financing and incentives.

The system's operation should begin with planning. All assignments to develop new technology and put it into production are included in the topic

plans of scientific research, design and process engineering organizations and in the appropriate sections of technical, industrial and financial plans of enterprises. Differentiated rates should be used in seeing that the enterprise has the production capacities, manpower and other resources to fulfill assignments for new technology and to perform all its other activities.

The price is an instrument of planning. Therefore the method of determining prices of new products for industrial and technical purposes should give preference to new technology in computation of such indicators as the volume of sales, profit and profitability. The use of premiums, deductions and ceiling prices should create advantages for manufacturers of new technology over enterprises which are manufacturing products put into production long since. Consumers of new technology should be guaranteed that they will derive a portion of the economic benefit through application of ceiling prices and adherence to the requirement that the cost per unit of useful effect is lower when the price for the new technology is set.

The manufacturer's costs in the initial period of putting the new technology into production are usually higher than those taken into account on the costing sheet when the price is determined. To eliminate the adverse effect of this period on indicators used to evaluate the performance of enterprises, the mechanism of compensating the higher costs is used. The manufacturing enterprise receives compensation for the higher costs from special funds (YeFRNT) for each unit of the new product, so as to ensure that standard profit incorporated in the price and in the incentive premium is obtained from the very first product.

Aside from compensating the higher costs for each new product in the period when it is being put into production, the enterprise should be reimbursed losses on incentive funds related to reduction of the volume of output during that period as compared to the volume which could have been obtained producing the products manufactured previously. The source of the reimbursement should guarantee standard replenishment of incentive funds.

The effect of these elements of the integrated system needs to be strictly interrelated both in terms of the size and also the time set for each type of technology. In each individual period of putting new technology into production a comparison of standard costs and results whose stability is ensured by applying the special funds will make it possible to determine the actual contribution the collective makes to the cause of scientific-technical progress.

Use of the plan, the price and the compensatory mechanism makes provision for enterprises manufacturing new technology to obtain higher profits than those manufacturing products put into production long since. A portion of this profit goes to economic incentive funds. The formation and distribution of incentive funds is the task of the last element in the integrated system--material incentives paid to workers for advances in the domain of scientific-technical progress.

In this case incentives are paid both from the material incentive fund, which is formed in accordance with the results of economic activity, and also from special funds earmarked for payment of incentives for creation of new technology and for putting it into production. Distribution of the resources of the incentive fund among enterprises, organizations and individual workers should take into account their contribution to fulfilling assignments for new technology. The size of bonuses and awards should be set so as to take into account indicators reflecting the economic benefit and the level of the technology created.

The smooth functioning of all the elements of the system for planning and stimulating scientific-technical progress can be guaranteed only if there is the proper economic substantiation of the system's mechanism and legal formulation of the normative documents, whose number should be reduced to a minimum and whose content must not allow differing interpretations of identical elements.

The scholars of the USSR Academy of Sciences are doing a great deal of work in this area. Many institutes of the academy, among them the Economics Institute (the head organization coordinating scientific research projects in the field of the economic problems of scientific-technical progress), the Central Mathematical Economics Institute, and the Institute for Social Welfare and Economic Problems are concerned with the economic problems of creating new technology.

The scholars of the academy are giving important aid to Gosplan, the State Committee for Science and Technology, the USSR State Committee for Labor and Social Problems in drafting documents that define and regulate the activity of ministries, departments, associations, enterprises and organizations in the domain of scientific-technical progress. A great deal of work is being done under contracts concerning creative cooperation to provide methodological and methods assistance to ministries, enterprises and scientific research organizations with respect to perfecting the procedures used to plan, finance and economically stimulate efforts to create new technology. The symposium devoted to the economic and legal questions of stimulating scientific-technical progress, which the Institute of Government and Law and the Economics Institute held in 1979 by decision of the Presidium of the USSR Academy of Sciences has played a definite role in this activity.

The tasks set by the 25th CPSU Congress related to improving the mechanism for planning and stimulating scientific-technical progress can be successfully performed only through the joint efforts of scientists and practitioners--economists and legal experts.

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INTRODUCTION OF NEW TECHNOLOGY

CRITERIA FOR EVALUATING NEW TECHNOLOGY EXAMINED

Moscow VOPROSY EKONOMIKI in Russian No 2, Feb 80 pp 56-66

[Article by A. Koshita: "Criteria for Evaluating Effectiveness of New Technology"]

[Text] Under the conditions of developed socialism, ever new demands are placed upon the methods and structure of economic management, on the technical level of production, and on the quality of the produced product. The Decree of the CPSU Central Committee and USSR Council of Ministers "On Improving Planning and Strengthening the Effect of the Economic Mechanism on Raising Production Efficiency and Work Quality" defines the areas of further economic growth on the basis of the intensive development of production. Among them an important role is given to accelerating scientific and technical progress, to improving all work in the area of capital construction, and on this basis, optimizing the ratio between expenditures and results for the purpose of increasing the economic effect of manufacturing and utilizing new equipment.

A solution to the problem of raising national economic efficiency of new equipment, in our opinion, cannot be reduced merely to ensuring an exceeding of the consumer's savings over the expenditures on development and manufacturing, regardless of the degree and measure (the absolute total and percentage) of such an exceeding. For this reason it is important to establish the optimality of the manufacturer's expenditures on achieving the expected economic effect from employing the new equipment. In other words, it is essential to establish technically sound expenditure rates for obtaining the designated improvements in the technical and economic operating parameters of the new products.

The efficiency level of new equipment and capital investments largely determines the growth rate of production, and the methods of calculating this define the criteria for determining the national economic effectiveness of the decisions to be taken to build the projects, and to develop, manufacture and employ new implements of labor, automation, control systems and other types of equipment. The efficiency calculations for capital investments and new equipment, regardless of the advances made by economic

science, require further generalization of practice as well as an improvement and theoretical basis. An important question in the theory, methodology and practice of determining national economic effectiveness of new equipment is the question of to what degree this equipment should provide a rise in the consumer's savings in comparison with an increase in the expenditures on its production as a whole.

The calculated economic effect from the use of the new equipment as stated by the developers is accepted as the basis for judging the results of the activities of sectorial science and the design organizations and associations (enterprises). This effect is one of the crucial factors in the setting of wholesale prices and figuring the total profit for the new articles, and ultimately serves as a source for creating the economic and material incentive funds of the collectives engaged in the development, designing and introduction of new products into industrial production. The share of the effect channeled into the economic and material incentive funds is greater the larger the calculated effect stipulated by the developers of the new equipment. Here a rise in the effectiveness of the end national economic results and an increase in the income of the state budget should outstrip the growth of the economic and material incentive funds of the developers and manufacturers of the new equipment. However, in practice the growth rates of the calculated effect given by the manufacturer of the new equipment are far from always characteristic of the growth rates of the real income of the national economy. The calculated effect of employing new equipment, without a comparison with the increased expenditures of the manufacturer for achieving the effect, does not reflect its end national economic effect.

An analysis of the normative documents for setting economic effectiveness of production and the use of new implements of labor indicates that a solution to the question of putting any new equipment or machine into series production is taken by the developers and manufacturers, as a rule, even with a minimum exceeding of the effect of its use (for 5 and more years) over the production expenditures. Here the economic effect of the new product over several years is compared with the particular expenditures on its creation and production, since the adjusted expenditures do not include the expenditures on development, the establishing of the production methods and the development of the new article up to the second (and in a number of instances, the third) year after the start of series production. For this reason, the real effect from the creation and use of new equipment can be obtained by society in observing certain proportions in the exceeding of results over the expenditures on the given equipment.

As is known, the economic effect of new implements of labor in use over an extended time is determined by the formula:[1]

[1]See "Metodika (Osnovnyye Polozheniya) Opredeleniya Ekonomicheskoy Effektivnosti Ispol'zovaniya v Narodnom Khozyaystve Novoy Tekhniki, Izobreteniy i Ratsionalizatorskikh Predlozheniy" [Procedure (Basic Provisions) for Determining the Economic Effectiveness of Using New Equipment, Inventions and Rationalization Proposals in the National Economy], Izdatel'stvo Ekonomika, 1977, p 8.

$$E = \left[Z_1 \cdot \frac{B_2}{B_1} \cdot \frac{R_1 + O_n}{R_2 + O_n} + \frac{(I_1^1 - I_2^1) - O_n(K_2^1 - K_1^1)}{R_2 + O_n} - Z_2\right] \cdot A_2, \qquad (1)$$

where E--the economic effect adjusted for the year for the service life (to obsolescence) from the production and use of new equipment, that is, the national economic effect, in rubles; Z_1 and Z_2--the adjusted expenditures of a unit for, correspondingly, the base and new product; B_1, B_2--the annual volumes of product (work) produced in using a unit of, respectively, the base and new product, in physical units; B_2/B_1--a coefficient considering a rise in the productivity of a unit of the new means of labor in comparison with the base (α); $R_1 + O_n/R_2 + O_n$--a coefficient considering a change in the service life of the new means of labor in comparison with the base (β); R_1 and R_2--the share of deductions from the balance sheet value for complete replacement (renovation) of the base and new means of labor (calculated as amounts inverse to the service lives of the products and determined considering their obsolescence); I_1^1, I_2^1--annual operating outlays of the consumer in his using of, respectively, the base and new means of labor calculated for the volume of product (work) produced using the new means of labor, in rubles ($I_1^1 - I_2^1 = \Delta I$); K_1^1 and K_2^1--the ancillary capital investments of the consumer (capital investments not considering the value of the designated means of labor) in using the base and new means of labor in a calculation for the volume of product (work) produced using the new means of labor, in rubles ($K_2^1 - K_1^1 = \Delta K$); O_n--the normed efficiency coefficient (0.15); A_2--the annual volume of producing the new means of labor calculated per year (in physical units).

A new implement of labor is considered sufficiently advantageous for society with any positive result in calculating the economic effect using formula (1), although in a number of instances only minimum effectiveness is achieved corresponding to its normed coefficient ($O_n = 0.15$). Such an approach to evaluating economic effectiveness of the new implements of labor means, in essence, that individual developers and manufacturers are not oriented at achieving a maximum national economic effect, considering as sufficient a minimum exceeding of the increase in the effect for the consumer (E_c) of the new equipment over the increase of the adjusted expenditures ($Z_2 - Z_1$), that is, that the calculated effect of producing and employing the new equipment be greater than zero ($E > 0$).

The inadvisability of producing new equipment the economic effective of which insignificantly exceeds the normed coefficient of effectiveness (O_n) can be shown from the following example. The productivity (α) and durability (β) of a new machine tool (N) are, respectively, 2- and 1.5-fold greater than the machine tool being replaced (B) with adjusted expenditures (Z_1) of 15,000 rubles. Over a period of 5 years of operation, the new machine tool provides the consumer with a savings in current operating expenditures (ΔI) and ancillary capital investments (ΔK) totaling 26,000 rubles. Here the manufacturer projects that the adjusted expenditures of the new machine tool (N) are 70,500 rubles. In accord with the calculations

using formula (1), the economic effect (E) of the new machine tool (N) over 5 years of operation will be 500 rubles ($E = Z_1 \cdot \alpha \cdot \beta + \Delta I + \Delta K - Z_2 = 15 \cdot 2 \cdot 1.5 + 26 - 70.5$); the increase in the calculated effect of using (E_c) the new machine tool (N) is 56,000 rubles ($E_c = Z_1 \cdot \alpha \cdot \beta + \Delta I + \Delta K - Z_1 = 15 \cdot 2 \cdot 1.5 + 26 - 15$).

As we see, for a rise in the effect for the consumer totaling 56,000 rubles in using the new machine tool over 5 years, the manufacturer "takes" from society even during the current year an additional 55,500 rubles in the form of material, energy, labor and financial resources for producing the machine tool (N), not counting the expenditures of the same resources for the development, preparation and introduction of it into series production, as well as for developing the production of new types (shapes) of metal and preassembled articles. With such a ratio of the expenditures and results in producing and using new equipment (if the new equipment does not provide a fundamentally different effect, that is, does not satisfy qualitatively new needs of society), the national economy not only does not receive an additional savings, but over the 5 years even loses in comparison with a situation where the designated resources, including expenditures on research and development, were used for expanding the production of a previously developed product with a minimum effectiveness of 15 percent.

The introduction of a competitive selection of the most effective designs for all models of new (modernized) machines, equipment and devices would also help to raise the effectiveness of new equipment being developed, along with the above-indicated necessity of optimizing the ratio of expenditures and results. The development of the narrow specialization of scientific research and design organizations even within one sector, along with numerous positive results, has led to a situation where the development of new (modernization) end designs of implements of labor, with the exception of preassembled units (parts), in practical terms is the result of the creativity of specialists in one department (subdepartment) of an institute or design bureau. As a rule, a separate specialized institute (design organization), in turn, is concerned with the development of preassembled articles.

This leads to a situation where, in developing new machines and equipment or their complexes (systems), use is made of the only (or at best, extremely limited number) existing design of the preassembled products (units) which are not always suitable for the machines being developed, and for this reason do not improve their design and operating performance. Such facts are often encountered also in modernizing the implements of labor for which production has been halted on previously manufactured preassembled articles, while the advantages of the parameters of new standardized articles are not employed in the final machines.

The shortcomings of the principle of judging the effectiveness of new equipment from its normed level have already been commented on in economic literature. In this context, the opinion has been voiced that for raising the

degree of comparability between expenditures and results, and for strengthening the relationship between the national economic effect and the economic accountability one in determining the economic effectiveness of new equipment, it is advisable to proceed not from the normative amount of effectiveness $O_n = 0.15$, but rather from the level of the long-range (R_c) or the actual profitability (R_a) achieved in the sphere of employing the variation of new equipment being designed.[2] If the actual profitability in the sector exceeds 15 percent, then the use of a new implement of labor which produces an effect only on the normative level (15 percent) and does not improve the achieved economic indicators of the sector, is also not sufficiently effective from the viewpoint of the user. In such an instance, an orientation to the actual or long-range profitability level, and not the normative coefficient (O_n) is justified.

However, an evaluation of the effectiveness of new articles for the consumer in terms of the long-range profitability (R_c) of their use instead of the normed coefficient (O_n) does not solve the problem in essence, although here the condition will be met that $O_n < R_c > R_a$, that is, the level of the long-range profitability is higher than the achieved (actual), and also higher than the normed coefficient for the effectiveness of the new equipment. The use of the indicator of actual (R_a) or even the long-range (R_c) profitability as a criterion of effectiveness can justify the development, production and use of insufficiently effective new products, if the products being replaced were loss or low-profit. But the main thing is that the problem is not solved of an optimum, most effective ratio for results and expenditures as a whole for the national economy. For this reason the achieving of simply greater profitability on the basis of employing the new equipment than was achieved by the old, previously developed equipment, but also a slightly greater savings per unit of expenditures in comparison with the normative coefficient $O_n = 0.15$ cannot be the aim of designing new equipment for achieving the highest effect with least expenditures. In our opinion, the ensuring of an optimality of expenditures for the creation and output of new equipment, in comparison with the expected effect of its use, is possible by a different method, and namely by sound norming of the expenditure proportions of the manufacturer for obtaining the calculated savings by the consumer in one-shot and current expenditures. The normative coefficient (O_n) here is kept as a general criterion for the minimum acceptable level in the effectiveness of using new equipment, but cannot be a measure of optimality for the ratio of results and expenditures in assessing the effectiveness of production and the use of new equipment.

Formula (1) for the calculation of the annual economic effect merely shows the component elements of the effect for the consumer as a result of employing the new equipment, but does not determine the optimum structure of

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[2]See L. Shevchenko, "Effectiveness, Price and Obsolescence of Equipment," VOPROSY EKONOMIKI, No 6, 1979, pp 22-33.

savings and additional expenditures on achieving it. Here the components of the effect are primarily the changes in one-shot expenditures ($Z_1 \cdot \alpha \cdot \beta - Z_1$), current expenditures ($I_1 - I_2$) and ancillary capital investments ($K_2 - K_1$) of the consumer. It is advisable to divide the savings in current operating expenditures of the consumer ($\Delta I = I_1 - I_2$) into the savings of current expenditures of the first type (ΔI^1) which is a direct consequence of a rise in productivity (the volume of work) of the new means of labor (α) and its durability (β), and the second type of savings in current expenditures (ΔI^2) formed as a result of an improvement in the other qualitative technical and operating characteristics (parameters) of the new means of labor.

The first type of savings in the current expenditures of the consumer (ΔI^1) includes primarily the savings in the wages of workers due to a rise in productivity, routine maintenance and repairs, and so forth. The second type (ΔI^2) can include the savings obtained by the consumer due to a change (improvement) in such parameters as a rise in the efficiency of the units, the cos f of electrical equipment, a reduction in the no-load losses (for transformers), a reduction in the proportional consumption rate of fuels and lubricants (in using internal combustion engines), and so forth.

The greatest effectiveness of additional expenditures by the manufacturer on obtaining the expected savings is determined depending upon the type of savings from the use of the new means of labor. This, in turn, makes it possible, with limited expenditures, to achieve the greatest effect. The possibility of a limitation, that is, a norming of expenditures for obtaining the corresponding total savings, stems from the essence of the methodological principles in determining the economic effectiveness, and is substantiated by the results of an analysis and generalization of the practice of creating and using a new product.

The necessity of limiting (in a minimum amount) the expenditures of all types of resources to ensure the highest effectiveness is particularly urgent in the selecting of optimum variations for the design of new machines by designers (production engineers). In this stage of developing the new equipment, its absolute and relative (proportional) economy and national economic effectiveness are determined. A substantial savings in material, labor and financial resources is achieved precisely at this stage, when the questions are settled of the technical level, the quality and progressiveness of the new equipment. As for the stage of manufacturing, that is, the possibility of providing a savings of resources by improving the manufacturing methods for the new equipment, and using the internal production reserves, this is limited by the design of the new machine, by its advantages and shortcomings. For precisely this reason the determining of the national economic effectiveness of new equipment using the entire arsenal of methods for calculating the useful effect and the limiting of expenditures for achieving this is an essential condition for setting the specifications for the designing of new products.

In designing new equipment with greater productivity (α) and durability (β), a change in the manufacturer's expenditures should be directly dependent upon a rise in the designated parameters. The establishing of such a directly proportional dependence will also be the limit for the growth of the designated expenditures. In procedural terms this can be set proceeding from the conditions of raising the economy of the new design. With an increase in the size of the new machines, that is, with a rise in their unit capacity (productivity) and durability within the limits of obsolescence, the proportional expenditures per unit of the designated parameters should not rise but rather decline. This can be seen from the results of analyzing numerous data on the dynamics of the change in the proportional adjusted expenditures per unit of capacity (productivity) for such uniform articles as all types of internal combustion engines, electric machines, turbines, turbo- and hydrogenerators, and so forth. For the consumer to achieve a savings in the one-shot expenditures within a certain amount, on the basis of employing a new machine, the manufacturer cannot design an increase in the same volume for the adjusted expenditures on producing the given machine. Although frequently this may be encountered in reviewing the calculations made by manufacturers for the effect of new products.

The first premise for the optimality of a ratio in the one-shot expenditures and the expected results can be formulated in the following manner: the increase in adjusted expenditures for producing the new means of labor of only increased productivity ($\Delta Z\alpha$) or durability ($\Delta Z\beta$) cannot exceed the increase in the potential savings of one-shot expenditures for the consumer. This can be expressed by the equation:

$$\Delta Z\alpha + \Delta Z\beta \leqslant Z_1 \cdot \alpha \cdot \beta - Z_1, \qquad (2)$$

where Z_1--the adjusted expenditures for producing the implement of labor to be replaced; $\Delta Z\alpha$, $\Delta Z\beta$--the increase in adjusted expenditures for the manufacturer on raising, respectively, the productivity and durability of a new implement of labor in comparison with the analogous parameters of the one to be replaced.

An equality in both parts of formula (2) is the limit for the increase in the adjusted expenditures of the manufacturer on raising the productivity and durability of the new implement of labor. However, optimality is achieved in instances when a savings is provided in producing a new implement of labor of increased productivity and durability (the left-hand part of this equation is smaller than the right-hand). Under this condition, equation (2), along with reflecting the limiting of the optimum ratio of expenditures with results, characterizes the possible (potential) savings for the consumer in one-shot expenditures as a consequence of using the new implement of labor, and the real savings will equal the actual positive result. The observing of this premise for the optimality of the ratio of expenditures and results on producing and using new equipment will make it possible to ensure not only high economy in employing a new product, but also a progressive design of the given equipment and manufacturing method, and as a consequence of this, a savings in all types of resources.

When the conditions of the first premise are not observed, the proportional indicators for the economy of the new product, as a rule, worsen in comparison with the indicators of the one being replaced, and this jeopardizes the progressiveness of its design, manufacturing methods or the reliability of the planned expenditures on producing the new products. Thus, the productivity (α) of a new high-frequency unit (heater) model VChD2-265/81 is 1.8-fold higher than the productivity of the model being replaced. Durability (β) and the other operating parameters of the new unit are the same as the one being replaced. The adjusted expenditures for the product being replaced (Z_1) are 1,500 rubles. With a rise of 1.8-fold in the useful effect of the new high-frequency unit as its productivity (α) rises, that is, with the growth in the potential savings of the consumer in one-shot expenditures calculated in accord with the right-hand part of formula (2), they are 1,200 rubles ($Z_1 \cdot \alpha \cdot \beta - Z_1 = 1,500 \cdot 1.8 \cdot 1.0 - 1,500 = 1,200$), while the additional adjusted expenditures ($\Delta Z\alpha$) on the growth of the productivity of the VChD2-265/81 in the first year of series production, according to the initial design of the manufacturing plant, equal 1,900 rubles, including 1,300 rubles due to the additional expenditures on materials and purchased semifinished articles. The total amount of the adjusted expenditures (Z_2) for the new unit is 3,400 rubles ($Z_2 = Z_1 + \Delta Z\alpha = 1,500 + 1,900$). Consequently, $\Delta Z_2 > Z_1\alpha - Z_1$.

This means that for the new high-frequency unit, they did not observe the conditions of the first premise for the optimality of expenditures and results. In other words, the manufacturing plant, in improving just one parameter of the unit (increasing its productivity by 1.8-fold) provides for a rise of more than 2.2-fold in the adjusted expenditures (3,400 rubles:1,500 rubles). Such a ratio of expenditures and results was justified by the plant by the fact that for the given product a positive total savings is achieved as calculated according to the above-given formula (1) for determining the economic effect.

An analysis has shown that the overstating by the manufacturer of the planning calculations for the adjusted expenditures on the new high-frequency unit was caused by a rise in the proportional metal and labor intensiveness, and led to an unjustified worsening of its economy. Thus, the full costs of a unit of productivity and weight of the new unit were, respectively, 58.4 rubles and 5.1 rubles, and for the unit being replaced, 35.5 rubles and 4.3 rubles, that is, they rose by 1.6-1.9-fold. Here the proportional value of the materials (including the purchased semifinished articles) per unit of productivity and weight of the new unit increased, respectively, by 1.2-1.4-fold, and the total labor expenditures by 1.4-1.6-fold.

The design calculations of the manufacturing plant were made in terms of the conditions of beginning the development of production without considering the requirements of the developed production process for series manufacturing of the new unit. From the results of the analysis, the manufacturing plant made corrections in the initially submitted calculations. The adjusted expenditures (Z_2) for the VChD2-265/81 unit were increased proportionately to the growth of its productivity ($\Delta Z_2 = Z_1\alpha - Z_1 = 1,200$ rubles).

There is reason to expect that under the conditions of series production for the new unit the actual expenditures will be less than the design ones. This stems from the reliable pattern of a substantial decline in expenditures under the conditions of series production in comparison with the initial period.

The use of individual types of new implements of labor with increased productivity and durability causes a change (growth) in the ancillary capital expenditures (ΔK) for the consumer. Ultimately this reduces the increase in the useful effect of the new implements by the amount of ΔK. For such new implements of labor, the adjusted expenditures of the manufacturer on increasing productivity ($\Delta Z\alpha$) and durability ($\Delta Z\beta$) should be less or at least equal to the possible savings of the consumer in one-shot expenditures ($Z_1\alpha\cdot\beta - Z_1$) as reduced by the total increase in the related capital investments (ΔK). An essential consequence of the growth of productivity and durability of new equipment is a decline in the first type of current operating expenditures (ΔI^1) for the consumer as a result of savings in the wage fund of production workers (as a consequence of the growth of labor productivity), the saving of production energy, expenditures on routine maintenance, repairs, and so forth.

If, with an increase in the productivity (the volume of work) and the durability of a new implement of labor, in comparison with the one being replaced, for example, by 2-fold, the consumer doubles the number of workers and their total wages, as well as the total expenditures on production energy, routine maintenance and repair of the new implement of labor and other related expenditures, such equipment, as a rule, cannot be considered new or progressive since it does not provide an effect in use. And although this savings of the consumer (of the first type) is often a calculated one and not reflected in the normative and technical specifications, the rise in the productivity and durability of the new equipment cannot help but lead to the formation of a savings for the consumer. Thus, a change (reduction) in the first type of operating expenditures (ΔI^1) for the consumer is not only a consequence but also an essential condition for economic effectiveness from the growth of the productivity and durability of new implements of labor.

From this stems the second premise for optimality in the ratio of results and expenditures from the use of new equipment. If the new implements of labor differ from the ones being replaced solely in increased productivity and durability and do not satisfy the qualitatively new needs of society, then the savings for the consumer in the first type of current operating expenditures (ΔI^1) should not be accompanied by additional expenditures of the manufacturer (above the total adjusted expenditures) on the growth of the productivity ($\Delta Z\alpha$) and durability ($\Delta Z\beta$) of the new means of labor. The obtaining of an effect by society due to employing qualitatively new equipment is far from always capable of being expressed in a monetary savings or calculated by formula (1). It must also be considered that the dynamics and ratio of manufacturer's expenditures on the development and initiating

of production of such a new type of equipment will also have its particular features.[3]

Thus, a rise in the adjusted expenditures on producing new implements of labor having increased productivity (power) and durability is considered to be an optimum under the condition that the total of this increase will lag behind the total rise in the useful effect for the consumer due to the one-shot expenditures (proportionately to the growth of the productivity and durability of the new machines), while the use of the new machines will ensure the obtaining also of an additional savings in the first type of current expenditures (ΔI^1). Here the total and the feasibility of the additional savings for the consumer for the first type of current expenditures will be greater the more the productivity and durability of the new implements of labor rise.

However, the presence of an additional savings for the consumer in the first type of current expenditures cannot be used for establishing the validity of an additional increase in the manufacturer's expenditures for new equipment above a limit of their optimum amount as calculated in accord with formula (2). For achieving the long-range (over the service life of the new equipment) savings in the first type of current expenditures, in particular for the wages of maintenance personnel, in the process of operating the new implement of labor, even in the current year additional workers (basic and auxiliary) must be brought in for the process of manufacturing this implement of labor and the assemblies (articles) comprising it. The total of their wages, considering the adjustment of wages over this same time to the initial year, will equal or exceed the wages accepted in the calculation of the operational effect.

Let us examine an example. A new centering semiautomatic lathe (with program control) model 1B732F3, in the process of operation, over its service life until the first major overhaul (8 years), according to the manufacturer's calculations, will provide a savings of 44,700 rubles for current expenditures, in comparison with the operation of the old semiautomatic hydraulic copying lathe (without program control) model 1B732. The productivity of the new semiautomatic lathe exceeds the productivity of the old by 2.3-fold. For producing a unit of the new semiautomatic lathe, including the creation of the numerical control unit and other components, the manufacturer spent 14,000 rubles on the wages of additionally used basic workers (not counting the wages of engineers, technicians, white collar personnel and auxiliary workers). The total amount of the adjusted expenditures on the new semiautomatic lathe, according to the manufacturer's calculations, were around 102,000 rubles, in comparison with 40,300 rubles on the one being replaced, that is, this had risen by more than 2.6-fold, while productivity had gone up just 2.3-fold. The remaining operating characteristics (parameters) were unchanged.

[3]See A. Konson, "The Effectiveness of Qualitatively New Equipment," VOPROSY EKONOMIKI, No 2, 1979.

A comparison of these data indicates that the use of the new semiautomatic lathe provides the consumer with a savings totaling 45,000 rubles in the first type of current expenditures (ΔI^1) over the 8 years. But for producing this semiautomatic lathe it is essential to hire additional workers, engineers, technicians and white collar personnel, and their total wages, considering an adjustment for the year over this same time (8 years) will be more than 50,000 rubles, including 35,000 rubles above the optimum limit.

An analysis of the projected adjusted expenditures has shown that their overstatement was caused by excessive expenditures on producing the numerical program unit and other preassembled articles, as well as by the increased internal expenditures of the machine tool building plant during the first years of developing the output of the semiautomatic lathe. As a rule, such expenditures should be financed from the unified scientific and technical development fund set up in the sectors from deductions from the additional profit of the serially produced and previously developed product.

The more rapid growth of expenditures over the rise in the productivity of new implements of labor, if their other operating parameters are not improved and they do not ensure qualitatively new results, is a consequence of shortcomings in organizing the output of new equipment as well as in the system of financing the increased outlays of the initial period of developing and producing the product. Such an outstripping of expenditures can be justified only in those instances when in developing the new implements of labor, in addition to a change in productivity or durability, a substantial improvement is provided in the other important operational parameters such as increasing precision characteristics, reducing consumption rates and losses of resources used in the process of operating the new equipment.

As a result of using new equipment which, along with (or regardless of) the rise in productivity and durability, improves the above-noted technical and economic operational characteristics, the consumer gains a savings in the second type of current operating expenditures (ΔI^2). As a rule, the manufacturer spends additional money on improving these operating parameters of the new equipment. However, in this instance, not all the manufacturer's additional expenditures can be considered sufficiently effective solely because they are below the consumer's savings on the second type of current expenditures (ΔI^2) obtained over a number of years from improving the quality parameters of the machines.

The ratio of such results and expenditures for the manufacturer (in addition to the conformity of the results to the normative effectiveness coefficient) should also meet definite limit proportions, that is, the manufacturer's expenditures on improving the quality parameters cannot be simply restricted by the amount of the useful effect for the consumer, but rather should be in definite limited proportions with this. What should these proportions be? Calculations indicate that for new equipment with a service life of at least 6 years, the optimum ratio for the second type of savings (ΔI^2) obtained by the consumer for this time and the manufacturer's expenditures for these purposes should be no lower than a ratio of 2.5:1.

Only with such a ratio do the manufacturer's expenditures provide a significant savings for the national economy.

The establishing of the adjusted optimum proportion in the ratio of expenditures and results consists in the following. The manufacturer's expenditures on improving the second type of quality parameters of the new equipment (ΔZ_m^2) to be included in the adjusted expenditures (Z_2) do not reflect the full expenditures by society on these purposes. The full expenditures on improving the quality parameters of the new means of labor (in addition to the growth of productivity and reliability) include, in addition to the direct outlays by the manufacturer, in addition the expenditures on research, development and the embodiment of the idea in metal, on the production of new types of materials and preassembled articles which realize a qualitative change in the parameters of the finished article. Such additional parameters are not reflected in the adjusted expenditures directly on producing the new implement of labor (Z_2), since they are repaid by society (from the budget or from the unified scientific and technical development fund formed from the profits of previously developed equipment to be replaced).

Consequently, the manufacturer's expenditures on improving the designated quality parameters of a new implement of labor, considering the listed additional expenditures, are increased in comparison with the adjusted expenditures (Z_2) by almost double (and more for individual types of equipment). These must be considered in determining the national economic effect of the new equipment. In order to consider them in determining the effect from the difference in the adjusted expenditures using formula (1), it is essential to provide an optimum limiting (by 2.5-fold) for the exceeding of the second type of savings (ΔI^2) received by the consumer in 6 years over the total expenditures of the manufacturer (ΔZ_m^2) considered in the adjusted expenditures on the new implement of labor (Z_2) for improving its other quality parameters.

A new machine considering all the operational parameters cannot be considered effective if its use over its life will save an equal or slightly greater amount of labor than is spent on manufacturing it. As for the savings for the consumer (ΔI^2) over the life of the new machine, this only in a proportion of not less than 2.5:1 can provide society with an additional effect and recover the additional national economic expenditures on improving the second type of quality parameters for the given new equipment.

From this derives the third premise for the optimality of the ratio between expenditures and results: additional manufacturer's expenditures (ΔZ_m^2) on improving such quality operational parameters as improving the precision of machining, the efficiency of the machines, and reducing the specific consumption of production energy and all types of fuel, lubricants in operating the new equipment, and so forth, will bring the national economy a real tangible effect, if the consumer's savings adjusted for the year for the second type of current operating expenditures (ΔI^2) over the life of

the new equipment will exceed these expenditures by at least 2.5-fold. Undoubtedly, depending upon the types of new equipment as well as the nature of the changing quality operating parameters of the second type, the established overall proportion for the optimality of expenditures and results can be differentiated. It is advisable to consider such a differentiation in the sectorial procedures for determining the economic effectiveness of new equipment.

A significant portion of the new machine building products are developed and put into production not to replace previously developed products but rather to perform new production functions. It is essential to work out overall and sectorial provisions for calculating the economic effectiveness of developing and employing equipment which broadens the parametric series of the machines, equipment and instruments for performing new production functions. In our view it is possible to determine the optimum limits of expenditures on developing and producing new types of the same parametric series of implements of labor on a basis of utilizing normative parametric methods (a multifactor correlation dependence of expenditures on parameters, a point evaluation of machine parameters in terms of optimum expenditure limits, and so forth). The use of these methods makes it possible to work out such standards in the stage of setting the specifications for designing new models of implements of labor, that is, when the technical level, the quality and economy of the new equipment are being established. Here conditions will be created for the broad and effective use of electronic computers for calculating the expenditure limits.

These, in our view, are the general outlines for the basic premises for limiting the manufacturer's expenditures to achieve their optimum ratio with the results. The realization of these premises will make it possible to ensure the development, production and use of new highly efficient equipment with the least expenditures of all types of resources. An optimization of the ratio of results and expenditures lies at the basis of raising the national economic effectiveness of new equipment and the end results of the work done by the scientific research and design organizations, associations and enterprises. Their consideration will help to improve the procedures and practices of evaluating the effectiveness of the decisions being taken in working out and putting new implements of labor into series production. In our view, it is advisable that the sectorial scientific research institutes engaged in the designing and development of new implements of labor, work out recommendations for the product groups or types for defining the optimum ratios of expenditures and results, and on the basis of these, optimum expenditure limits. Greater efficiency of the new implements of labor will also be aided by the joint work of the manufacturers (developers) and the users in the area of clearly defining and regulating the entire complex of technical and economic parameters for the new equipment and reflecting these in the specifications for its designing.

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