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USSR Report

ECONOMIC AFFAIRS

(FOUO 9/79)

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WAYS OF INCREASING THE EFFICIENCY OF CAPITAL INVESTMENTS

Moscow VOPROSY EKONOMIKI in Russian No 7, Jul 79 pp 120-132

[Article by Academician T. Khachaturov]

[Text] In publishing this article, the editorial office opens the discussion on the questions dealt with in it and invites authors to send in articles with their recommendations for increasing the effectiveness of capital investments and improving capital construction.

The questions of improving the capital construction in the USSR are of great importance to the national economy and go far beyond the confines of the construction industry. This is explained first by the fact that by way of capital construction one carries out the expanded reproduction of fixed assets, which determines both the increase in the country's production potential and the increase in the volume of output produced, and the increase in the degree of satsifying the public and personal needs of Soviet citizens. Secondly, the increase in capital construction requires greater and greater material, labor, and financial resources. The chief source of capital investments is the national income, the part of that income which is being accumulated. Part of the capital investments are carried out at the expense of the recovery fund. The benefit derived from these funds occurs after a more or less prolonged period of time that is necessary for the planning of capital investments, the designing of construction projects, and the construction and assimilation of the capacities to be created. Thirdly, the growing scope of construction, with its tremendous importance at the stage of mature socialism and the creation of the material-technical base of communist society, poses with a greater and greater degree of acuity the questions of increasing the effectiveness of capital investments.

Capital investments have been increasing with every passing year. In 1978 they constituted 129 billion rubles and were 14 percent more than in 1975, that is, during those three years they increased by 4.5 percent a year. The activation of fixed assets in 1978 achieved 120 billion rubles and exceeded by 13.6 percent the 1975 level. During a period of eight years from 1971 through 1978, inclusive, capital investments constituted 862 billion rubles, or

almost half the total investments during the years of the Soviet authority (1833 billion rubles), and the activation of fixed assets during the same period came to 799 billion rubles, or 48 percent of the activation between 1918 and 1978 (1692 billion rubles).

In order to carry out capital construction on such a scope, the national economy allocated a considerable part of the national income for accumulation. The share of accumulation in the national income was equal in 1977 to 26.4 percent.

The overwhelming part of capital investments -- more than 71 percent -- is channeled into our production sphere, and the remainder into housing construction (15 percent), the construction of institutions of science, culture, art, and national education (more than 5 percent), as well as public health, communal economy, and other projects (8 percent). As a result of the investments, there has also been a substantial increase in the production and nonproduction funds in the national economy.

In 1971-1978 the fixed production assets increased by 89 percent and constituted 1006 billion rubles as of the end of 1978. These figures characterize the increase in the country's production potential. The capacities that were activated at electric-power stations during 1971-1978 are equal to 41 percent of the existing capacities as of the end of 1978. In other branches, the capacities activated during the same period achieved the following, in respect to the volume of production in 1978: for iron ore, 70 percent; fertilizers, 53; synthetic resins and plastics, 45; turbines, 35; motor vehicles, 54; tires, 37; tractors, 29; and cement, 24 percent. Thus, for all the types of output that were indicated above, the capacities activated during the past eight years constituted a considerable part of the existing capacities or volumes of production.

Capital investments for the individual branches of the national economy increased rather unevenly, as can be seen from the data in Table 1.

There was a rapid increase in the capital investments in agriculture and the construction industry; this corresponds to the necessity of overcoming the lag in the development of these two important branches. There was a considerable increase in the capital expenditures for transportation and communication (excluding railroad transport, which, with regard to growth rates, occupies the next-to-last place in the table). Capital investments in the Group B industry, the construction of institutions of science, culture, art, education, and housing construction are growing more slowly than in the other branches of the national economy.

A positive factor in the dynamics of the capital investments in the production sphere is the increase in the proportion of the expenditures for the remodeling, expansion, and technical re-equipping of the existing enterprises in the overall volume of capital investments in industry, which is attested to by the figures in Table 2.

Table 1

Increase in capital investments (in percentages with respect to 1960)

		(11) 1965 г.	(12) 1970 г.	(13) 1975 г.	(14) 1977 г.
(1)	Всего по народному хозяйству	136	195	273	296
(2)	Промышленность	139	192	271	297
(3)	группа «А»	142	193	278	307
(4)	группа «Б»	118	189	224	244
(5)	Сельское хозяйство	173	263	417	450
(6)	Транспорт и связь(все виды)	137	193	300	337
(7)	Железнодорожный транспорт	126	168	219	237
(8)	Строительная индустрия	127	256	375	417
(9)	Жилищное строительство	102	142	173	181
(10)	Наука, культура, искусство и образование	144	185	246	264

Key:
1. Total for national economy
2. Industry
3. Group A
4. Group B
5. Agriculture
6. Transportation and communication (all types)
7. Railroad transportation
8. Construction industry
9. Housing construction
10. Science, culture, art, and education
11. 1965
12. 1970
13. 1975
14. 1977

During the past 50 years there have been progressive changes in the structure of capital investments by types of operations, which can be seen from the random data for individual five-year plans, as cited in Table 3.

The share of capital investments in construction-and-installation operations, which are conventionally called "passive," has been decreasing since the First Five-Year Plan, and the share of the "active" part, that is, investments in equipment, tools, and stock, which are directly used in the production of output, has been steadily increasing. This is explained only partially by the increase in the prices of machinery and equipment, but for the most part reflects their improvement, increased complexity, and the increase in productivity.

During the 1971-1978 period, as a result of capital investments, the nonproduction assets increased by 62 percent and, as of the end of 1978, constituted 532 billion rubles. During those years, 18 million new apartments were built, providing housing for 65 million persons. We activated 24,000 general-educational schools with accommodations for 12 million students, hospital institutions with 540,000 beds, and 63,000 retail-trade enterprises. There was a noticeable expansion in the communal economy.

Table 2

Capital investments in existing enterprises (in percentages with respect to the volume of capital investments in industry)

	(11) 1960 г.	(12) 1965 г.	(13) 1970 г.	(14) 1975 г.	(15) 1977 г.
(1) Всего по объектам производственного назначения	55	61	58	68	69
(2) В том числе					
(3) Электроэнергетика	20	28	20	32	38
(4) Угольная промышленность	62	71	85	78	77
(5) Черная металлургия . . .	63	61	60	73	82
(6) Химическая и нефтехимическая промышленность . .	52	46	45	63	65
(7) Машиностроение и металлообработка	77	76	63	71	76
(8) Промышленность строительных материалов	41	51	50	64	67
(9) Легкая промышленность . .	52	46	40	64	68
(10) Пищевая промышленность	62	65	66	72	73

Key:
1. Total for projects destined for production use
2. Including
3. Electric-power engineering
4. Coal industry
5. Ferrous metallurgy
6. Chemical and petrochemical industry
7. Machine building and metal-working
8. Building-materials industry
9. Light industry
10. Food industry
11. 1960
12. 1965
13. 1970
14. 1975
15. 1977

The expansion of the country's production potential and the rise in the level of the national standard of living are the prerequisites for the rise in the national income, which increased by 45 percent during 1971-1978 (from 290 billion rubles in 1970 to 422 billion rubles in 1978).

Despite the tremendous importance of the construction-industry complex in assuring the expanded reproduction, its percentage as part of the branches of the Soviet national economy is not large. The total number of persons employed in the construction industry in 1977 reached 10.9 million, including 8.1 million in construction-and-installation operations. The number of construction workers constitutes less than 12 percent of the total number of persons employed in material production. Capital investments in the construction industry in 1977 exceeded 3.9 percent of the total amount of investments. Fixed production assets in construction by the end of 1977 constituted 43 billion rubes, or only 3 percent of the country's fixed assets (4.6 percent of the fixed production assets).

Table 3

Structure of capital investments for state and cooperative enterprises and organizations (excluding kolkhozes, in percentages of total)

		Строительно-монтажные работы	Оборудование, инструмент и инвентарь	Прочие капитальные работы и затраты
		(8)	(9)	(10)
(1)	Первая пятилетка	83	12	5
(2)	Вторая пятилетка	77	17	6
(3)	Четвертая пятилетка	59	34	7
(4)	Восьмая пятилетка	51	40	9
(5)	Девятая пятилетка	50	40	10
(6)	1976 год	46	44	10
(7)	1977 год	45	45	10

Key: 1. 1st Five-Year Plan
2. 2nd Five-Year Plan
3. 4th Five-Year Plan
4. 8th Five-Year Plan
5. 9th Five-Year Plan
6. 1976
7. 1977
8. Construction-and-installation operations
9. Equipment, tools, and stock
10. Other capital operations and expenditures

During 1970-1977 there was a considerable increase in the quantity of construction machines and machinery: excavators, from 103,000 to 153,000; scrapers, from 29,000 to 44,000; bulldozers, from 102,000 to 158,000; traveling cranes, from 119,000 to 190,000. That made it possible to increase labor productivity in the construction-and-installation operations and to reduce the percentage of workers engaged in manual labor. Despite the increase in the mechanization of construction operations, its level continues to be insufficient. This pertains especially to the labor-intensive finishing operations, and to operations linked with the remodeling and expansion under conditions of existing production, when it is impossible to employ heavy, powerful earth-digging and construction machines. It must be kept in mind that the volume of operations involved in remodeling, as its share in capital investments increases, will grow more and more. The low level of mechanization also explains the fact that, as compared with industry, the individual output per worker in construction is 6,900 rubles, as compared with 7,400 rubles of net output per worker each year in industry. The number of persons employed in construction in the USSR is twice as large as in the United States (in 1977, 5.2 million persons), with the approximately identical volume of capital investments.

In addition to the construction industry, the construction-industry complex also includes the branches of industry that provide construction with materials and equipment -- the building-materials industry, the timber and

wood-processing industry, machine building and metal-working, and ferrous metallurgy. These branches provide construction with materials, structurals, and parts, technological equipment to be installed at enterprises that are under construction or that are to be remodeled, construction equipment and machinery, technical-sanitation, electrical, and other equipment. With a consideration of this fact, the percentage of capital investments in the entire construction-industry complex in the overall total of capital investments is approximately one and a half times greater than in the construction industry.

The data provided concerning the capital investments, production assets, and the activation of capacities attest to the large achievements in capital construction. However, this success could be much greater if there had been complete implementation of the measures stipulated in the decisions of the 24th and 25th CPSU Congresses, the materials pertaining to the Plenums of the CPSU Central Committee, and the decrees of the CPSU Central Committee and the USSR Council of Ministers that were aimed at eliminating the shortcomings existing in capital construction.

The unused capabilities are attested to, first of all, by the fact that the country's national income is increasing more slowly than the capital investments are growing. The produced national income, in prices that are actually in effect, increased during 1971-1978 by an average of 4.7 percent a year, with an average annual increase of 5.7 percent in the capital investments. In the past, the ratio between the growth of national income and capital investments was more favorable. For example, from 1961 through 1969, the national income increased by an average of 6.9 percent, that is, at a rate that was 1.5 times faster than in 1971-1978, while capital investments increased by 6.5 percent a year -- more slowly than the national income.

Inasmuch as the national income recently has been growing more slowly than the capital investments, there has been a reduction in the return on investments. National income, in terms of a single ruble of fixed production assets, in 1970 was 55 kopecks, and in 1978, 42 kopecks. Correspondingly the assets-intensity of the national income, that is, the fixed production assets per ruble of national income, increased from 1.83 rubles in 1970 to 2.40 rubles in 1978. This attests to the fact that, during recent years, there has developed an undesirable assets-intensify type of reproduction in the national economy of the USSR.

The increase in the assets-intensity of production, in and of itself, does not yet attest to the reduction in the effectiveness of production. The increase in assets-intensity and capital-intensity can compensate itself by the reduction in the production costs. That means that the increase (or decrease) in effectiveness is influenced by the entire course of production, by all its qualitative indices. The reduction of production costs is influenced by the increase in labor productivity, the reduction in the material expenditures, and the improvement in the use of equipment.

However, in recent years the reduction in the production costs has slowed

down, and in certain branches the production costs have increased. Let us consider the relationship between the capital investments in industry and the reduction in the expenditures for the production of the commercial output of industry.

Table 4

Capital investments and the reduction of the production costs in industry

	(6) 1960 г.	(7) 1966 г.	(8) 1970 г.	(9) 1975 г.	(10) 1977 г.
(1) Валовая продукция промышленности в сопоставимых ценах на 1.1.1967 г. (в млрд. руб.)	153,8	253,6	349,2	500.0	553,7
(2) Изменение затрат на рубль товарной продукции промышленности (в процентах к предыдущему году; в сопоставимых ценах)	−1,8	−0,8	−1,0	−0,7	−0,3
(3) Снижение затрат на весь объем продукции промышленности (в млрд. руб.)	2,8	2,0	3,5	3,5	1,7
(4) Капитальные вложения в промышленность (в млрд. руб.; в сопоставимых ценах)	14,3	21,3	28,0	38,9	42,7
(5) Отношение капитальных вложений к снижению затрат (годы)	5,1	10,6	8,0	11,1	25,1

Key:
1. Gross output of industry in comparable prices as of 1 January 1977 (in billions of rubles)
2. Change in expenditures per ruble of commercial output of industry (in percentages as compared with preceding year; in comparable prices)
3. Reduction in expenditures for entire volume of output of industry (in billions of rubles)
4. Capital investments in industry (in billions or rubles; in comparable prices)
5. Relationship of capital investments to reduction in expenditures (years)
6. 1960
7. 1966
8. 1970
9. 1975
10. 1977

The annual capital investments in industry, which constitute more than 35 percent of the total investments in the national economy, and which are, to a considerable degree, channeled into the expansion of production and the introduction of new technology, are supposed to lead to a reduction in the expenditures for the production of output. It can be seen from the table that

this does occur, but it does so unevenly. For example, in 1960 the expenditures per ruble of commercial output dropped by 1.8 percent, but in 1966, by 0.8 percent; in 1970, by 1 percent; and in 1977, by 0.3 percent. Correspondingly, the saving of expenditures per ruble of commercial output in 1960 constituted one-fifth of the capital investments in industry; in 1966, approximately one-tenth; in 1970, one-eighth; and in 1977, just one-twenty-fifth, that is, the repayment period was equal to 25 years. It can be seen from the table that, with the steady increase in capital investments, their repayment periods can be decreased if provision is made for a greater reduction in the expenditures per ruble of commercial output. It is easy to show (as will be mentioned later on) that a considerable reduction in the expenditures both of live and past labor is completely possible as a result of using the existing reserves.

In other branches of the national economy, one observes absolutely no reduction in the production costs. In agriculture, production costs are growing both on sovkhozes and on kolkhozes. In transportation, especially rail transportation, one observes a tendency toward the increase in the shipment costs. There has also been an increase in production costs in construction. Consequently, the capital investments as a result of a reduction in the production costs have not been repaying themselves here.

The causes of the increase in the assets-intensity of output both in industry and in construction can be objective or subjective. The objective causes include first of all the worsening of the quality of raw materials and the increase in the price of obtaining them. The best deposits of raw materials that were used during the years of the first five-year plans have been, to a considerable degree, worked out (the petroleum of Baku, Groznyy, Emba, and other old areas, the iron ore in Gora Magnitnaya, the coal from a number of deposits in the Moscow Basin and the Donbass, the timber in the Northwest, etc.). And yet the needs for raw materials have been increasing as a result of the substantial increase in production. Therefore it is necessary to use more remote raw-material sources, raw materials with a lesser content of the beneficial component. During recent years the capital-intensity of the country's fuel-and-energy complex rose by 17 percent, with the raise for the fuel industry being 20 percent, and that for the petroleum-drilling industry, 44 percent (see VOPROSY EKONOMIKI, No 3, 1979, pp 22, 23). One can expect a further increase in the capital-intensity of the fuel-and-energy complex over the long run too. Titanium-magnetite and other ores with a relatively low iron content require concentration. The specific capital investments per ton of increase in production of commercial iron ore increased from 47 rubles in 1961-1965 to 70 rubles in 1971-1975, that is, by a factor of almost 1.5. That tendency will apparently continue in the future.

The increase in the capital-intensity of production is promoted by the shifts in the placement of industry, and its rapid development in the eastern areas. This is leading to an increase in the shipping distances.

Construction costs are also increasing considerably in the new areas. Here, as a rule, it is necessary to create a number of concomitant branches, to develop power engineering, to construct electrical-transmission lines, roads,

repair enterprises, housing, mass-cultural enterprises, and many other projects. All this considerably increases the expenditures and cannot repay itself until subsequently, as the new territories are assimilated. The increase in the assets-intensity and capital-intensity of production can occur as a consequence of the crowding out of manual labor and its replacement by machinery, mechanized labor, as occurs, for example, in agriculture and construction. Without the introduction of machinery, the increase in production would be impossible. The increase resulting in assets-intensity from all these causes is justified and is progressive. As the production of output increases, the increase in assets-intensity is replaced by a decrease in it.

A negative effect is exerted upon the economic indices by the fact that labor productivity is lagging behind the increase in the capital-labor ratio. This is attested to by the following comparisons for 1971-1977.

Table 5

		(5) Рост фондовооруженности труда	(6) Рост производительности труда
(1)	Промышленность	+56	+14
(2)	Сельское хозяйство	+91	+24
(3)	Железнодорожный транспорт	+39	+22
(4)	Строительство	+69	+37

Key: 1. Industry
2. Agriculture
3. Rail transportation
4. Construction
5. Increase in the capital-labor ratio
6. Increase in labor productivity

The extent to which the increase in labor productivity is lagging behind the increase in the capital-labor ratio is especially great in agriculture, the technical base of which requires considerable intensification. But in construction and rail transportation also the gaps between these indices are extremely substantial.

The increase in the capital-labor ratio -- a value index -- can depend to a certain degree upon the change in prices of equipment and machinery. Therefore it is more desirable to compare the increase in labor productivity not only with the capital-labor ratio, but also with the technical-labor ratio of labor, for example, with the electrical-labor ratio, power-labor ratio, machinery-labor ratio, etc. It is typical that in industry the increase in labor productivity is outdistancing the increase in electrical-labor ratio. These figures constitute respectively 44 and 33 percent. In agriculture, and also in rail transportation, the situation is different. In agriculture the power-labor ratio increased from 1970 to 1977 by 77 percent; in rail transportation the labor productivity is considerably less than the growth in the electrical-labor ratio.

However, the increase in labor productivity is also influenced by factors other than the technical-labor ratio: the improvement in the organization of production; the specialization and formation of cooperatives; the increase in the proficiency level of the workers; and the providing of material and psychological incentives for them. These factors can account for no less than one-third of the increase in labor productivity. Apparently their influence is still insufficient if the labor productivity not only fails to grow in proportion to the increase in the capital-labor ratio, but also considerably lags behind it. It is necessary to activate all the indicated reserves for increasing the labor productivity.

Factors of great importance for accelerating the increase in labor productivity would be the scientific organization of labor; the compression of the work day; and the releasing of excess workers. It is typical that with regard to the labor productivity of the basic production workers, machine-tool operators, blast-furnace workers, etc., the USSR stands on the level of the most advanced countries, but the large number of auxiliary and maintenance personnel leads to a reduction in the final indices of labor productivity.

One of the objective causes for the increase in the assets-intensity of production lies in the every increasing expenditures to protect the environment. During the current five-year plan these expenditures in the state budget alone will amount to 11 billion rubles and, with the passage of time, they will increase. The total figure representing the expenditures for the protection of the environment even now is considerably greater than the figure indicated above. It is also necessary to take into consideration the fact that the assets-intensity in the broad sense -- the assets-intensity of the national income -- is increasing also as a result of the expenditures for the development of the infrastructure and the services sphere, for the increase in the comfort factor in housing, and other measures aimed at improving the living conditions of the Soviet citizens.

The considered objective causes for the increase in the assets-intensity of production should be carefully analyzed, and one should develop methods for the partial or complete elimination of the negative consequences that arise. But at the same time measures that are even more necessary are those involved in eliminating the subjective causes for the increase in assets-intensity, which depend upon shortcomings in the work performed by people. They include first of all the instability of the capital-investments plan. Despite the 28 May 1969 decree of the CPSU Central Committee and the USSR Council of Ministers concerning the improvement of the planning of capital construction and the providing of incentives for construction production, the five-year plan has not yet become the basic planning document that directs the entire course of capital construction in the country. Frequently the annual capital-investments plans are also adjusted and refined. The introduction of numerous changes has a detrimental effect upon the entire course of construction.

Moreover, there has been a failure to fulfill the important instruction in the same decree concerning the concentration of funds at the decisive projects, primarily those that are scheduled for activation in the next planning

period. The plan continues to include an excessively large quantity of projects being simultaneously constructed. This is a situation that leads to the progressive dissipation of the capital investments. The number of production projects alone that are included in the plan is 250,000-260,000. If one compares that figure with the number of construction workers employed in the construction of production projects (approximately 4 million), the average number of workers per production project is only 15-16. It is necessary to analyze and study the reasons why such major and generally known shortcomings as the instability of the plans and their frequent re-examinations, the dissipation of capital investments, and the poor quality of operations have not yet been eliminated despite the steps that are being taken.

The result of the dissipation of capital investments is the dragging out of the construction periods. It takes an excessively long period of time for constructing projects, and the actual periods of time required for construction considerably exceed the approved norms. It takes 5-10 years or more to construct large-scale industrial projects, and 3-4 years to construct medium-sized ones. This is considerably more than the construction times in the United States and other developed countries, where large-scale enterprises in ferrous metallurgy are erected in periods up to 24 months, and enterprises in most of the other branches, within a year. There are currently excessively long periods required for the planning of projects. Often this takes 2-3 years or more, and the time required for the technical and economic assimilation of the introduced production capacities. As a result, when a new or remodeled enterprise begins to operate at full capacity, it proves to be already obsolete from a technical point of view. And this is not surprising, taking into consideration the modern rates of scientific-technical progress.

Unfortunately, one cannot agree with certain statements that have appeared in the press to the effect that in recent years the construction periods have accelerated. The existing data does not permit us to come to that conclusion. The opposite tendency is attested to by the increase in uncompleted construction -- from 69 percent of the annual volume of capital investments in 1965 to 73 percent in 1970, 75 percent in 1975, and 85 percent in 1977. Moreover, for projects destined for production use the uncompleted construction is even greater, and in individual branches of industry -- electric-power engineering, coal, ferrous metallurgy, chemical and petrochemical industry -- it substantially surpasses the annual volume of capital investments.

In order to put the volumes of construction into conformity with the capacities of the construction organizations and to assure that they are not assigned work programs that they are unable to implement, it is necessary to determine those capacities and their possible increase over the course of the year. There should be no discrepancies such as those that were reported in the article by chief of the Main Economic-Planning Administration of the USSR Ministry of Construction, A. Yakovlev (see Ya. Yakovlev, "How to Develop an Experiment," PRAVDA, 25 March 1979), when an increase of 13.7 percent in the annual volume of contractual operations was planned at USSR Minstroy; 14.9 percent at

Minpromstroy; and more than 30 percent in individual construction subdivisions, depending upon rayons. In order to fulfill these increased work volumes, it is necessary to bring in approximately 150,000 workers and create anew 75 large-scale construction trusts, and this is unrealistic.

The acceleration of construction, with a curtailment of the uncompleted construction, to a large extend depends upon increasing the responsibility and creating the self-interestedness of the construction organizations in turning over completely completed projects on deadline or ahead of deadline. In this instance the construction workers must be paid bonuses from the saving that the customer derives from the preterm handing over of the project. At the same time it is necessary to put an end completely to the old system of financing the contractors for the fulfillment of a volume of operations by stages; this leads to their self-interestedness in the primary execution of the "profitable" operations and the dragging out of the "unprofitable" ones, and, in the final analysis, to the increase in uncompleted construction. With this system the capital-investments plan is fulfilled but the plan for handing projects over for operation is not fulfilled. The changeover to a system of having the customers make settlements with the contractors for the projects that have been completed and handed over is provided for in the previously mentioned decree of the CPSU Central Committee and the USSR Council of Ministers, but it has not been completely carried out, partly because of the shortage of working capital at the contracting organizations.

In recent years the positive experience of the Ministry of Construction, Belorussian SSR, is becoming increasingly widespread. The broad introduction of that experience makes it possible to accelerate construction and activation of projects. As in industry, the settlement in this instance is made for the commercial output, that is, the finished projects to be turned over "under lock and key." The incentive for the contractors here is the profit that they can obtain. If there is a shortage of working capital, the contractor gets a loan at Stroybank. As a result of the adopted system, there was an increase in the handing over of finished projects, a decrease in the number of projects being simultaneously constructed, and a reduction in the volume of uncompleted construction. But the overall amount of "assimilated" funds decreased, and it is specifically according to that gross indicator that one still judges the plan fulfillment. It is necessary, consequently, to reject completely that method of evaluating the results of the work performed by the construction workers. An experiment analogous to the Belorussian one is also being carried out by Ministry of Construction, Lithuanian SSR. Positive results have also been obtained there, although in the course of the experiment other shortcomings -- such as the lack of balance in planning -- were also ascertained.

An important role in eliminating the shortcomings in capital construction can be played by the broader use of long-term credit instead of unrepayable budgetary planning. The changeover to the granting of credit increases the customer's responsibility for the making of the decision concerning the construction of the particular project. The funds obtained on credit must be returned. This should force the customer to give careful substantiation for

the desirability of the capital investments and assure the effective operation of the constructed project, whereas, with budgetary financing, it is sufficient to "achieve" the inclusion of the project in the plan and the allocation of the funds to construct it. Broad application of long-term credit is promoted by the changeover to the control of the economy by way of the system of cost-accounting production associations as recipients of credit who are responsible for its effective use and prompt return. Long-term credit is not being completely used yet. Its share in the financing of capital investments, although it has increased somewhat during recent years, comes to approximately 12 percent, and it should be brought up to 25-30 percent. It would be desirable to use credit in the construction of all projects with a repayment period of up to 8 years. Practical life shows us that construction projects carried out on the basis of credit are put into operation on schedule or ahead of schedule to a much greater degree than the construction projects being financed by the budget.

A factor that considerably drags out the work performed by the construction workers and delays the activation of the projects is the tardy and incomplete delivery of equipment, and, not infrequently, its inadequate quality. As a result there are periods of idle time in the course of construction and excessively long periods of time for the adjustment and assimilation of the equipment. The Basic Trends in the Development of the USSR National Economy in 1976-1980, which were adopted by the 25th CPSU Congress, stipulate increasing the role and responsibility of the enterprises in the machine-building ministries in assuring the complete delivery, installation, and assimilation of the equipment that is manufactured by them. These tasks also confront the component-supplying organizations in the system of material-technical supply. It is necessary to discontinue the shipment of equipment to machine builders "in bulk." It is necessary to assure the opportunity of paying the machine builders for received equipment at two times: payment of 70-80 percent of the value of the equipment after the delivery, with final settlement after the installation and start-up, with the machine builders having the right to obtain bank credit for the period of time between the partial payment and the final settlement.

The lagging behind of the construction operations and the interruptions in the obtaining and installing of equipment lead to the formation of large reserves of equipment at the warehouses, with a total value of several billion rubles, and simultaneously to the existence of empty production areas, which are measured in the millions of square meters.

The failure to fulfill the activation on the new capacities on schedule not only reduces the effectiveness of the construction itself, but also exerts a detrimental effect upon the entire national economy, since the output that is planned to be obtained from the activated capacities has been previously distributed in the supply plans, and assets have been issued for it; tardy receipt of output from the unactivated capacities violates the normal operation of the enterprises that are the holders of the assets, disrupts their plans, and keeps operating like a chain reaction, affecting other enterprises.

In the field of civil construction, a factor of great importance for improving its entire organization is the application of the method used by the Orel construction workers. In conformity with that method, provision is made for creating in the city a single customer-organization for civil construction, which concentrates in its hands all the relations between customers and contractors. This creates a flexible system of planning and fulfillment of the construction operations and the maneuvering of construction machinery, materials, and workers. In addition, the planning of construction operations in this instance is carried out in accordance with a sliding plan drawn up annually for a two-year period, with the aim of eliminating the "all-out effort" toward the end of the year and the creation of the necessary carryover backlog for work to be done during the subsequent period. These methods should become widespread, but for some unaccountable reasons this is not yet being done.

The raising of the level of organization of construction is promoted by the broad extension of the brigade-contract method, the initiator of which was N. A. Zlobin. According to this method, the brigade assumes the responsibility of carrying out all the operations involved in the construction of the project and has complete disposal of the obtained funds. At the present time a large number of collectives are operating according to the Zlobin method at thousands of projects. The fulfillment of construction operations has been accelerated, a saving of many millions of rubles has been achieved, and simultaneously the workers' earnings have increased. There are different varieties of the brigade contract, each with its own type of payment by the job -- by deadlines for fulfillment of assignments, by payment deadlines (with payment of an advance), etc. An important condition for the successful application of the brigade-contract method is the continuous supplying of the construction site with materials and equipment. Consequently, the success of the method requires the initiatory work not only on the part of the brigade collective, but also on the part of the construction-site administrators, and, if there is any complication in the system of coordinated activities, at even higher economic levels.

One of the major shortcomings of construction is the considerable increase in its costs as compared with the original estimate -- sometimes by a factor of 1.5-2, or even more. The increase in construction costs can be explained only partially by objective reasons -- rise in prices of materials and equipment, increase in wages. More frequently the surpassing of the estimated cost of construction is the result of subjective factors that are completely amenable to elimination. When developing the estimate, both the designers and the customers have a self-interestedness in assuring that the estimate is drawn up as rigidly as possible: the designers with a view to receiving a bonus, and the customers with a view to seeing that the "cheaper" project is included more quickly in the plan. But after it has been included in the master construction list, it is almost always necessary to reconsider the estimate for purposes of increasing it.

An unfavorable effect is exerted upon the estimated cost of the project by the long delay in the fulfillment of the construction operations: the longer

the construction time, the greater its cost. Moreover, the cost, as a rule, increases progressively. Actually, the cost of construction greatly depends upon the organization of the construction operations, upon the prompt delivery of everything needed for construction.

One ought to recognize as a great omission the fact that no executive estimates are drawn up for us, and there is no analysis of the actual effectiveness of the capital investments. Without this, it is impossible to supervise the results of construction. Therefore it is necessary to analyze the cost of the executed operations by individual components, ascertaining the reasons for the increase in cost and identifying the individuals responsible for the failure to take these factors into consideration promptly. The acceptance of the turned-over construction project onto the customer's balance sheet should be done not on the basis of the approved estimate cost, as is currently done, but on the basis of the actual cost. The organizations and individuals who have allowed an overexpenditure should bear the responsibility for that. Only under these conditions is it possible to improve the evaluation of the executed construction operations and to prevent a sharp increase in the cost of the projects to be handed over. It would also be desirable to systematize the estimate prices with a consideration of the increase in prices of materials, structurals, and articles, with a consideration of the payment for credit, changes in the territorial placement of construction, the increase in the shipping distance, etc. It is necessary to resolve the question of the possibility of developing consolidated prices for individual standard projects, which would greatly facilitate the computations of the effectiveness at the initial stage of planning of projects, when their technical-economic substantiation is being made.

It is important to reject completely the existing system of evaluational indices pertaining to the work of the construction workers, proceeding from the expenditures of capital investments. At such time there is created a self-interestedness on the part of the construction workers which is contrary to common sense and which lies in the use everywhere of expensive and heavy materials. And this occurs even in agricultural construction, where, for example, prefabricated reinforced concrete is used even to construct cow sheds. It is necessary to create the construction workers' self-interestedness in the use of materials that are the most effective for the particular project, for example, brick, in the automation of the production of which considerable successes have recently been achieved (thus making it possible to effect a sharp reduction in its production costs) and various light-weight and inexpensive materials and heaters, plastics, steel flooring for buildings, monolithic reinforced concrete, and other types of materials.

The broad application of prefabricated reinforced concrete played an important role in achieving major successes in our capital construction. But this does not mean in any way that it should be used in absolutely all types of construction operations or to construction the most varied projects. For example, in the area of the Tyumen' petroleum-gas complex, under marshy conditions with a lack of roads and an acute insufficiency of means of ground transportation, it is more desirable to employ monolithic reinforced concrete,

which makes it possible to save fuel and metal. Monolithic reinforced concrete obtained locally can be more economical than shipped-in prefabricated. Another large benefit could be provided by the use of various wooden structurals that have been properly impregnated to protect them from destruction.

Progressive methods of organizing and executing planning operations deserve to be more widespread. For example, during the construction of the Volzhsk Automobile Plant, in many instances, there was a failure to adhere to the ordinary "sequential" procedure of carrying out the designing and construction operations, and the designing and construction were carried out in parallel. That provided the opportunity to reduce the overall construction time and the volumes of the design documentation, which, unfortunately, continues to be excessively large and cumbersome.

Something that can be of great importance is the execution of construction operations by complexes, with the purpose of handing over of large-scale combines in individual phases, thus making it possible to accelerate the return on capital investments during the implementation of each phase of the construction operations. The elimination of the previously mentioned shortcomings will provide a tremendous economic benefit. If the 1978 return on investments had remained at the 1971 level, then with the amount of fixed production assets in 1978 -- 1006 billion rubles -- the national income that year would have been 552 billion rubles, or 113 rubles (37 percent) more than that which was actually produced.

Capital investments that have the purpose of eliminating the major losses in individual sectors of the national economy are providing to be highly effective.

Here is the first example. In machine building and metal-working, every year approximately 19 million tons of metal waste products are produced, half of which are shavings.

The average efficiency of metal in the country is 78 percent, as compared with 85 percent in the United States. One of the reasons for such a considerable amount of waste products is the high share of metal-working by cutting, and the insufficient share of processing by means of pressure (respectively 86 and 14 percent). The increase in the processing by means of pressure is restrained by the small share of sheet in the production of rolled metal -- approximately 40 percent, including cold-rolled thin sheet -- only 7 percent. In order to decrease the losses, capital investments are needed for the development of the production of rolled metal from sheet and the production of precision castings, as well as the production forge-press machinery. That will make it possible within the very near future to reduce the amount of metal waste in machine building and metal-working by at least 2 million tons, with an annual saving of current expenses of 400 million rubles and with the repaying of those expenditures within 3-4 years.

Here is the second example. With the annual shipment of trimmed timber from

the logging sites in a quantity that somewhat exceeds 300 million cubic meters a year, all types of waste products in the processes of timber operation, transportation, sawmill operation, and woodworking constitute as much as 200-250 million meters, including branches, tops, roots, logs that sink during floating operations, and sawmill waste products. A considerable part of these waste products could be used. If one were to collect and process only part of these waste products, converting them into wooden slabs, cardboard, paper, etc., which would require capital investments in the corresponding industrial enterprises and transportation, one could save more than 2 billion rubles of investments in the creation of new capacities in logging and shipping of timber which would be necessary if the waste products were not used.

And a third example. In agricultural production, every year there are losses of a large quantity of grain, potatoes, vegetables, fruits, and live weight of livestock because of a shortage of storage capacities at elevators, vegetable storage facilities, warehouses, and primary-processing enterprises, and the poor road condition. Computations indicate that the capital investments in elevators can repay themselves within 3-4 years as a result of the preservation of the grain, and in vegetable storage facilities within an even short period -- 1-1.5 years. It is necessary to increase the capital investments in the storage, shipment, and primary processing of agricultural output until the sufficient storage facilities have been created, in order to reduce the losses and improve the supplying of products to the consumers.

Analogous problems confront the other branches. It is necessary to achieve a sharp increase in the number of trailer machinery to be pulled by tractors in agriculture, to begin to produce small tractors and other machinery for use on private plots, to expand the production of truck trailers in order to make better use of the tractive force of trucks, and to create more means of minor mechanization in construction. The elimination of this and similar disproportions in individual types of technical re-equipment requires comparatively small capital investments, but can yield a considerable benefit in the national economy.

This article has considered the question of how to assure an increase in the return on investments, given the particular volumes of capital investments and their trends. But it is also necessary to pose the question of how to change these trends, what it is necessary to build in order to increase the effectiveness of capital investments and the return on investments. This should become the topic of special analysis, on the basis of which one can ascertain those branches, rayons, and projects in which one should invest the capital investments in order to achieve their greatest effectiveness.

The merits of the Soviet construction workers in expanded socialist reproduction, in the creation of our country's production potential, in the development of the nonproduction sphere, are extremely large and are generally acknowledged. But these successes could be much greater. It is necessary to use the internal reserves existing in construction in order to achieve a

substantial increase in the effectiveness of capital investments and the activities of the entire industrial-construction complex of the Soviet Union.

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STRUCTURAL RESERVES FOR THE SAVING OF PRIMARY RAW MATERIAL RESOURCES

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/Article by Sh. Rozenfel'd/

/Text/ Raw material resources are the initial material base for the development of productive forces, and this determines their important role in public production. As the latter develops, the problem of how to supply the national economy with a reliable, highly-efficient raw-material and fuel-energy base acquires ever greater significance. This is explained, on the one hand, by the enormous scale of raw-material and fuel consumption and the continuous growth in the demand for them, and, on the other hand, by the specific features of the sphere of raw-material resource extraction and production.

Our country has created a powerful fuel-energy base which is capable of meeting the rapidly growing demands for raw material resources. For a majority of minerals the reserves which have been discovered are large enough to support exploitation over an extended historical period, but they are not limitless. The reserves of certain--especially high-quality--forms of raw materials and fuel are declining in relative terms (calculated in terms of supply). The natural physico-chemical properties of minerals are limited, and in many cases they do not meet new production requirements that arise from scientific and technical progress. The mining and geological, as well as the economic conditions for the extraction of primary raw materials and fuel are often found to be declining, and this leads to an increase in the per unit cost for raw materials as well as for the final product.

In a number of cases the specific characteristics of primary raw material resources (limited reserves, composition and physico-chemical properties, increased mining costs) result in those resources becoming a restraining factor in the development of material production. However, under the influence of scientific and technical progress there are significantly expanding opportunities for making economic use of new[1] types of raw materials, as well as low-grade raw materials,[2] of which there are greater reserves than there are of resources with a high mineral content;

it is becoming practicable to work rich new sources of raw material resources and to extract minerals located at great depths;[3] conditions are being provided for the comprehensive utilization of raw materials and the creation of waste-free production. Technical progress also plays an important role in lowering the relative mass of raw materials, and of their per unit expenses and cost.

Thus, the development of productive forces and the acceleration of scientific and technical progress compensates for the limitations characteristic of raw material resources, and they create the necessary conditions to provide the country with an economical raw material base. The realization of the achievements of science and technology in this sphere requires the implementation of an extensive set of complex measures to improve the structure of production and consumption of fuel and raw-material resources. As the raw-material demands of production increase, there is ever greater significance to the need to improve the proportions between raw material consumption volumes and the output of finished products and to further increase the output of the latter and to reduce the level of raw-material use (raw-material intensiveness) in all public production. In sum, this means an increase in the mass of consumption costs per unit of primary raw materials as a result of the intensification of production; it also means all-possible savings in raw materials and fuel, a reduction in relative volume of the raw materials which are consumed, as well as of the labor expenditures and of the fixed production capital used to extract (or produce) and process raw materials.

The implementation of a set of these measures requires the mobilization of reserves in all spheres of the economy. We shall consider one of these--the structural reserves for saving fuel and raw-material resources in the extraction and processing procedures.[4] It is important to analyze in which processes (production units) these reserves are concentrated and the fundamental methods for using them. An evaluation of the reserves for saving material and labor resources should, in our view, be carried out primarily on the basis of data about the functional structure of the raw materials (in its weight and cost forms), as well as about the level of labor expenditures and of fixed production capital. The wisdom of using any given sources of reserves depends on the targets which have been set.

According to our calculations, the total mass of raw materials and fuel in terms of weight is made up of the following: one-half is ore and mineral non-ore (crushed stone, gravel, sand, etc.) raw materials for the production of building materials (including about 40 percent for building parts), more than one-third is for energy resources and one-tenth is for agricultural raw materials. In terms of cost the proportions are different: agricultural raw materials account for less than three-quarters, energy resources for one-sixth, and ore and non-ore raw materials for less than one-sixth.[5] For this reason a substantial reduction in the mass of the raw materials which are consumed requires

structural changes first of all in the sphere of construction and power engineering, where three-fourths of the total weight of raw materials and fuel is used. A reduction in the total cost of raw materials is possible primarily on the basis of improvements in the production of agricultural raw materials and of an increase in its effectiveness.

Large reserves for the reduction of labor and capital expenditures are also located in agricultural production, which has significant concentrations of labor and material resources--nearly nine-tenths of the total number of employed people and approximately 75 percent of fixed capital of all raw-material sectors. In comparison with the average indices for all other types of raw materials, the labor intensiveness is 2.6-fold greater here, while the capital-intensiveness is only 10 percent less. Aside from the objective reasons (the seasonal nature of the work, the influence of natural-climatic conditions, etc.), the high labor-intensiveness of agricultural work is explained by the fact that the technical level is lower than that of the extracting industry (i.e., the lack of automation and the significantly lower level of mechanization and electrification of production processes). In the extracting industries and forestry, fuel raw materials account for nearly 40 percent of all workers and 60 percent of fixed capital. Moreover, petroleum production dominates in terms of fixed capital and coal in terms of the number of workers. A large proportion is employed in logging.

Among all forms of mineral resources and timber, the most capital intensive (1.3-1.4 in comparison with the average indicator) are petroleum production, underground mining of coal, metal ores and mining-and-chemical raw materials, while the indicator is 0.4-0.6 for logging and the mining of mineral non-ore materials. The labor-intensiveness for extraction processes is highest for underground coal mining, for logging (1.7-1.8 on average), as well as for the extraction of non-ore raw materials. It is lower for the mining of metal ores and chemical raw materials (0.6-0.8) and is the lowest for gas and petroleum production and for open mining of coal (0.1-0.3).

It should also be taken into account that the level of capital-intensiveness and labor-intensiveness for the most important types of minerals is as a rule, significantly higher than in the corresponding production units for the processing of raw materials: for petroleum the figures are respectively nearly 4-fold and 1.5-fold, for metal ores more than 2-fold and 1.5-2-fold, for mining and chemical raw materials they are 2- and 1.5-fold. The labor-intensiveness of logging is 1.5-fold greater than it is for wood processing. For this reason a reduction in the capital and labor intensiveness of extraction processes yields a great effect when the calculations are made for a comparable unit of production (in terms of cost).

In analyzing the indicators for a group of raw material production units for mineral resources and wood, we see that one of the first-

priority tasks is to mobilize the large reserves for the reduction of both labor and capital expenditures for underground coal mining. Among other sectors it would be most effective to reduce fixed capital first of all in the extraction of petroleum, ore and mining-and-chemical raw materials and to reduce labor expenditures in logging and the extraction non-ore raw materials. This direction and sequence for the lowering of labor and capital expenditures will ensure a relatively large effect on the unit of production cost, and consequently, a noticeable increase in the effectiveness of public production.

In order to determine the means and methods for the effective utilization of raw-material resources it is essential to examine the specific conditions of the individual stages of a single technological process as well as of each raw material industry. The formation of the raw materials structure begins virtually at the stage of geological explorations. The size of the increase in the reserves of progressive types of raw materials, fuel and, consequently, of the structure of the reserves depends largely on the thrust and intensity of these explorations. Increasing the scale of these explorations and improving their technical level constitute a top-priority goal. This applies especially to ore raw materials, energy resources (primarily petroleum and gas), as well as to a number of raw materials which are in short supply although not used in large amounts. As an important reserve for increasing the nation's raw-material potential it is advisable to work intensively on bringing into production common multi-component resources (specifically granite, basalts and other raw materials containing various ore elements), as well as low-grade raw materials.

In the immediate future improvements in the organization of labor and fuller utilization of available production capacities will provide the greatest results without substantial additional investment in the extraction of raw materials and fuel, where labor expenditures and capital intensiveness are high. However, the intensification of mineral resource extraction based on the application of new technology has decisive significance for the technical improvement of the extracting sectors. It is especially important to emphasize this as a result of the rapid growth in open mining of minerals and an increase in the depth of underground mining. With the open method of mining there is an opportunity to create powerful complexes (metallurgical enterprises, electric power plants and others) with the most favorable conditions for the organization of waste-free production. And special machinery and equipment systems must be created for these complexes. As the depth of mining increases, it is more and more important to have automated mining and to create the conditions for mining without the use of people, i.e., to eliminate underground labor. However, it should be taken into account that the scale of the mining intensification and its effectiveness are limited by the size of capital investments. Also, in a number of cases the application of new equipment provides only a partial result--the lowering of labor-intensiveness. For this reason

it can be expected that in the extraction sphere the greatest effect will come from the more complete extraction of natural resources from the earth. This will also provide savings of fixed capital and an increase in the real reserves of raw materials.

In order to reduce the relative mass of the raw materials consumed, that is, to increase the effectiveness of their utilization, there must be further improvement in the qualitative composition of raw materials and intensification of the processes for working them. In recent decades--under the influence of scientific and technical progress--there have been substantial changes in the qualitative composition of the raw materials consumed. This has been seen in the broad use of petrochemical raw materials after the production of polymer materials first started; in a sharp increase in the consumption of non-ore raw materials as a result of the broad development of the production of reinforced concrete construction parts and in the reduction in amount of brick clays used to produce less effective products; in a significant reduction in wood consumption as wood is being displaced by other raw materials; in the rapid increase in gas and petroleum consumption resulting from the gasification of the economy and the increased demands of all branches of the national economy for diesel fuel.

There has also been a substantial change in the ratio between the volumes of initial raw materials consumed (including agricultural), and energy resources on the one hand, and of processed items of labor on the other hand (as a result of using in production raw materials which were formerly consumed in an unworked form). According to our approximate calculations, this ratio was 2:3 in 1950 and 1:4 in 1975.

Changes of this kind have been observed most clearly in the processing of agricultural raw materials and in the fields of energy and construction. For example, the development of a number of branches of the food industry (mixed feed, butter and cheese making, milk, fruit and vegetable industry and others) resulted in new-raw material resources being brought into production, and the fraction of agricultural raw materials being processed increased from 40 percent in 1959 to 55 percent in 1975. More than one-third of the total volume of fuel and energy resources is used for the production of electrical and thermal energy. Most of the coal and nearly all of the ore raw materials are subjected to an enriching process. A majority of the most important non-ore raw materials are used to make building materials, while in the early fifties these raw materials were sent directly to construction sites where they were used, as a rule, in unprocessed form.

Improvements in the methods for processing raw materials and intermediate products have manifested themselves in the broad utilization of oil, wood and other materials to produce high-quality items based on multi-stage technology; in a significant increase in the proportion of high-grade petroleum products; in the expansion of the fourth conversion

in metallurgy, etc. At the same time it is, as before, extremely important to improve the processes for enriching raw materials and to meet all of the demands of the consuming industries for the prepared product.

And, finally, the effectiveness of the raw materials structure depends in significant measure (and in a number of cases mainly) on the quality of the finished products obtained from the raw materials and on the degree to which the raw materials are utilized. For example, the great demand for metal ores and especially for non-metalliferous raw materials is caused by the production scale for metal and precast reinforced concrete, by the inadequate qualitative composition of the latter and by the relatively low utilization factor for metals, etc. In particular, the higher average consumption of primary raw materials per unit of finished product in our country as compared with the USA can be explained to a significant degree by differences in the qualitative composition of construction materials. For example, U.S. output of forestry products includes a higher proportion of paper and cardboard, and U.S. production of ferrous metals includes more sheet metal and economical sections, etc., i.e., products which require more processing and a lower per unit volume of raw materials.

Our estimates show that the use of non-metalliferous raw materials or binding materials of improved quality provides a 10-20 percent savings of raw materials. Changing the type of construction materials by producing more economical forms--those with improved qualities of strength, durability, etc. or light-weight types--make it possible to reduce the mass of initial raw materials for various types of metals from 10-20 up to 40 percent, and to make a 2-fold to 3-fold reduction for construction parts based on non-metalliferous raw materials. The mass of raw materials consumed is lowered still further when metals or products from non-metalliferous raw materials (and the latter to a greater degree) are replaced by polymer materials and light metals.

A significant effect can also be obtained from the complete utilization of raw materials, wastes, secondary resources and from a reduction in the raw-material consumption per unit of output of the desired quality. As a rule, fuller utilization of raw materials is more economical than mining more of the material. With complete processing petrochemical raw materials can be 60-70 percent utilized (in terms of weight) instead of 30 percent utilized when only one component of this raw material is processed. The complete utilization of aluminum raw materials contributes to a reduction in the mining of a number of other raw materials. The use of metallurgical slag and ashes from thermal power stations for the manufacture of construction materials makes it possible to save not only natural raw materials, but also fuel. Further, in comparison with the production of goods from natural raw materials, current expenditures are reduced by 10-20 percent and the volume of capital investment by 35-50 percent.

Production wastes, which often amount to the greater part of the total mass of raw materials consumed are similarly important. For example, in machine building and metal working they account for 25 percent and in production units which use forest products the figure is 20 percent. In certain production units the figures are much higher (for example, in the furniture industry the figure is more than 60 percent). When tree wastes are used as secondary resources in the forestry industry and in railway transportation the savings (calculated per cubic meter of wood) total: 0.9 man/days in labor, 16 rubles in manufacturing costs and 62 rubles in capital investment.

The main methods to further reduce raw-material intensiveness in various production sectors are not identical. In the construction materials industry, improvements in qualitative composition play a decisive role. As the data show, the improved composition and qualitative characteristics of rolled products made from ferrous metals have resulted in savings over the past 20 years which have reached 20 million tons; this is equal to a savings of approximately 120-140 million tons of various raw materials which are used in metallurgy. Improvements in the qualitative characteristics of ferrous metals provide approximately one-third of the total savings of metal in the machine building industry. The utilization of efficient building designs and materials provides more than half of the total savings of material expenditures (including savings from the use of wastes and savings of fuel-raw material resources as well as from other factors) and provides approximately 90 percent of the possible reduction in the weight of buildings and other facilities. The implementation of measures to improve the qualitative composition of building materials will make it possible to reduce the annual consumption of raw and processed materials for construction by approximately 80-100 million tons by the end of the current five-year plan.

In the near future the bulk of the savings can be expected from improvements in the qualitative characteristics (primarily strength characteristics) of the highest tonnage traditional materials (ferrous metals, precast reinforced concrete structures and others) and especially from the expansion of the output of economical, especially light-weight products. The use of polymers and light-weight metals will make it possible to substantially increase the production yield from a unit of raw material. However, the total savings of raw materials here will not be as great as in the production of metals and reinforced concrete structures due to the relatively small output volumes for polymer materials. An increase in the ouptput of the finished product from forestry materials requires primarily the total processing of the wood, broad utilization of the wastes and a significant increase in the proportion of output derived from deep processing (paper, cardboard, etc.).

In utilizing intermediate products from ore raw materials, one of the main goals continues to be the systematic reduction in metal scraps on the basis of advanced methods of metal working, and it is especially important

to bring as closely into line as possible the forms and amounts of intermediate products and the forms and amounts of finished goods. Technical improvements in the process for enriching and increasing the volume of primary working of the raw materials are of great significance for the lowering of the amount of non-metalliferous raw materials which are consumed.

The above-enumerated means and methods for the intensification of raw material utilization are particularly timely inasmuch as the consumption of raw materials per unit of a specific type of finished material (for one ton of cast iron, cement, etc. of the same quality) will remain practically at the same level. A substantial reduction in the raw material consumption per unit of any given product requires fundamental changes in the technology of production. In recent years the per unit consumption of raw materials for many products has changed little, while the consumption of iron ore has even increased.

The further reduction of fuel-intensiveness in production, especially with an energy resource structure which is changing little, will require first of all an increase in the intensification of the processes of fuel consumption. In previous years expenditures for fuel were reduced in significant measure as a result of the rapid growth in the consumption of oil and especially of gas. In the future an increase in the economical forms of fuel--hydroresources, cheap coals and atomic fuel--will exert a similar influence, but the effect will obviously be much less.

For this reason one of the urgent goals in the field of fuel conservation is the utilization of the reserves of the fuel-consuming industries, especially of the most energy-intensive industries, through intensification of the technology for reducing fuel consumption and fuller utilization of energy resources. The further reduction in the per unit consumption of fuel and the inclusion on a broad scale of secondary energy resources in production processes are of substantial significance. For example, the utilization of secondary resources (without flue gases and other fuel wastes) in metallurgy makes it possible to obtain an additional 0.12-0.14 tons of comparison fuel calculated per ton of smelted steel, while the total adjusted expenditures are one-half to one-third of what they are under mining conditions in the European part of the USSR. There is evidence of the significance of secondary resource utilitzation in the fact that at the enterprises of certain industries (ferrous metallurgy, petroleum refining and machine building) these resources may cover from 29.7 percent to 32.3 percent of the total fuel demand.[6]

At the same time it is important to make more rational use of energy resources and primarily of oil and gas, which as raw materials should be used mainly for chemical production and technological fuel in specific industries. The significance of the most economical types of coal

for the production of electrical energy is growing substantially, especially in regions where the cheaper grades of coal are mined. Coal will continue to be used as both an operating fuel in metallurgy and other branches of industries and partly as a chemical raw material.

The reduction in expenditures for agricultural raw materials also depends largely on a raising of the level of equipment and the rational utilization of raw materials in the processing sphere. However, in contrast with other types of raw materials, the main structural reserves for savings are in the sphere of agricultural production itself; this is the result of the specific features of this production and of the significantly greater (in comparison with the industrial processing of this raw material) labor and capital intensiveness of agricultural work (which are 5-fold and 6-fold greater respectively).

The results of the analysis of sources for savings on raw material and fuel consumption make it possible to draw a number of conclusions about the main trends in the structural dynamics of future raw material consumption and about the necessary measures to improve it and increase its efficiency. The main reserves for the reduction of the total mass (weight) of raw material resources which are consumed lies in the sphere of industrial consumption of mineral non-metalliferous raw materials for construction and of fuel for power engineering. The main reserve for the reduction of the total costs of all raw materials lies in the substantial growth of labor productivity in agriculture and the resulting decrease of the per unit expenditures for the production of raw materials. The most important and most effective ways to mobilize these reserves are the following: in the extracting sectors--the complete extraction of raw materials and fuller recovery of them; in the processing industries--the complete utilization of raw materials and especially the development of production for new and better light-weight goods; in the production of agricultural raw materials--the intensification of this production primarily on the basis of a substantial increase in the agrochemical level of agriculture.

These directions in scientific and technical progress will give rise to a comprehensive effect in all spheres of the economy, including production of the final product and in distribution (in transportation, storage, etc.). For the raw material sectors the comprehensive effect is expressed in a relative reduction in the demand for raw material resources, as a result of which there is to a significant degree (although not proportionally) a relative decline in the demand on the part of the raw material sectors both in the number of those employed and in fixed capital. In addition, there is practically no limit to the use of these methods, and they can be used at every stage in the further development of the economy. The data cited above show that the main reserves for a relative reduction in the necessary mass of minerals and timber, as well as a decline in the demands of the mining industry for workers and fixed capital are located in the sphere of industrial

consumption of raw materials and fuel, that is, in the processing sphere. As a rule, priority should be given to the implementation of these measures in comparison with measures which provide a limited, unilateral effect.[7]

For the achievement of a comprehensive effect in the extraction and consumption of raw materials it is essential to plan a technical policy for systems of raw-material extraction and processing based on the comparative effectiveness of improvements in the technology of raw material extraction as well as in improvements of the qualitative composition of the product obtained from it.

Rationalization of the raw-material base will give rise to progressive tendencies in the structural dynamics of raw-material resource consumption. The following trends are characteristic for all groups of raw materials: 1) an increase in the absolute dimensions of raw material demands as a result of the further development of productive forces; 2) improvements in the structure of interchangeable raw materials; 3) reduction in the per unit consumption of raw materials under the influence of technical progress and the improved organization of production. The first of these factors will give rise to growth and the other two will give rise to a reduction in the total volumes of raw material consumption. In general, however, the total mass of necessary raw materials will grow more slowly than the volume of goods obtained from it (construction materials, petroleum products, energy, etc.).

The distribution of individual groups of raw materials in their entire balance can be presented in this way. There will be relatively greater growth in the demands for petrochemical and mining-and-chemical raw materials and for energy resources as a result of the probable rapid advance in the production of plastics, chemical fertilizers and electrical energy. In addition, there will be relative increases in the demand for ore raw materials as a result of the utilization of poorer ores and for fuel as a result of the expansion in the open mining of low-grade coals. And, on the other hand, wider use of atomic fuel and hydro-energy in place of coal, as well as growth in economical types of ferrous metals, will lower demands for these raw materials. Finally, it is obvious that there will be an increase in the consumption of petrochemical raw materials as they replace other raw materials, especially wood. In general, a noticeable increase in the proportion of petro-chemical and mining-and-chemical raw materials, as well as a reduction in the proportion of wood, can be expected in the total volumes of raw materials and fuel. The volumes of non-metalliferous raw materials will grow at a relatively slower pace as a result of the slackened growth in the volumes of construction projects (in comparison with industry); this will also be due to an increase in the output of light-weight building structures.

The utilization of reserves for saving raw material costs also requires that the appropriate organizational conditions be provided in the area of production planning and management. One of the reasons for the low level of comprehensive utilization of raw materials, fuel and secondary materials is, in a number of cases, a departmental approach to the solution of problems of how to supply the country with raw materials and how to conserve them. Industrial reserves are determined, as a rule, on the basis of one main component (or a limited number of components), which is essential for the establishment of a narrowly specialized production unit. In the planning of specialized enterprises the suitability of the location is frequently determined unilaterally, without taking into account the effect of the processing of other raw materials, as well as the production wastes. This kind of approach largely explains the weak material interest of departments and enterprises in the full utilization of resources.

Increasing the scientific level of planning and strengthening the cost-accounting methods of management at enterprises which extract or produce raw materials will contribute a great deal to the total utilization of raw material resources and the effective realization of their structural reserves. First of all it is essential to have a long-range state plan for the effective utilization of all raw-material resources which specifies the order in which they will be brought into production. Further, the principle of the comprehensive utilization of raw materials must serve as one of the most important starting points for planning the nation's raw material base. This plan may be worked out on the basis of theoretical and prognostic data on the comparative effectivenes in the exploitation of major deposits of raw materials, of interchangeable primary and secondary raw materials and their wastes, as well as data on the effectiveness of specialized and combined production units to manufacture finished goods from raw materials.

The long-range plans must be used to work out concrete plans for the construction and operation of new raw material bases, raw material combines, individual deposits, etc. They should specify the volumes of all raw materials to be extracted (without dividing them into main and by-products), the necessary capital investment, material and labor resources. At the same time the departments in whose jurisdiction the deposits of combined raw materials are located must be fully responsible for the entire plan, and the results of their activities must be judged by taking into account fulfillment of the plan for the extraction of both the primary as well as the secondary raw materials. A centralized organization for the utilization of raw-material resources and production wastes is of first-rank significance for the newly created territorial-production complexes, especially in the nation's East.

Measures for the utilization of structural reserves must be carried out at all levels of planning and management. At the same time, it should be taken into account that many of the ways to save raw materials,

and especially the utilization of these resources in a comprehensive manner, are intersectorial and interregional in nature. They are related to the solution of major questions of technical policy, the economic advisability and the sequence in which measures should be implemented to conserve raw materials in various sectors and rayons, as well as to questions of the appropriate distribution of capital investments, etc. For this reason comprehensive planning for raw material resources on the scale of the entire national economy is of decisive significance for the effective mobilization of structural reserves for saving raw materials.

FOOTNOTES

1. The discussion concerns new, extremely promising forms of fuel (nuclear and hydrogen fuels and various fuel elements); the utilization of tens of kinds of ores for alloying metals and for producing metal alloys; the use of nephelines and alunites and others as raw materials for the aluminum industry, in addition to traditional materials such as bauxites; fundamental change in the raw material base of chemistry; the continuous expansion in the variety of the raw materials used for the production of building materials; the enormous new role of industrial "wastes" and, finally, artifical parent substances from natural raw materials, and the significance which these substances are coming to have for the future.

2. The application of advanced methods for extracting useful substances from the raw material mass which is being mined--methods such as ore flotation, the extraction of metals from log-grade ores or of chemical compounds by means of chemical reagents, the magnetic separation method, etc.--make it economical to use poor-quality raw materials which would not have been considered useable before.

3. The utilization of resources from the sea bottom and sea water; sources such as energy from the sun, wind, tides and the Earth's heat; the organization of mining for minerals at great depths (up to 15-20 km), where enormous reserves of raw materials are are concentrated.

4. Savings of raw materials and fuel during transportation and storage are not considered here or at any further point in the article.

5. Differences in the functional structure of raw materials in terms of cost and weight are caused primarily by a significant gap in the level of labor costs and correspondingly in the costs for the various raw materials.

6. See Krapchin, I.P. "Ekonomika ispol'zovaniya vtorichnykh energoresursov promyshlennosti" /The Economics of the Utilization of Secondary Energy Resources from Industry/, Izdatel'stvo Nauka, 1968, p 14.

7. This does not apply to those cases in which it is essential to achieve substantial results in a specific area (for example, the use of new equipment to sharply reduce labor intensiveness as a result of a labor shortage, to improve labor conditions or to increase quickly the yield of some raw material, etc.).

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