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Planning a Socialist Economy

Vol. 1

This book has been written by members of the Department of Organisation and Planning of the Soviet Economy in the Economics Faculty of Moscow State University in collaboration with a number of economists from other institutions. It provides a systematic account of the main aspects of planning and looks at theoretical questions, organisational experience, and the methodology and method of national economic planning.

The general logic of the book reflects the logic and order of work in compiling a macroeconomic plan. Particular attention is paid to the use of economic-mathematical methods in planning, and to the work being done on major complex problems, automated systems, and planning estimates.

Planning a Socialist Economy

Volume 1

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INTRODUCTION

THE ECONOMIC AND POLITICAL PRECONDITIONS FOR PLANNING

Social ownership of the means of production, necessitated by the social character of the production process, forms the economic basis for national economic planning.

Capitalist socialisation at the stage of machine industry stimulated a rapid advance in the social division of labour, which led to the emergence of large-scale, interdependent, specialised industries instead of independent and loosely linked branches of industry. As Lenin said, many disparate production processes had merged into a single social production process.[1]

The really social character of the production process, requiring planned management by society and the ensuring of proportionality and coordination between the various elements and stages in that process, had emerged. But private ownership of the means of production contradicts in principle the social character of production and prevents society from managing the economy in accordance with a general plan. "The colossal productive forces," Engels wrote, "are only waiting to be taken possession of by a society organised for cooperative work on a planned basis...."[2]

In order to create the right conditions for making the transition to planned organisation of the economy, a revolutionary change is needed in the mode of production, and private ownership of the means of production must be replaced by social ownership (the economic precondition

[1] See V. I. Lenin, *Collected Works*, Moscow, Vol. 1, pp. 175-76.
[2] Frederick Engels, *Anti-Dühring*, Moscow, 1969, p. 181.

for planning), while the capitalist state must be replaced by a state of the working people headed by the working class and its political party (the political precondition for planning).

These conditions were established in Russia, for the first time in history, as a result of the Great October Socialist Revolution. Having overthrown the power of the landowners and capitalists, the proletariat set up a new, socialist type of state, and affirmed a new, higher form of democracy—democracy for the working people. The basic means of production, the large factories and mills, railways, land, and banks were transferred to national ownership and became social property. A socialist economic structure was established.

On the basis of social ownership of the means of production and a socialist economic structure, the Soviet state set itself the task of unifying the country's economic affairs on the basis of a single plan and made a start at planning the economy.

Economic planning began at a time when different forms of ownership and associated elements of five socio-economic systems existed and coexisted in the country: (1) the patriarchal system; (2) small-scale commodity production; (3) private capitalism; (4) state capitalism; and (5) socialism. The small-scale commodity peasant economy was the predominant form. The Soviet state had to confront the task of overcoming petty bourgeois spontaneity, setting the peasants on the road to socialist cooperation, strengthening the socialist structure of the economy, and then making it the only and universal one, thus ensuring the establishment of a communist society.

The process of establishing and developing planned organisation of the Soviet economy was based on the plan for building socialism, drawn up by the Communist Party under Lenin's leadership; its main points were industrialisation, peasant cooperation, and a cultural revolution. Through the implementation of the prewar plans, socialism won in the USSR and a powerful economy was established that ensured the country's defence capacity and military defeat of the fascist aggressors. As a result of the carrying out of the postwar plans, a developed socialist society has

been built in the Soviet Union, which means that a complex solution can now be sought for a wide range of social, economic, scientific, and technical tasks, and successful work done on laying the material and technical basis of communism.

With the formation of the community of socialist countries after the Second World War, the conditions were created for the development of planning in these countries and over the last three decades they have accumulated a vast amount of rich experience in this field. This experience is based on Lenin's pioneering ideas in the field of planning and reflects the particular features of development in each socialist country.

SOCIALISM'S BUILT-IN ADVANTAGE—PLANNED MANAGEMENT OF THE ECONOMY

Planned management of the economy ensures its smooth, crisis-free development at high, stable growth rates, with full employment and increasingly efficient use of resources. The successful performance of a socialist economy is inseparably linked with planned management.

The USSR has made a gigantic leap forward from the age-old backwardness to the very heights of economic, social, and technological progress; it now holds first place in the world in the output of many key industrial products and is unequalled for its volume of capital construction, while the scale of farm and consumer production is immense. The country's national wealth at the beginning of 1976 was 1,900,000 million roubles. The number of workers, collective farmers, and employees working in the economy was 118 million, of whom three quarters had higher or secondary education.

As a result of completing nine Soviet five-year plans vast quantitative and qualitative changes were brought about in the conditions, living standards, and way of life of the people. In fact, the planned economy has provided unprecedented growth of the material prosperity, education, and culture of all strata of the population in the lifetime of one generation. For objective historical reasons it was not easy for the first socialist state in the world fully to realise the

opportunities for improving the people's life inherent in it.

Gradually, however, as socialism was established, consolidated, and developed, the advantages of the new society and of the planned economy disclosed themselves more and more. This link between accelerated development of social production and steady rise in the people's well-being became particularly clear and indisputable in the stage of developed socialism.

In the past ten years alone, as a result of the implementing of a broad social programme to raise wages, improve pensions and social insurance, increase scholarships and grants, lower taxes, and other measures, carried out in conditions of general stability of state retail prices and charges for services, per capita money incomes were nearly doubled.

In order to obtain a fuller appreciation of how successfully the Soviet planned economy has developed, it is necessary to look back and see what kind of a place pre-revolutionary Russia was. It was an agrarian country in which foreign capital held positions of strength. Russia came bottom of the list of major capitalist countries for per capita output. Savage capitalist and feudal exploitation, poverty, unemployment, illiteracy, technological backwardness—this is a far from complete description of the state of the Russian economy before the First World War.

The situation was considerably worsened by the destruction caused by the imperialist war, foreign intervention, and the Civil War. The economic position of the young Soviet state was described by the 6th Party Congress, held in 1917, as one of complete exhaustion of productive labour and disorganisation of production, total disruption and disintegration of the transport network, near bankruptcy of the state finances and, as a consequence of all this, a food crisis of famine proportions, an absolute shortage of fuel and means of production in general, rising unemployment, and enormous impoverishment of the mass of the people.

In 1920 the volume of industrial output had fallen by 75 to 80 per cent compared with 1913, the output of iron by 97 per cent, of steel by nearly 95 per cent, of coal by

70 per cent, and of oil by around 58 per cent. Farm production was half that during the war.

In 1975 production of pig iron was 103 million tons or 24.5 times as much as in 1913, and of steel 141 million tons, or 32.8 times as much; 701 million tons of coal were mined, or 24 times as much as in 1913, and 491 million tons of oil extracted, or 47.7 times more than in 1913.

The growth of national income, which reflects the development of all branches of material production—industry, agriculture, construction, and trade—provides clear evidence of the rapid growth of the Soviet economy. Over the period 1901-13, the average annual rate of increase of the national income was 2.6 per cent, in 1929-40 it reached 13.4 per cent or five times the prewar rate. The average annual growth rate of industrial output in the same periods more than quadrupled, from 3.8 per cent in 1901-13 to 15.8 per cent in 1929-40.

Despite the very heavy losses suffered in the war with Hitler Germany (1941-45), the Soviet economy continued

Table 1

Main Indices of the Development of the USSR Economy (1965—74) (1950 = 100)

Indicator	1965	1974
National income	364	666
Gross industrial output	457	916
Gross farm product	182	244
Capital investment	447	830
Freight traffic of all forms of transport	388	693
Fixed production assets	406	839
Productivity of labour:		
in industry	294	437
in agriculture	239	375
in building	257	428

to grow at an extremely rapid pace in the postwar period, as can be seen from the main indicators of economic development in the period 1950-72.

At present some 40 per cent of the total volume of world industrial output falls to the share of the socialist countries, around 7 per cent to the developing countries, and about 53 per cent to the developed capitalist countries. The socialist countries' volume of industrial production has reached about 75 per cent of that of the economically developed capitalist countries. Their mean annual rate of industrial growth between 1950 and 1975 was 9.6 per cent, while that of the developed capitalist countries was 4.6 per cent, or less than half as fast. The share of the socialist countries in world national income—and that is the main indicator of economic growth—is now one-third, and that of CMEA countries one-quarter.

In L. I. Brezhnev's Report to the 25th Congress of the Communist Party of the Soviet Union it was noted that "...an economic crisis erupted in the capitalist world, the intensity and scope of which even bourgeois politicians admit to be comparable only with the crisis of the early thirties. It spread simultaneously to all the main centres of the capitalist world economy".[1] While the economy of the socialist community is growing year by year at high tempos, not only was there no economic growth in the capitalist countries in 1975, but there was a deep crisis fall in industrial production, further growth of unemployment, and a decline in the living standards of the workers. The fall in the gross national product of the major capitalist countries from the highest pre-crisis level was around 85,000 million dollars (in 1970 prices).

From 1949 to 1973, the member-countries of the Council for Mutual Economic Assistance increased their volume of industrial output more than 12 times, compared with a four-fold increase only in the advanced capitalist countries. The share of CMEA member-countries in world national income—which is the chief indicator of economic potential—was a quarter of the total in 1972.

[1] L. I. Brezhnev, *Report of the CPSU Central Committee and the Immediate Tasks of the Party in Home and Foreign Policy, XXVth Congress of the CPSU*, Moscow, 1976, p. 33.

There is a striking upward trend in the growth of the overall volume of national income of CMEA member-countries. It increased nearly 5.7 times between 1950 and 1973, or nearly double the rate for the advanced capitalist countries.

The historical experience of economic development in socialist countries shows that a socialist economic system which has planning as its main feature is able to achieve a steady extension of production and secure full employment, the most efficient use of material resources and natural wealth, and a constant improvement in the working people's living standards.

While building up its own economic potential, the USSR economy is helping developing countries to establish and consolidate their independence. In Africa, for example, more than twenty engineering and metal-working plants built with Soviet technical aid are already operating. They include works producing forgings, welding electrodes, machine tools, aluminium cable, radio sets, and television sets, and are in fact the first enterprises of this kind on the continent. On the basis of agreements concluded up to 1 January 1975, the economic potential of African countries will be raised as follows by Soviet economic and technical assistance: pig iron 3,000,000 tons; steel 3,200,000 tons; coke 1,000,000 tons; oil-refining capacity 2,650,000 tons; electricity generating capacity 2,800 megawatts.

The socialist countries provide developing countries assistance in planning their economies. Although planning is not yet all-embracing in most of them, it is broadening in scope from year to year. Expansion of the area of planning is a complex and lengthy process. Proof of this can be found in the history of Soviet planning which became fully comprehensive only after it had gradually brought different aspects of social and economic life into its orbit.

FROM THE HISTORY OF SOVIET PLANNING

The process of setting up the world's first planned economy in the Soviet Union was both complex and difficult. It was a matter of seeking out new ways. Theoretical and methodological principles, organisational forms, and planning methods had all to be worked out for the very first time.

The system of planned management of the economy was principally set up in the first ten years of Soviet government. Gradually, starting with operational and then longer term plans for particular sectors of the economy, the Soviet Union progressed towards a single, complex, macro-economic plan.

In the conditions of civil war, intervention, and the worst imaginable devastation, planning and economic management were strictly administrative in character. The peasants had to hand over all surplus produce to the state in the form of food requisitions. Private trade was forbidden. Literally every hundred weight of raw materials and fuel, every single metre of cloth, every pound of bread, sugar, etc., was rationed by the central organs. Rationing and compulsory labour service were introduced for the public.

With the change-over to peace-time socialist construction, the country followed a new economic policy (NEP). "The essence of this policy," Lenin said at the Ninth All-Russia Congress of Soviets, "is the alliance of the proletariat and the peasantry, the union of the vanguard of the proletariat with the broad mass of the peasants."[1]

The state now took from the peasants in the form of a food tax not the whole of their surplus produce but only a part; the rest they could sell freely on the market. This freedom of private trade meant a certain revival of capitalism and the starting up of small private enterprise but the commanding heights were still in the hands of the proletarian state. NEP was designed to ensure victory for the socialist elements, to abolish the exploiting classes, and to build socialism.

Private small-scale industry, which was now able to sell its output at high prices in conditions of acute shortage of goods grew very quickly. Nevertheless, the state sector gained the advantage in the economic competition with the private sector. Trade turnover increased more rapidly in the socialist sector; and, moreover, once the goods market had reached saturation point and prices had fallen, growth and expansion of private trading enterprises came to an abrupt halt, which led to a fall in the share of private industry and an increase in the share of state industry, and finally to the complete exclusion of private industry and trade. Soviet experience proves that development of the state socialist sector is the basis for fast growth and consolidation of the planned national economy and provides the economic basis for real macro-planning.

[1] V. I. Lenin, *Collected Works*, Vol. 33, p. 171.

At the first stage of organising planning, when the part played by spontaneous market forces was still great, it was not possible to cover all aspects of the state's economic affairs in the plan, nor to construct a coordinated plan for all sections and elements of social production. Right up to 1925, planning covered only individual branches of industry. Special attention was paid to such branches as fuel, metallurgy, chemicals and light industry. These industry plans were not sufficiently linked together and were both aggregative and approximate.

The first ever unified plan for economic development on a national scale drawn up for a period of ten to fifteen years was the plan for the electrification of Russia (known as GOELRO) drawn up under Lenin's direct guidance by a special GOELRO Commission, from which the State Planning Committee (Gosplan) was later formed. The history of Soviet perspective plans begins with GOELRO. Since 1928, economic affairs in the Soviet Union have been conducted in accordance with five-year plans drawn up by the State Planning Committee on the basis of directives issued by the Communist Party and Soviet Government.

The GOELRO plan envisaged the creation of major power capacities and the development of all sectors of the economy on the basis of electrification. It was the first perspective plan for the complex development of the economy, a programmatic document of the Communist Party that fixed the substance of economic policy for many years ahead. The GOELRO plan, which was a grandiose one for those times, was completed ahead of time: 40 regional power stations were built instead of the 30 originally envisaged; within a short time, the economy, shattered during the First World War and the ensuing intervention, was restored. By 1928 production of key industrial output exceeded the 1913 level.

Successful completion of the First Five-Year Plan (1928/29-1932/33), at a time when an extremely destructive world economic crisis was hitting the capitalist countries hard, greatly increased the international authority of socialist planning. As a result of successfully completing the three prewar five-year plans, tasks that were gigantic in scale were successfully tackled: industrialisation, strengthening of the Soviet state's defence capacity, and the socialist reorganisation of agriculture on the basis of collectivisation.[1] The exploiting classes and the grounds for man's exploitation of man were eliminated, as also was unemployment, that real scourge of the working people. New socialist relations of production, opening up the way to a rapid development of the productive forces, became dominant.

During the war (1941-45) the Soviet system of planned management of the economy was put to a severe test and passed it brilliantly. All industry was restructured within a short time to correspond to the country's defence needs. Special war-economy plans for developing industry in areas far from the front were drawn up. In a very short time productive capacities and manpower were evacuated to the east of the country—an economic manoeuvre previously unknown in world experience. A war economy capable of providing the front with advanced military equipment, uniforms, and provisions was created on the basis of carefully considered plans. This was an important factor in the Soviet Union's victory over Hitler Germany. In 1946 a five-year plan for reconstruction and development of the Soviet economy for 1946-50 was drawn up and confirmed. It was considerably overfulfilled: the prewar level of industrial output was reached as early as 1948.

Fulfilment of the postwar plans brought the economy of the USSR to new levels of development. Whereas its national income was 31 per cent of that of the United States in 1950, in 1974 it was around 66 per cent; correspondingly the volume of industrial production for those years rose from 30 per cent of that of the United States to 80 per cent.

[1] The Third Five-Year Plan was interrupted in 1941 by Nazi Germany's attack on the Soviet Union.

The Ninth Five-Year Plan (1971-75) occupies a special place in the history of Soviet planning. Its significance was emphasised by the 25th Congress of the CPSU: "The results of the five-year plan are especially impressive if we evaluate them from the point of view of how the country's economic might has grown in these years and what the absolute increments are.

"In this respect the Ninth Five-Year Plan has no equal. We have achieved a higher growth of industrial output, capital investments and state appropriations for new measures to raise the people's living standards than in any other preceding five-year period. The list of major products of which the Soviet Union is now the world's biggest producer has become even more impressive. In recent years steel, petroleum and mineral fertilisers have been added to the list which includes coal, iron ore, cement and some other items."[1] Today the Soviet Union and the other socialist countries face a task of historic importance, namely, to integrate the achievements of the scientific and technological revolution with the advantages offered by a socialist economic system, to develop still further its own socialistic ways of combining science with production, to surpass the main capitalist countries in the scientific and technical field and on this basis secure the highest living standards in the world.

THE TENTH FIVE-YEAR PLAN (1976-80)— PLAN OF EFFICIENCY AND QUALITY

The Ninth and Tenth Five-Year Plans are a single whole in their main tasks and main lines of development. The economic strategy of growth and development in these years and in the ensuing perspective is clearly oriented to growth of the people's material and cultural living standards. The means and the roads leading to that are dynamic, proportional development of social production, raising of its efficiency and of the productivity of labour, acceleration of scientific and technological advance, improvement of the

[1] L. I. Brezhnev, *Report of the CPSU Central Committee and the Immediate Tasks of the Party in Home and Foreign Policy, XXVth Congress of the CPSU*, p. 33.

quality of work in all levels and branches of the economy.

The Soviet economy has reached such a level of development and acquired such a scale of production that satisfaction of the growing end needs of society for products of high quality, and use of the latest machinery and technology in the process of production, are becoming more and more vital conditions of further planned advance. That is why the Tenth Five-Year Plan is called the *plan of efficiency and quality.*

The 25th Congress laid down the general lines for raising the efficiency of industry and the quality of work at all levels of the economy. It set the task of achieving far-reaching progress in the structure and technical level of the economy. The problem of improving quality is understood in its broad sense as simultaneous saving of labour and of material and financial resources, increase of export possibilities, and in last analysis as better, fuller satisfaction of society's needs.

Special attention is being paid to speeding up growth of labour productivity, which is to rise by 27 per cent over the whole of the economy in 1976-80. That is equivalent to economising on the labour of 26 million average man-years. It is planned to raise productivity in industry by 30 to 34 per cent, and to obtain 90 per cent of the total increase of industrial production in this way.

In addition the task has been posed of raising the return on assets considerably. In 1971-75 it had not yet been stabilised in all industries. In the Tenth Five-Year Plan period increase in industrial capacity will come about primarily through the reconstruction and modernisation of enterprises and the carrying out of a complex of measures to improve production organisation. The effectiveness of this approach can be gauged from the fact that 60 per cent of the increase in industrial production in 1971-75 was achieved through this factor. In 1976 a 1 per cent rise in the return on assets in Soviet industry will give a saving of 3,500 million roubles. In 1980 the fixed production assets of industry should increase by 40 per cent, and the "weight" of each 1 per cent increase in the return on them will also grow. A most important item in raising the efficiency of social production is improving product quality. In *Guidelines for the Development of the*

National Economy of the USSR for 1976-1980 the task is posed for decisively improving the quality of all types of production and raising the proportion in their total volume of articles of the highest categories. The whole mechanism of planning and management, the whole system of financial and moral incentives, the efforts of engineers and designers, and the skill of workers must, as the 25th Congress said, be directed to that end.

Everyone knows that economy and economics have the same root. The art of economy has always been and always will be the guarantee of successful development of the socialist economy. It is especially important now when the scale of production, capital construction, and the transportation and handling of freight have grown immeasurably. In the USSR every 1 per cent reduction simply in current financial expenditure on output is equivalent to increasing the national income by nearly 4,000 million roubles.

The entry of the Soviet economy on the next, qualitatively new five-year spiral of its planned development calls for radical improvement of the quality of management at all levels. Improving the discipline and personal responsibility of everyone, beginning with the worker at the bench and finishing with the minister, and evaluation of managerial and planning work by end macro-economic results are as important indicators of the quality of work as productivity of labour, return on assets, consumption of materials per unit of product, and quality of the final product.

The Tenth Five-Year Plan is a new stage in building the material and technical foundation of communism, and a major step in increasing the production potential of the country and consolidating its capability. The *Guidelines for the Development of the National Economy of the USSR for 1976-1980* adopted by the 25th Congress envisage a 35 to 39 per cent increase in industrial production during the quinquennium. In absolute terms the increment will be 183,000 to 203,000 million roubles against 158,000 million roubles in the Ninth Five-Year Plan period. Production of means of production will grow at accelerated rates, above all production of implements of labour, chemicals, fuel, and metals. That is a necessary condition for ensuring dynamic and effective development of the whole economy.

Production of means of production (group "A" industries) is to rise by 38 to 42 per cent.

A characteristic feature of the Tenth Five-Year Plan is systematic improvement of the structure of the economy. That finds reflection in the growing role of industry as the industrial base for the development of all social production. In 1976-80 the share of industry in the social product should rise from 66 to 68 per cent.

Under the Tenth Five-Year Plan farm production must more fully meet the people's needs for food products and industry's needs for raw materials, and provide the necessary state stockpiles. Capital investment in agriculture will increase both in absolute terms and as a percentage of the total investment in the economy: 172,000 million roubles will be allocated to agricultural development, or 41,000 million roubles more than under the Ninth Five-Year Plan. Considerable funds will also be allocated to industries supplying farm machinery, fertilisers, and other mineral resources for agriculture.

The targets of the Tenth Five-Year Plan must be achieved with a lower investment growth rate than in 1971-75. The volume of capital investment is to rise by 24 to 26 per cent against 42 per cent under the Ninth Five-Year Plan, the total investment will be 630,000 million roubles.

The USSR's five-year plans span almost half-a-century of its socio-economic development. The Tenth Five-Year Plan is the first plan for the next fifteen years (1976-1990), during which the material and financial resources of the economy will approximately double compared with 1961-75. This means that Soviet society will achieve a qualitatively new standard of meeting the material and intellectual needs of the people in 1976-1990. The Tenth Five-Year Plan—the plan of efficiency and quality—will occupy a worthy place in this advance.

DEMOCRATIC CENTRALISM AND PLANNING

The underlying principle of the organisation of economic planning in the Soviet Union is that of democratic centralism, which assumes and implies the combination of centralised planned guidance and growing independence and initiative on the part of local authorities, amalgamated and single enterprises, and organised production work forces.

Democratic centralism in planning means, first, that the process of compiling the plan is carried out at all stages with the participation, and under the control, of the masses of working people. Thus the draft of the main lines of development of the economy for the five-year plan period is discussed at Union and republican Party congresses, at sessions of the Union and republican Supreme Soviets (after having been previously debated in detail in the permanent commissions of the Union and republican Supreme Soviets), and in the leading bodies of the Soviet trade unions. It is particularly important to emphasise that this same draft of the main lines of economic development is discussed in public at meetings of working people and in national and local newspapers.

It is appropriate in this connection to recall that Lenin saw as democracy in management and planning the vital, creative activity of the broad masses of the people, in the display of initiative by workers, who become under socialism the subject (not the object) of management.

Second, the centralised plan incorporates the most important indicators fixing the basic trends of development for the economy, e.g. growth rates and the proportions of the economy as a whole and of its key sectors. The range of indicators passed down to the lower levels by directives is limited and it primarily includes those key indicators that determine the final results of their activity and have an effect on the proportions between industries.

Third, in the preliminary stages of compiling the plan, the draft development plans for enterprises and production units are worked out with broad involvement of the workers, and are then submitted to the leading industrial (sector), republican, and all-Union bodies. Soviet planners start from the premise that macro-proportions can only be established "from above" on the basis of full information about the state of the economy as a whole. On the other hand, it is only "from below" that micro-proportions can be established and reserves discovered for potential growth of production and better use of fixed assets and manpower, etc. This explains the need to work out what are called counter-

plans, in which additional reserves for increasing production and improving the quality of output are brought to light. This is why the integral unity of centralised planning and the planned independent activity of lower-level bodies is objectively necessary and helps to increase the efficiency of social production.

The wide spread of socialist emulation and of the movement for meeting plans and undertaking obligations has made it possible to fulfil the macro-economic plans successfully and to improve production efficiency. In industry alone, through meeting plans and the obligations of collectives, output worth more than 30,000 million roubles was produced over and above plan during the years of the Ninth Five-Year Plan.

COORDINATION OF ECONOMIC PLANS OF SOCIALIST COUNTRIES

With the emergence of socialism beyond the limits of a single country and the formation of the world socialist system, it has become both possible and necessary to coordinate the national economic plans of countries belonging to the socialist community.

The Comprehensive Programme makes the point that the coordination of economic plans is the principal method for organising cooperation between socialist countries: "The member-countries of the Council for Mutual Economic Assistance believe that cooperation in the field of planning, and especially plan coordination, is the principal method for organising cooperation and extending the international socialist division of labour...."[1]

The socialist countries' vital interests require their economies to be developed along coordinated lines on the basis of international socialist division of labour and extension of mutually advantageous economic and scientific and technological cooperation. The planned combination and

[1] *Comprehensive Programme for the Further Extension and Improvement of Cooperation and the Development of Socialist Economic Integration by the CMEA Member-Countries*, Moscow, 1971, p. 24.

coordination of efforts by the socialist countries opens up further new possibilities for the most rational use of the advantages offered by a socialist system and the successful solution both of domestic economic tasks of each individual country and of the general developmental problems facing the world socialist economic system.

The compilation of perspective plans of economic development by national bodies in each of the countries is the starting point for coordinating economic plans. Naturally, in compiling a national plan, account is taken of the additional possibilities arising from the planned international socialist division of labour. This is done on the basis of plan coordination which plays an important role in ensuring proportionality and a high degree of efficiency in social production and helps make the best use of all available resources, especially investments.

CMEA members do not coordinate all the indicators of their plans, but only the most important ones, which they are interested in coordinating and dovetailing. The area of coordination includes first and foremost the main branches (types) of industrial production, and of agriculture, transport, capital construction, and the main fields of scientific research. At the same time there is a whole number of sections and indicators in the national plans that do not require coordination. Thus, there is no need to coordinate plans for domestic trade or for expanding the provision of amenities, cultural facilities, the health services, housing and the other local authority services, etc.

The coordination of macro-economic plans during their drafting enables the mutual export possibilities and import needs of CMEA member-countries to be taken better into account, and reflected in the material balances drawn up. The agreement achieved between them is backed up by long-term trade agreements on cooperation in the most important branches of industry. The more extensive the division of labour between countries and the more intensive the exchange of goods, the greater is the interconnection and mutual complementariness of their economies and the greater the volume of coordinated targets.

"To ensure the fulfilment," it says in the *Guidelines*, "of Socialist Economic Integration and the coordinated plan

of multilateral integration measures of CMEA member-countries for 1976-80."[1] The coordinated plan of multilateral integration measures envisages broad involvement of the countries concerned in building new capacities on the territory of the USSR to produce types of raw materials and fuels in short supply and to transport them to the consumer countries. The USSR in turn will continue to extend technical aid in building facilities in the other CMEA countries. There will be a further development of mutually profitable cooperation in the production of metallurgical and power generating equipment. There will be further development of component and subassembly cooperation in the production of individual types of complex items. Coordinated deliveries of parts and assemblies for the vehicles of the Volga Motor Works will be extended; and under agreements with CMEA members complete units, subassemblies and parts will be delivered for the lorries of the Kama Motor Works. There will be a marked growth in deliveries of assembled units and parts for Soviet building and road machinery, looms, and farm machinery. Broad cooperation in the production of equipment for atomic power stations is also planned.

The coordination of national plans is a component of the process of drawing up five-year and long-term economic development plans and at the same time a leading form of economic cooperation between socialist countries. Planning experience indicates that the development of all other forms of economic and scientific and technical relations between them in many ways depends on the results of this work.

CONSTRAINTS ON PLANNING UNDER CAPITALISM

Since the Second World War all developed capitalist countries have had recourse to extensive state intervention in the economy and state regulation.

One form of state monopoly regulation is what is known as economic programming. In his speech at the international

[1] *Guidelines for the Development of the National Economy of the USSR for 1976-1980*, Moscow, 1976, p. 106.

meeting of Communist and Workers' Parties in 1969, Leonid Brezhnev said: "The programming and forecasting of production, state financing of technological progress and scientific research, and all measures that aim at a certain restriction of spontaneous market forces in the interests of the biggest monopolies are becoming increasingly widespread. In a number of countries this is leading to a certain increase in the efficiency of social production."[1]

Special bodies for regulating the entire economy (the General Planning Commission in France, the Central Planning Bureau in the Netherlands, the National Economic Development Council in Great Britain, etc.) have become part of the administrative machinery of the capitalist state; their job is to use bourgeois economic instruments in order to preserve capitalist relations.

The methodology of economic programming rests on a system of articulated national accounts, which are a form of input-output tables borrowed to a considerable extent from the planning practice of socialist countries. Various kinds of economic models are used as a practical tool in making long-term calculations. Most experience in employing these models has been acquired in France, Japan, Italy, the Netherlands, and Great Britain.

Socialist planning and capitalist programming differ fundamentally as regards their social character, functions, and methods, owing to the fundamental difference between property relations under capitalism and socialism. A socialist economy is based on a series of interconnected and coordinated plans—macro-economic, sectoral, regional, and enterprise plans. The national plan underlies and is based on the sectoral and regional plans, while the latter in turn rest on enterprise plans.

Socialist planning makes it possible to achieve coordination among all those participating in production and between the interests of the whole economy and its various sectors, economic regions and individual enterprises. Such coordination is achieved by recognising the decisive role played by the centralised macro-economic plan which takes

[1] *The International Meeting of Communist and Workers' Parties, Moscow 1969*, Prague, 1969, p. 141.

full account of both social needs and economic resources throughout the country.

In view of the prevalence of private ownership of the means of production, capitalist programming is organically incapable of covering all levels and sections of the economy. Programming within individual firms and monopolies pursues its own particular interests which inevitably come into conflict with each other. In this way two uncoordinated levels of capitalist programming come into being—at the national and at the corporate level.

Socialist planning and capitalist programming are also opposed with regard to their aims.

Socialist planning is concerned with ascertaining the volume and structure of social needs and the material resources and manpower required to satisfy them. Its specific function is to assess the needs of society as a single entity. This function first arose historically along with the emergence of the new social system, socialism. The approach to planning from the viewpoint of social needs means taking into account not only current consumption needs, but also the necessity of continually raising the standard of living. Planning therefore presupposes an optimal combination of production and consumption and of production and investment in keeping with social needs in order to ensure the maximum satisfaction of these needs over the whole perspective period of economic development.

Capitalist programming does not and cannot put forward the planning of social needs as its objective, since in capitalist conditions the link between production and consumption is broken by spontaneous market forces, and it is impossible to establish this link with the help of programming without affecting private property.

Socialist planning and capitalist programming both tackle one of the most important problems of economic development—that of economic efficiency—on entirely different principles. The criteria of efficiency are very different in conditions of social and of private ownership. Under socialism the chief criterion of the efficiency of social production is achievement of the best results at the least cost in the interests of society. Private capitalist ownership makes it impossible to raise the question of maximum satisfaction

of social needs on the basis of efficient use of all society's resources, since there is a basic contradiction between efficiency from the point of view of society as a whole and of the individual capitalist or group of capitalists joined together in a monopoly. What typifies socialism is the principle that what benefits society and the economy as a whole benefits the individual enterprise and its workers.

The opposed nature of the aims and content of socialist planning and capitalist programming is reflected in the radically different methods and instruments used by them. Indicative planning is inherent in the latter in contrast to directive planning, by which is meant the centralised macro-economic planning carried out in the Soviet Union and other socialist countries. Indicative planning consists essentially in making recommendations to the private sector, which need not be implemented if they are contrary to its interests. The modern capitalist economy continues to remain unplanned, because the basis for this lack of planning is still preserved intact, i. e. the predominance of private ownership and the capitalist market.

PLANNING AND PROGRAMMING IN DEVELOPING COUNTRIES

In many developing countries that are carrying out progressive social and economic reforms at the present time, planning is regarded as the most efficient method and instrument for securing high rates of economic growth and raising living standards.

More than 70 countries in Asia, Africa, and Latin America compile economic development plans or programmes. A considerable amount of experience has been acquired in this field in a number of countries, especially in Southern and South-East Asia. The first steps in this direction were taken right at the beginning of the 1950s. India, Pakistan, and other countries are already carrying out their fourth five-year plans. Perspective programmes, moreover, for the next ten to twenty years, which will be given more concrete expression in medium- and short-term plans and programmes, are being drawn up. In other countries these development plans or programmes have been compiled

comparatively recently. And although it would be too much of an exaggeration to say that planning has truly become an effective instrument for speeding up economic development in all the developing countries, yet the experience of a number of countries (India, Algeria, Pakistan, etc.) shows that it can indisputably become a reliable means of overcoming economic backwardness and establishing a developed and independent economy

Economic planning-programming is in the process of being established at the moment in developing countries. It differs in content from socialist planning, but it is also noticeably different from capitalist programming. Its character is determined by the specific features of their present situation: a low level of development of the productive forces, the mixed social nature of the economy, socio-economic and techno-economic diversity, and struggle around the course of further political and economic development.

As the countries of Asia, Africa, and Latin America develop economically, they come to realise that they are able to tackle not merely particular problems but problems of a national dimension. An increase in employment in one sector of the economy achieved at the expense of an increase in unemployment in other sectors, instead of doing away with the problem of unemployment in the economy as a whole, makes it even greater. For that reason the developing countries are obliged to pay serious attention to aggregate macro-economic proportions: the ratio between investment and consumption, the links between the extractive and the manufacturing sectors, the interaction between labour productivity and employment, the ratio between effective demand and the availability of consumer goods and services, etc.

Choice of a correct strategy for development is a complex process requiring not only analysis of the various trends of development in the economy as a whole but also a careful estimate of the interaction between economic, social, political and cultural processes. A correct solution of these extremely complex tasks can only be achieved in the conditions of developing countries on the basis of planning.

In countries with a socialist outlook that are making use of Soviet planning experience, special attention is being

paid to expanding the state sector, establishing and developing national industry, carrying out agrarian reforms, and eliminating the dominant position of imperialist monopolies. In these countries planning is gradually extending its sphere of influence to development of the whole economy.

* * *

In recent years the methods and organisation of Soviet planning have been rapidly improved, and the theory and practice of planning have reached a new level.

The 25th Congress of the CPSU defined the main lines for further improving the management of the economy, of methods of compiling and tying up long-term, five-year, and current plans, and of the industrial and regional breakdown of plans, and pointed out the need to develop complex programmes for major scientific, technological, economic, and social problems, it also called for the concentration of resources on their solution within the framework of a single macro-economic plan. The Party's directives stress that the drafting of plans should be based on a comprehensive assessment of social needs, balanced development of the economy, and the unity of the social, economic, and scientific and technological problems.

In the course of drafting up plans, successful work is continuing on the application of economic-mathematical models in planning practice, methods of optimal planning, and the principles of systems analysis, while much wider use is being made of computers in making planning estimates.

The authors of this book have tried to find the best combination for reflecting the experience accumulated by the Soviet Union and other socialist countries in planning the economy and explaining the new approaches adopted in recent years. Many of the chapters therefore not only expound well-established planning methods but also contain an account of quite recently introduced methods and models.

The general logic of this book reflects the logic and sequence of the compiling of an economic plan, the pre-plan estimates of growth rates and the structure of social production, sectoral projections and sectoral plans, and summary input-output calculations in the concluding stage.

CHAPTER I

THE SUBJECT MATTER AND TASKS OF ECONOMIC PLANNING THEORY

1. THE APPLICATION OF ECONOMIC LAWS IN PLANNING

Economic planning rests on knowledge and correct use of the objective laws of social development, and especially of the objective economic laws of socialism.

The planned nature of a socialist economy calls for conscious application of economic laws throughout society. Proper understanding and application of economic laws becomes an essential condition for achieving planned extension of social reproduction under socialism.

Conscious social regulation of production as a whole is impossible under capitalism. Economic laws exert themselves in it as the unforeseen results of activity on the part of blind forces. In contrast to this, socialist society exercises conscious control over its economic affairs through the planned allocation of production resources to different sectors of the economy in order to achieve previously-established goals. Conscious control of the economy by no means implies that people can behave in whatever way they like. The economic laws of socialism operate in accordance with their own internal objective logic, independently of people's wishes and desires. Recognition of the objective laws of socialism does not invalidate freedom of choice in economic planning decisions. Marxism-Leninism teaches, however, that this freedom consists not in some imaginary independence from the operation of objective economic laws but in understanding them and being able, on the basis of this knowledge, to make planned use of them in order to achieve set aims. "Freedom," Engels wrote, "does

not consist in the dream of independence from natural laws, but in the knowledge of these laws, and in the possibility this gives of systematically making them work towards definite ends.... Freedom of the will therefore means nothing but the capacity to make decisions with knowledge of the subject."[1]

The planned organisation of social production changes a conscious principle into a necessary element in the progress of a socialist economy. Herein lies the enormous advantage that socialism has over capitalism. Planning puts into practice, makes a reality of those advantages possessed by an economy based on social ownership of the means of production. It would, however, be incorrect to believe that conscious regulation of a socialist economy constitutes some kind of subjectivism. Subjectivism results from the incorrect reflection of objective processes in the consciousness; it represents a failure to understand their essential nature. It can be overcome in the course of gaining an understanding of objective economic laws.

Equally energetic measures should be taken in planning to combat a fatalistic attitude to objective laws and putting faith in the automaticity of their operation. The objective operation of economic laws has nothing in common with spontaneity, nor does it turn the planner into a slave of circumstances and facts, but calls for active selection of the ends and means of an economic policy based on social knowledge of the patterns of economic development.

Economic laws reflect a wide range of basic, stable relationships among economic phenomena and processes in society. As is known, there exist both general economic laws, common to all types of socio-economic formations, and specific economic laws, found in only one type of system and characterising the fundamental features of production relations in that particular mode of production. The general economic laws found in all economic formations are refracted through the operation of specific laws. An extremely important theoretical conclusion arises from this—that it is essential, in planning an economy, to base the work primarily on knowledge of the specific economic laws of socialism.

[1] Frederick Engels, *Anti-Dühring*, pp. 136-137.

The difference between the essential nature of economic laws and the forms in which they appear has considerable importance for theory and methodology. Planning is not restricted to a knowledge of the general and specific laws of socialism but makes a continuous study of the actual economic processes in which these laws appear. Special attention is paid to studying the functional relationships and causal connections existing between various elements in the economy.

When economic laws are used in practical work, their quantitative aspect must necessarily be taken into account. It is therefore not sufficient to simply talk, for example, about the basic economic law of socialism; in the course of planning, this law must find expression in actual economic magnitudes describing the dynamics of personal consumption, the satisfaction of the people's spiritual needs, and general educational and cultural level.

The conscious application of economic laws assumes, first, that society understands their essential nature and their operating mechanism and, secondly, that this social knowledge is put into practical effect. "Mere knowledge...," Engels wrote, "is not enough to bring social forces under the domination of society. What is above all necessary for this is a social *act*."[1]

The elaboration of scientific principles for planned management of the economy, and especially planning methodology which defines the methods for translating the requirements of economic laws into the language of actual planning assignments, is a necessary step in making the transition from an understanding of economic laws to "social act". It is also important to devise some mechanism for management and economic stimulation that brings all sections of the economy into action in order to make effective use of known economic laws in the interests of society.

Thus, the essential conditions for making conscious use of economic laws are: the theoretical elucidation of the nature of economic laws; the elaboration of a scientific methodology for taking them into account and using them in planning; and the establishment of some mechanism for economic management and economic stimulation.

[1] Frederick Engels, *Op. cit.*, p. 376.

Both the tasks facing economic planning and its content are determined above all by the demands made by the basic economic law of socialism.

Socialist society gears social production in a planned way to achieving a high level of prosperity and the all-round development of all members of society. The basic economic law of socialism fixes the chief aim of social production, i.e. the greatest possible satisfaction of the ever-increasing needs of all members of society.

Establishment of a correct relationship between social needs and production possibilities is the basis for constructing a plan. Starting from the requirements of the basic economic law, the optimality criterion for national plans is decided on and a system of indicators is set up which enables that variant of the plan to be chosen from among all others that simultaneously ensures high rates of growth of the people's standard of living and an extension of production, while also taking account of the need to solve other social and economic tasks, especially that of strengthening the country's defence capacity.

The methods for putting the basic economic law into effect in combination with the effect of other economic laws (payment for work done, growth of productivity, etc.) are determined in the course of drawing up a plan. People's living standards may be raised by increasing pay or bonuses, by cutting retail prices, or by spending more money on social consumption.

The requirements of the basic economic law are taken into account in working out the methods for planning the end product, the national income and its allocation between the funds for consumption and accumulation, and ways of encouraging social production efficiency that directly link people's personal and social economic interests in the plan.

The multi-targeted nature of socialist planning is emerging much more clearly in present-day conditions when a whole number of major socio-economic tasks have to be tackled simultaneously in a complex manner. In this connection primary importance is attached to substantiating in theory the extent to which social and economic aims are to be effected and in what order. At any given moment in time, society has quantitatively fixed (limited) production

resources at its disposal while social needs exceed the possibilities available for satisfying them.

Society is therefore obliged to weigh up the priorities and the extent to which particular needs can be met and to take these factors into account in organising production and allocating material resources.

The necessity of satisfying society's growing needs more and more fully is a powerful stimulant to growth of socialist production and raising of its technical level.

By the needs of society, moreover, is meant cultural and social needs as well as material ones. No small efforts are still required of the Soviet economy to realise the tasks involved in improving the people's material, housing, and living conditions, above all to attain a level and structure of rational consumption of goods and services by scientifically validated norms. A drive for a high level of satisfaction of material wants is not, however, the be-all and end-all of the socialist economy but the means, the *sine qua non* for man's harmonious development. Together with growth of material prosperity such notable phenomena as the raising of social targets and priorities are occurring in the Soviet economy. This applies above all, it was noted at the 25th Congress, to further improvement of the Soviet people's prosperity, improvement of their working and living conditions, marked progress in the health services, education, and culture, that is, in everything that furthers moulding of the new man, all-round development of the individual, and improvement of the socialist way of life.

Economic planning is a direct reflection of the law of planned, proportional development of the economy. The social character of the production process requires that correct proportions are maintained between its various elements and stages. This requirement arises from the social division of labour. "That this *necessity* of the *distribution* of social labour in definite proportions," Marx noted, "cannot possibly be done away with by a *particular form* of social production but can only change the *mode* of its *appearance*, is self-evident."[1]

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[1] Karl Marx, Frederick Engels, *Selected Works*, Vol. 2, Moscow, 1969, pp. 418-19.

Under capitalism society's resources are allocated to various sectors and types of production under the spontaneous operation of the law of value.

In a socialist economy proportionality is maintained by conscious, purposive activity on the basis of macro-economic plans. Proportionality in the development of social production under socialism is planned proportionality. "Constant, deliberately maintained proportion would, indeed, signify the existence of planning...," wrote Lenin.[1]

The most important requirement of the law of planned, proportional development is to ensure a correct balance between all the basic elements in extended reproduction. In a macro-economic plan balance is achieved above all by coordinating production and the supply of materials and technical equipment, the growth of working people's incomes and the production of consumer goods, as well as the volume of services that have to be paid for, etc. In this respect it is important not only to coordinate the basic proportions of reproduction in quantitative terms but also to achieve the maximum correspondence in their structure.

Balance and proportionality in the economy are achieved by making the volume and structure of production correspond to the volume and structure of social needs. In doing so, it is necessary to make certain that the volume of production slightly exceeds the amount of effective demand, that is, reserves must be created so as to ensure stable proportionality of economic growth. The degree of balance achieved has a direct effect on the forms and methods of planning. Tight physical balances (input-output relations) will make for a rigid system of distributing physical resources from stocks, and a more formal character of business agreements and contracts between suppliers and consumers will not adequately stimulate improvement of product quality, and so on.

The achievement of complete balance in economic proportions on the basis of a highly efficient use of labour, material and financial resources is the chief requirement for the proper running of a socialist economy, starting from the law of planned development and the law of saving labour

[1] V. I. Lenin, *Collected Works*, Vol. 3, p. 617.

time. "Economy of time and planned distribution of labour time over the various branches of production, therefore, remains the first economic law for common production; it becomes law even much more strictly."[1] The achievement of complete balance in developing the economy on an optimal basis is what is required by the laws of planned development and the saving of labour-time. Two basic methods for drawing up plans arise from these two laws—the method of physical balances (input-output) and the method of optimising planning decisions.

Commodity-money relations still operate under socialism; as the Programme of the Soviet Communist Party says: "It is necessary in communist construction to make full use of commodity-money relations in keeping with their new content in the socialist period. In this, such instruments of economic development as cost accounting, money, price, production cost, profit, trade, credit, and finance play a big part."[2] The new content of commodity-money relations in the conditions of a developed socialist economy consists in their becoming a necessary element in the mechanism of planned economic management and the system of economic incentives.

When due allowance is made for the law of planned, proportionate development of the economy and for commodity-money relationships, centralised planning system can be combined with the operational, managerial autonomy of the individual production units in socialist society and with economic motivation in developing socialist production.

The economic motivation of social production is based on applying Lenin's principle of ensuring that the working people have a material interest in achieving high levels of output. In working on plans for building the new society, Lenin pointed out that socialism should be built "not directly relying on enthusiasm, but aided by enthusiasm engendered by the great revolution, and on the basis of personal interest, personal incentive and business principles.... Otherwise we shall never get to communism, we

[1] Karl Marx, *Grundrisse*, Moscow, 1939, p. 89.

[2] *Programme of the Communist Party of the Soviet Union*, Moscow, 1971, p. 82.

shall never bring scores of millions of people to communism."[1]

Socialism creates the objective preconditions for, but does not automatically ensure, a correct combination of the economic interests of society, enterprises, and workers. This is attained in the course of conscious, planned activity of the Soviet state and its planning and management bodies by working out and applying in practice a variety of economic levers and incentives (wages, bonuses, profit, credit, etc.).

Commodity-money relations provide the planners with powerful levers for economically stimulating high, taut targets and improvement of production efficiency. The new content of commodity-money relations in conditions of an advanced socialist economy consists in them being used throughout the system of economic laws in a planned and goal-directed way in the interests of society. Conscious use of these relationships is also a necessary part of establishing an efficient system of economic incentives.

The Marxist-Leninist theory of reproduction forms the immediate methodological basis of Soviet planning theory.

The schemes of reproduction set out by Marx in *Capital* and developed further in Lenin's writings, and the schemes for distribution of the social product under socialism, contained in Marx's *Critique of the Gotha Programme*, form the basis for the method of physical balances, for constructing an input-output scheme for the whole economy, and for formulating the sections and indicators of the economic plan.

The basic Marxist-Leninist categories and indicators of reproduction are widely used in the theory and practice of planning. The most important are: characterisation of the different stages of reproduction (production, distribution, exchange, and consumption), and the establishement of a dialectical link between these stages; demarcation of the sphere of material production and the non-productive sphere; definition of the nature of reproduction and its different types (simple and extended, extensive and intensive); analysis of the process of reproduction in terms both of its physical volume and of its value, etc. Marx was the first to use aggregate (summary) economic indicators of reproduction

[1] V. I. Lenin, *Collected Works*, Vol. 33, p. 58.

on a wide scale—gross social product, final social product, and national income, and to show their inter-relationship, their components (the consumption, accumulation, and amortisation funds), and their trends in different phases of reproduction.

The most important tenets of the Marxist-Leninist theory of reproduction, on which the science of planning is based, can be formulated in the following way.

The process of reproduction is a unity of reproduction of the productive forces and the relations of production. In formulating a macro-economic plan, production tasks are examined in close connection with property relations, income distribution, and other social problems.

In the dialectical unity of all the stages of reproduction (production, distribution, exchange, and consumption) production is dominant. Planning that embraces all stages and aspects of reproduction proceeds from the determining role of production; at the same time consumption plays a special role in perspective planning, for its final goal is the increasingly full satisfaction of society's needs.

Although all types of socially useful work are similarly necessary, the basis and condition of existence of the whole of society nevertheless is the production of material wealth by the labour of the workers in the sphere of production. From recognition of this objective fact stems the general planning principle that the national income is generated only by the labour of workers in the sphere of material production, and expansion of the non-productive sphere, and greater satisfaction of the needs of all members of society is only possible through growth of material production.

The process of reproduction takes place both in a physical and a value form; the means of production and consumer goods, and transferred value and newly-created value are their most general characteristics. The need to plan production in both its physical and its value aspects, in view of their organic unity arises from this principle.

Planning of the economy is based on complex use of the whole system of economic laws, above all the basic economic law, the law of planned, proportionate development, the law of economising labour-time, and the law of distribution according to work, and the whole set of commodity-money

relations with their new socialist content. The peculiarity of economic laws is that they operate both on the scale of the whole of society and in each particular section of the economy, from industry down to enterprise level. Proper understanding of the essential nature of economic laws and their use therefore forms the necessary theoretical basis for planning at all levels, from the enterprise to the economy as a whole.

2. THE SUBJECT MATTER OF PLANNING THEORY

In the course of planned socialist construction, a science of planning, which is working on the methodology for ascertaining and making use of the objective economic laws of socialism in planning, has been created and is being successfully developed in the Soviet Union. It has arisen from the need for scientifically validated management of the socialist economy and gives theoretical expression to the practice of planning in the Soviet Union and other socialist countries.

Planning theory works out the methodology and methods for defining the basic development indicators of a socialist economy over a perspective period and especially growth rates and proportions, methods for studying social needs and resources and ways of balancing them in the most efficient way, as well as methods for setting and achieving planning assignments and for checking on their execution.

Planning of the Soviet economy covers all spheres and sectors of the economy and all parts and aspects of reproduction. Both material production (industry, agriculture, construction, transport and communications, trade, procurement of farm produce and the supply of materials and equipment) and the non-productive sphere (education, health, culture, sport, science, municipal services and amenities, etc.), both economic processes and social relations constitute the object of planning. Planning presupposes an object of planning, which is the socialist economy, and a subject of planning in the person of the socialist state performing the role of direct organiser of the whole of social production.

The basic tasks of planning the economy include the following:

(a) assessing both production and non-production social needs with a view to meeting them as fully as possible, given the available resources;

(b) determining society's material, labour and financial resources and their most efficient allocation and use in accordance with current and long-term requirements;

(c) searching out ways of attaining high economic growth rates, while maintaining an optimal combination of growth in output and consumption;

(d) achieving a correct balance between different spheres, sectors and elements in the economy, and maintaining proportionality in economic development;

(e) securing the right technical, economic and organisational conditions for successfully fulfilling plans.

As a science, the Soviet theory of economic planning takes as its premises the basic conclusions of dialectical and historical materialism, and Marxist-Leninist economic science.

Planning theory is grounded in political economy, economic statistics, and cybernetics, on the economics of the specific industries and the corresponding technical sciences, in the sum total of knowledge of all the sciences needed to provide a profound, all-round validation of economic development plans.

Political economy, which studies economic laws, provides the immediate theoretical basis for the science of planning. The latter works out the correct methodology for applying the whole system of economic laws, provides the raw data for determining economic policy, and develops means of implementing it in development plans.

The political economy of socialism and the science of planning emerged and are developing simultaneously, interacting with one another and influencing each other. Thus, if the basic economic law of socialism forms the basis for determining optimality criteria in the plan, then elaboration of these optimality criteria in turn makes it possible to gain a deeper and more comprehensive understanding of the basic economic law. By giving concrete expression to the conclusions of political economy regarding planning tasks in each particular planned period, by checking them out in the course of generalising the experience of planned

management of the economy in theory, planning science presents political economy with new tasks. The development of political economy helps raise the scientific level of planning and makes it easier to tackle the tasks facing it with regard to improving planning methods, the price system, economic motivation, methods for increasing the efficiency of social production, etc.

Planning is closely connected with particular economic sectors. Thus, for example, planning theory studies the regularities that shape the organisational forms taken by the socialisation of labour (concentration, specialisation and the combination of production) in different branches of industry, agriculture and in other sectors of material production, especially when problems affecting sectoral structure and intersectoral linkages are being tackled and methods for planning these linkages are being worked out.

There is a similar tie-up between planning theory and statistics. Analysis of the initial plan level relies completely on methods of statistical analysis, basic indicators of economic development, and the data of annual report balances. It should be noted that statistics at present primarily performs checking and purely accounting functions, working on the individual indicators of separate enterprises. The system of statistical indicators still lags behind the growing need for deep economic analysis, especially the dynamics of economic processes at the macro-economic and intersectoral level.

Planning theory broadly uses methods of economic-mathematical modelling. They were first used in practice at the pre-planning stage, but they are now being used increasingly in the actual compilation of a plan.

Inter-sectoral models, multiple-factor models of economic growth, models depicting the structure of personal consumption, and sectoral optimisation models are among those that are most highly developed. Further work is being done on improving these models with a view to constructing an interconnected system of planning models which will enable work to be done on optimisation of the whole of the national economic plan.

Optimal sectoral models of production and regional location have become wide-spread in planning the development

of economic sectors. The use of these models in practice is already achieving a tremendous economic impact.

Planning is the central link or core in managing an economy since it is linked with the science of organising economic management. The general theory of management includes planning as the most important function of management.

3. THE JOB OF PLANNING THEORY AND PRACTICE

Improvement of management and its correcting in accordance with a dynamically developing economy is an important problem of the CPSU's economic policy at the present time. Measures to improve direction of the economy have to be considered as one of the main reserves whose use will help to fulfil the Tenth Five-Year Plan and get results in the immediate future.

The main tasks of macro-economic planning at the present stage of development of the economy are: accurate study of social needs; scientific forecasts and estimates of economic possibilities and reserves; all-round analysis and appraisal of the different variants of solutions; real evaluation of the immediate and long-term consequences of the planning decisions taken.

It is necessary in the first place to ensure closer combination of long-term, five-year, and current plans. A feature of the Tenth Five-Year Plan is that it was prepared simultaneously with drafting the basic principles for the country's development in the long term to 1990. The central planning authorities will have, in the future, to complete the drafting of the long-term programmes and concrete targets, jointly with scientific organisations.

A long-term development plan should reflect the objective laws of laying the material and technical base of communism; it should contain a formulation of the most important social, economic, scientific, and technical tasks and the main ways of tackling them, a description of the basic, elements of economic growth and inter-sectoral proportions, and a technical and economic assessment of future development in particular sectoral and regional complexes, and

should take account of the effect of the international division of labour. A long-term plan presents the basis for formulating five-year and annual plans.

Forecasts of scientific and technological progress are of primary importance in working on long-term social and economic problems. The chief methodological difficulty consists in combining scientific and technical forecasts with the social and economic development tasks facing the country. For in this case it is necessary not simply to fix the time-limits for deciding the most important scientific and technical matters but to select those trends in technological progress on which it is advisable to concentrate society's resources. The 25th Congress noted the need to improve the validity of forecasts of scientific and technological progress and of socio-economic processes, and to extend use of these forecasts in the drafting of macro-economic plans.

One of the most urgent tasks facing planning theory and practice is to improve the proportions of the socialist economy and ensure the balanced, efficient development of all its different sectors. It is a task which requires study in depth of the whole system of planning balances or input-output tables. Economic-mathematical modelling of structural shifts in the economy on the basis of inter-sectoral balances is an important trend in improving methodology in this field.

Successful use of the balance, or input-output, method in planning depends largely on the quality of technical and economic standards. It is therefore necessary to do further work on a system of progressive standards that reflect the impact of scientific and technological progress and other factors affecting intensified development of social production: to continue the work of devising a system of standard requirements in physical and value terms for all levels of planning, in order to improve the drawing up of balanced estimates and plans of production, material and technical supply and capital construction.

The new tasks facing the economy demand a more complex, target-programme approach to validating and making planning decisions. Major macro-economic target programmes requiring the joint participation of a whole number of

different sectors, government departments and enterprises acquire particular importance in this connection. For this reason part of the planning task is to make a clear decision regarding the order of priority of aims and programmes, the place taken by each sector in achieving them, and the volume of resources required. Planning, like all managerial activity, must be directed largely to achieving end results ensuring fuller satisfaction of public and personal needs.

At the present stage of economic development it becomes extremely important to work out a complex system for planning scientific and technological progress. Planning faces a task of historic importance; to integrate the achievements of the scientific and technological revolution with the advantages possessed by a socialist economic system and to develop more widely the forms for combining science and production that exist under socialism.

Extensive factors played an important role in developing the Soviet economy for a long period when production was extended mainly through increase of the numbers employed, and of the volume of raw materials and other resources used, and through the creation of new production capacities. Labour resources, raw materials and investments will increase in future too, but an increasingly important role must be played by the intensive use of inputs in securing high growth rates. Putting the economy on the road to comprehensive intensification of production means new tasks in the field of planning: the system and methods of management and planning must first of all be improved in the direction of securing an all-round intensification of social production and an improvement in its efficiency as the main line of economic development for the country both in the immediate years ahead and in the long term and as an essential condition for creating the material and technical basis for communism.

Centralised planning provides the framework for the main trends of economic development in the long term. Thus the rates of growth and main proportions of the development of the economy, the volume and structure of capital investment, and the tasks in regard to scientific and technological progress and the location of industry are decided during the drawing up of a plan. At the same time the role of economic

levers which allow group and individual interests to be combined more fully and correctly with those of society at large is growing significantly at the present stage. Planning science has the important task of working out the kind of economic incentives system that stimulates all sections of the economy to take on tight planning assignments and to use all available reserves.

Measures will have to be taken to increase the role of finance and credit, and of material and moral incentives, in combination with economic sanctions, and to improve the whole system of evaluation indices.

Improving the organisational structure and methods of management is becoming an increasingly important element in improving direction of the economy. In industry we shall have to complete the formation of amalgamations in accordance with the general management schemes, and continue work on the concentration and specialisation of production and reduction of the number of links in management. General management schemes will be developed and introduced in capital construction providing for going over to two- and three-level management systems; the lower building organisations will be integrated and the degree of specialisation raised. In agriculture inter-collective farm, collective farm, state farm, and state-cooperative units and organisations will be widely developed, and also agro-industrial complexes to produce, process, and market farm produce.

CHAPTER II

THE BASIC METHODOLOGY OF MACRO-ECONOMIC PLANNING

The methodology of macro-economic planning establishes the basic principles and methods for compiling a plan and the sequence and method of pre-planning work, and reveals and describes the internal logic of macro-economic planning—a process which is so vital to a socialist society. The methodology of macro-economic planning need to be distinguished from the methods used over a whole range of working methods and practices in carrying out concrete planning estimates.

1. THE PRINCIPLES AND METHODS OF SETTING UP A MACRO-ECONOMIC PLAN

Lenin laid the foundations for planning theory and practice. It was his ideas that formed the basis for the methodology of planning in the Soviet Union. Principles that have tremendous international importance for all countries engaged in socialist development and the creation of a planned economy were worked out on the basis of Lenin's ideas. They include the following:

(a) democratic centralism in planning which implies the integral combination of centralised planned management and maximum development of the independence and initiative of local authorities, enterprises, and production workforces;

(b) directive planning and the use of economic levers, i.e. a combination of strictly compulsory planning assign-

ments and the use of prices, credit, profit and other economic levers that have a goal-directed effect on plan execution and raising the efficiency of social production;

(c) unity of the macro-economic plan, meaning that all plans for different branches of production must be strictly coordinated. This principle is determined by the objective unity of the entire process of socialist extended reproduction;

(d) coordination of perspective and current plans, in which the perspective plan incorporating the major tasks of building socialism and communism plays the leading role;

(e) coordination of the sectoral and regional breakdowns for a particular plan arising from the interests of the economy taken as a whole and each region taken separately.

The most important principles underpinning work on a macro-economic plan—maintenance of a proper balance between all elements of the economy; a steady rise in the efficiency of social production, and the methods of socialist planning (i.e. the balance method and the method of optimal decision-making, by which proportionality and heightened efficiency of social production are attained)—have all been developed on the basis of Lenin's ideas.

Improvement of planning theory and practice calls, above all, for further development of planning and forecasting methods. Broad introduction of systems analysis and of economic-mathematical models helps ensure that plans for social and economic development are complex, that a large number of factors and trends can be taken into account in analysing and evaluating planning decisions and their outcomes, and that the best plan is selected for the particular concrete situation.

The Basic Principles of Setting up a Macro-Economic Plan

The principles of setting up a macro-economic plan are determined by the economic laws of socialism. In order to satisfy society's continually increasing needs to the maximum extent possible, the plan must secure, firstly, a steady growth of proportional, balanced social production and,

secondly, a rise in the efficiency of social production. These two planning principles determine the content of the plan and the process for setting it up.[1] They stem from the basic economic law of socialism, the law of planned, proportional development of the socialist economy, the law of saving time, etc., i.e. from the whole system of economic laws operating under socialism.

The direct link that exists between production and social needs, thanks to which it has become possible to plan production in the light of the structure and composition of those needs which society should satisfy before all others, is one of the most important advantages possessed by socialism. As Engels pointed out, the objective possibility of regulating production in accordance with needs is created in conditions of socialism. "The plans of the various branches of production," wrote Lenin, "must be soundly coordinated, and linked up so as to constitute the single economic plan we stand in such great need of."[2]

Raising the efficiency of social production constitutes another, extremely important principle of planning. The efficiency principle requires plan goals to be attained with minimum inputs of materials, labour and finance.

"To improve *planning...*," it says in the *Guidelines for the Development of the National Economy of the USSR for 1976-1980*, "by giving fuller consideration to social needs and meeting these needs with the least expenditure of labour, material and financial resources. To secure balanced planning through improving the system of budgets in physical and value terms as well as in terms of production capacities and manpower resources. To provide for the setting aside of adequate national resources."[3] Thus the task of improving the balance of macro-economic plans, orient-

[1] Some Soviet economists have put forward six or seven key planning principles, but these include principles of different kinds, some relating to the aims of the plan, others to planning organisation or to the setting up of a macro-economic plan, and so on. The two basic principles mentioned above relate directly to the process of setting up a plan for developing the economy.

[2] V. I. Lenin, *Collected Works*, Vol. 31, p. 511.

[3] *Guidelines for the Development of the National Economy of the USSR for 1976-1980*, p. 22.

ing them on raising the efficiency of industry is posed as one of the most pressing and imminent tasks of present-day planning.

The two basic principles of setting up a plan are closely interwoven. Society's need for fuel can, for example, be satisfied in large measure by the use of coal, peat, etc. If this is done, a correct balance of resources and needs will be achieved, but it will not be efficient. If balance is achieved with the use of inefficient types of fuel, the whole system of proportions deteriorates, a brake is put on economic development, and there are fewer opportunities for satisfying people's needs. If the share of gas and oil in the fuel balance is increased, then it becomes possible to meet society's requirements with fewer inputs. It is also possible to satisfy society's food requirements by disproportionately increasing the output of bread, potatoes, and other foods of low nutritional value—this requires relatively small inputs of labour but will not correspond to people's needs. Such a solution would destroy the proportion between needs and production in its structural breakdown.

Improvement of the structure of social production and raising of its efficiency have been provided for at all stages of Soviet perspective plans and this has been reflected in progressive changes in the structure of the fuel balance, in accelerated development of electricity generation, branches of the chemical industry, progressive branches of engineering, and other industries ensuring scientific and technological progress.

The structure of social production has been improved and its efficiency increased at all stages of building socialism by singling out the leading sectors. In conditions of centralised planning, society concentrates all types of resources (production, investment, manpower, etc.) and allocates them to developing key sectors and tackling the most important social problems.

It should be noted that, although our plans do on the whole achieve a proper balance, the job of improving the efficiency of social production is not yet being altogether satisfactorily solved.

Macro-Economic Planning Methods

Specific methods corresponding to the tasks and particular features of planning are used in compiling a plan. The principles for setting up a plan determine the macro-economic planning methods. The main ones are the balance or input-output method, which ensures that plans are correctly balanced, and the method for optimising planning decisions at all levels which ensures higher efficiency of social production. Like the two basic principles for setting up a plan, both these methods are interconnected and complementary.

The Balance or Input-Output Method. The balance method consists essentially in coordinating needs and resources throughout the whole of social production, in coordinating related branches of production and industries in the economy, and in ensuring proportionality and the coordination of all economic elements in the economy in accordance with the demands made by the objective economic laws of socialism.

This method makes it possible to establish and combine physical and value proportions in the economy in a planned manner and thereby ensure the unity of plans. Physical output, manpower, and financial input-output tables that are organically linked together and reflect different aspects of the single process of extended socialist reproduction are used in planning practice.

The production and consumption of particular types of output are coordinated by means of tables showing physical inputs and outputs (steel, electric power, etc.) in which resources and the demand for a given output are made to correspond. These tables reflect the linkages existing between different branches of production. Input-output tables for fixed assets and production capacities, which enable decisions to be made regarding the extent to which they need to be expanded in order to secure the planned volume of production, are appended directly to the physical output tables.

Input-output tables for manpower are compiled in order to make sure that the labour force required by the planned scale of production and growth of the non-productive sphere

is available. Their purpose is to bring manpower resources into line with the demand for labour in the planned period. Such tables are compiled for the Soviet Union as a whole, and for each republic and economic region. They make it possible to plan the allocation of manpower to different sectors of the economy and to different regions, to plan vocational training programmes, etc.

The financial tables reflect the generation and distribution of income belonging to the state, to socialist enterprises, and to the general public. The main ones deal with state income and expenditure, and personal money income and expenditure and are drawn up for the Soviet Union as a whole, for each Union republic, and for the various administrative territories and regions. Personal money income and expenditure tables are necessary in order to determine consumer demand, plan the volume of consumer production and of retail trade, plan those services that have to be paid for by the general public, draw up the State Bank's cash-reserve plan, etc.

The physical output, manpower and financial tables must be strictly coordinated in a single complex. It used to happen quite often that the development of certain important industries was held back because the allocation of financial resources had not been coordinated with the corresponding changes in the physical composition of accumulation (for example, the rates of extension in the production of chemical plant lagged behind the rates of growth of capital investments in the chemical industry, as a result of which the plans for the construction and commissioning of new capacities in the chemical industry were not fully implemented).

All these different types of table are combined in a table for the whole of the economy, which thus occupies a special place in the system of balances (see Ch. X, Vol. 2). The macro-economic table includes a table of the production, consumption, and accumulation of the social product, and another of the production, distribution, redistribution, and use of the national income. The planned balance table for the economy determines the general economic proportions of extended socialist reproduction.

One form of the latest development of the macro-economic table is the inter-sectoral balance of the production and

distribution of output integrating the general proportions with the actual inter-sectoral ones. An inter-sectoral table expressed in value terms describes such general economic proportions as the ratio between social product and national income, between consumption and accumulation, and between physical inputs and net output, and at the same time reflects the actual linkages that exist between many branches of production. The inter-sectoral planning table for 1970, for example, contained linkages between about 130 different sectors of the economy.

A commodity input-output table—an inter-sectoral balance in physical terms—represents a synthesis of all physical output tables; the one for 1970 covered 585 items. Work is still going ahead on inter-sectoral tables expressed in both physical and value terms. An extended model of inter-sectoral inputs and outputs also provides information on the increment in fixed assets in all branches of production that is needed in the planned period. The use of inter-sectoral tables represents a substantial addition to the present system of input-output planning estimates.

Methods for Optimising Planning Decisions. The 24th Congress of the CPSU stressed that special attention needed to be paid at all levels—be it enterprise, association of enterprises, ministry or Gosplan (State Planning Committee)—to the optimum character of decisions. Favourable conditions have been created in the new system of planning and stimulation for taking optimal planning decisions in all sections of the economy.

Frequently the most efficient variant of a planning decision is selected empirically by comparing the economic effectiveness of several variants. This kind of comparative analysis, which is widely used at all levels, does not guarantee selection of the optimum variant, since it may lie outside the range of the variants that have been drawn up and whose efficiency is being compared. Nevertheless it undoubtedly helps to increase the efficiency of social production in the planned period if the economic efficiency of a whole series of variants is compared and analysed.

In current methodology, indicators like unit capital investment, unit cost of output or calculated outlay (aggregate cost plus a coefficient of efficiency multiplied by the required

volume of capital inputs) are used as criteria of optimal resource allocation for comparing the economic efficiency of producing interchangeable or mutually substitutable types of output. The most efficient variant is that which has the minimal value of the appropriate indicators.

The following indicators are used to determine the economic efficiency of different variants regarding the volume and structure of capital investments throughout the Soviet economy, in the Union republics and in particular sectors: a coefficient of macro-economic efficiency defined as the ratio of net output to gross investment; coefficients of comparative efficiency calculated as the ratio of the total economy obtained from lowering output costs in the last year of the planned period to capital investment over the five-year period, etc. With the help of indicators such as these, it is possible to select the most efficient direction for investment.

As was noted at the 24th Congress broad use of economic-mathematical methods and computers will speed up the collection and processing of information, the drafting of different plan variants, and the finding of optimal planning decisions.

Mathematical programming methods allow the most efficient variant to be selected from among all those that are possible from the point of view of the criterion chosen. This method has already proved its viability in tackling a whole number of local and sectoral problems.

Economic-mathematical modelling methods, which allow the quantitative relationships between indicators to be expressed in mathematical form and a complex of possible planning decisions to be found, are being employed in solving problems relating to both balancing plans and selection of the most efficient variants of economic growth. Their use helps ensure that both the input-output method and the method for selecting efficient solutions become really scientific.

Economic-mathematical modelling needs to be grounded in an objective description of economic processes based on concrete, thorough analysis of these processes and founded on Marxist-Leninist theory.

Sometimes the method of technical-economic calculations or standard method is singled out in the economic literature and methodological instructions as special, which strikes us as unjustified. Estimates of the demand for goods of one kind or another, and the production of them that is feasible are obviously based on progressive standards (for example, standards of the use of rolling mills, open-hearth furnaces, etc. are employed in calculating production potential). Standard coefficients for the input of labour, supplies, raw materials, fuel, and plant and machinery are vital elements in any method of planning estimates.

Physical output, financial, and manpower balances must be based on scientifically validated standards. If efficient planning solutions are to be selected, then different variants for developing production must be compared, and standard coefficients must in turn be applied in calculating each variant. The optimisation of planning decisions is wholly related to the need to further develop and improve the basic standards in use. New standards also emerge in the course of drawing up an optimal plan that reflect the essence of the obtainable optimal relationships. Planned management of economy is impossible without the use of norms or standards; but the initial standards do not of themselves provide the grounds for establishing planning proportions and taking planning decisions. At the same time, basic planning methods—the input-output method and the method for optimising planning decisions—cannot be applied in the absence of a proper basis provided by standards.

2. THE METHODOLOGY OF PRE-PLANNING CALCULATIONS

Planning experience in the Soviet Union and other socialist countries shows that valid work on drawing up a macro-economic plan comprises a whole number of closely interconnected stages.

The following basic stages in planning can be distinguished:

I. the pre-planning stage (analysis, selection of aims and targets, forecasting);

II. the directive stage (elaboration of the plan's address targets);

III. the stage of amending and correcting plan targets (allowing for the course of their realisation, for new information on changes in the home and foreign economic situation, and for the availability of effective scientific and technical innovations not previously known, and so on).

The pre-planning stage comprises the following three phases:

1. analysis of growth trends in the pre-planning period. research into the state of the economy towards the beginning of the planned period, and analysis of plan implementation;

2. definition and selection of economic and social goals and tasks in the planned period and a preliminary outline of major complex programmes;

3. long-range forecasting, including work on forecasts of scientific and technological progress, social needs and resources, and the potential for economic growth.

The second and third phases of the pre-planning stage may be taken either separately or together. Aims common to all perspective macro-economic plans are determined by tasks that arise in laying the material and technical base of communism and can be formulated before any work is done on forecasting. It is, however, only on the basis of forecasts of scientific and technological progress and the growth of manpower and natural resources that it becomes possible to determine approximately the extent to which the key social and economic goals can be attained within the framework of a particular perspective plan. Consequently it is only after the forecasting stage that the basic goals of the planned period can be formulated in more exact terms. For example, one of the principal social tasks in building communism is to eliminate the substantial differences that exist between town and country, but which part of this task can be solved within a particular perspective plan depends to a considerable extent on what resources can be allocated for the further industrialisation of agriculture and for developing the rural infrastructure.

On the other hand, the preparation of different forecast variants should be based on knowledge of the basic aims of social and economic development in the long-term period.

Work on setting the aims and tasks for a planned period and on making forecasts therefore needs to be conducted in parallel.

Pre-planning work is integrally connected with the process of compiling a plan. Economic analysis of the initial level of development, the selection and definition of economic development goals over the planned period and the drawing up of complex inter-sectoral programmes, and long- and medium-term forecasts all help to establish the socio-economic conception of the plan as well as furnish preliminary information and provide the theoretical grounds for compiling a plan. It is essential in drawing up a plan to demonstrate the objective possibility of attaining the goals within the planned period, given the initial level of development and taking into account the results of the forecasts (of scientific and technological progress, resources, etc.).

The Initial Level of Economic Development

Analysis of the initial level of economic development attained by the beginning of the planned period is of decisive importance in current planning. The development of social production in the immediate years ahead is largely predetermined by the availability in the pre-planning period of production capacity, manpower, and other factors. Analysis of the initial economic situation also plays an important role in drawing up a perspective plan. A study of this kind includes an analysis of the volume, rates, and proportions of production, the extent to which social needs are being met, and an assessment of the reserves available for raising the efficiency of social production.

Consequently, an analysis of the actual economic processes and tendencies that have taken shape in the pre-planning period needs to precede work on drawing up current and perspective plans.

It is tremendously important, both politically and economically, to draw up a final balance-sheet and analyse the implementation of the preceding perspective (five-year) plan. The actual results of its implementing are analysed under the following heads: national income; industrial

output including producer and consumer goods; agricultural output; volume of investments; freight traffic (for all kinds of transport); retail trade turnover in the state and cooperative sectors; average earnings; average monthly income in cash and kind of collective farmers derived from their work on the collective farm; individual cash payments and other benefits from social consumption funds; and real income per capita.

The most important task which an analysis of the initial economic level must tackle is to ascertain if any reserves exist for increasing production, raising its efficiency, improving its quality, and making full use of production capacities, raw and other materials, fuel, etc. All information about reserves that have been brought to light at enterprises and production associations should be reported to the appropriate chief administrative departments and ministries and should be used as important data in the course of compiling a plan.

Analysis of actual data for the pre-planning period should be supplemented by provisional estimates relating to expected fulfilment of the plan, since the plan is drawn up at a time when the previous plan has not been fully implemented. Thus, the draft plan for 1971-75 was prepared over a period of two years. In making the planning estimates it was necessary to establish economic indicators for the whole of the preceding five-year period (1966-70) and for 1970, which was the base year for the Ninth Five-Year Plan. While the indicators for 1966-69 became available in the course of preparing the plan, those for 1970 had to be arrived at from actual data for a few months only, plus a short-term forecast for the remaining months of the final year of the previous five-year planned period. Adjustments had to be made in the draft as the final figures for 1970 became known.

Selection of the Goals and Tasks of a Planned Period

There is a direct connection between establishing planning goals and the tasks of socialist and communist construction. The longer the planned period, the greater the possibilities for carrying out major social and economic measures, and the greater the importance that attaches to selection of long-term economic development goals. Determination of the main ones also serves as the starting point for current planning, although current planning is connected rather more with the current situation.

The main tasks of concrete five-year plans are established by congresses of the CPSU which work out the economic policy for the forthcoming period. The main task of the Tenth Five-Year Plan is consistent implementation of the Communist Party's line to raise the people's material and cultural living standards on the basis of dynamic and proportional development of social production and improvement of its efficiency, acceleration of scientific and technological progress, growth of labour productivity, and improvement in every way of the quality of work at all levels of the economy.

Taking this main task as their starting point the *Guidelines for the Development of the National Economy of the USSR for 1976-1980* envisage the following:

1. the ensuring of stable growth and improvement of the structure of social production;
2. implementation of a series of measures to further the prosperity of the people;
3. encouragement in every way of improvement of the efficiency of social production and of the quality of output; and consolidation of a regime of economy in the national economy;
4. acceleration of the rates of scientific and technological progress;
5. improvement of the direction and management of the economy;
6. the working out and implementing of measures to protect the environment and for rational exploitation and reproduction of natural resources;
7. consistent development and extension of all-round cooperation with socialist countries, and consolidation of the world system of socialism.

Once a plan's basic goals have been fixed, an attempt has to be made to rank them according to their importance for the country and the order of priority for putting them into

effect. The ranking can be more or less strict, but there are obviously certain national ones that are equally important to achieve.

At the present stage the main (general) goals facing the socialist economy over the long-term period include the following: maximum satisfaction of people's material needs; satisfaction of their cultural requirements; consolidation and development of the system of social relationships; securing of conditions in which the whole economic system can function; creation of future economic potential; strengthening of the country's defence capacity; protection of the environment; consolidation and development of the socialist community; economic and cultural aid to other countries and support for them in their fight for independence.

Clearly, satisfaction of the people's material needs and strengthening of defence capability are vital national goals which it is impossible to rank. The socialist state allocates resources for these purposes after thorough economic and political analysis of the actual circumstances in each particular planned period; this allocation has to be adjusted in keeping with the international situation.

Each major goal of importance to the state can be broken down into several sub-goals. For example, maximum satisfaction of people's material needs can be broken down into such sub-goals as satisfaction of the people's need for a complex of foodstuffs, for clothing, housing, transport, telephones and postal services, health services, and so on. Each of these sets of requirements comprises in turn a whole number of sub-divisions constituting yet a third set of goals.

It is advisable in this connection to construct a "tree" of goals showing their hierarchy and interdependence, indicating the technology for achieving the general goal, and giving the link-up between it and the resources necessary for achieving it. Thus it is possible to show how the task of raising living standards is tackled in the form of a definite "tree" whose crown represents the goal and whose lower branches represent the sub-goals or sets of goals ensuring that these sub-goals are attained. The resources (partial substitutes) necessary for reaching the goals set are shown on the lowest branches.

The ultimate goal of a socialist society is to satisfy the growing needs of the working people. It is therefore necessary, even at the preliminary planning stage, to examine the shares of investment and consumption in national income when setting goals for the long-term period ahead. The task of establishing the optimal relationship between consumption and accumulation raises the problem of relating and attaching a comparative value to present and future interests. If the share of productive accumulation in the national income is increased, then faster growth rates will be achieved (see Ch. IV). On the other hand, if the share of consumption is substantially reduced, this will lead to a decrease in labour productivity and economic growth rates. Herein lies the whole complexity of the problem of finding the optimal relationship between consumption and accumulation in the national income. In order to help solve it, sociological surveys are conducted and optimality methods and criteria are worked out.

The pre-planning stage also includes the job of determining (in a preliminary manner and in aggregate form) the structure of demand. Validated consumption norms for particular goods and services, and indicators showing the availability of particular types of output at the start of the planned period and how far certain goods and services are preferred to others, all come in useful here.

Estimates of the structure of demand (relationships between non-substitute goods and services) cannot be made without conducting sociological surveys and making wide use of the data of statistics on family budgets, and so on. Problems connected with determining the structure of demand are very largely also matters of economic policy. In the Ninth Five-Year Plan, for example, one aim was a steep increase in the production of motor cars since, in present-day conditions, this can be done without harm to other, more vitally important branches of industry.

Thus, a whole series of complicated social, economic and political questions have to be settled in fixing goals for a particular planned period.

Work on Drawing up Complex Programmes

Major, complex (or general) programmes for achieving certain economic and social goals are drawn up in a preliminary form at the same time as goals for a particular planned period are fixed. These programmes then become vital elements in the macro-economic plan.

The need to apply the programmed-target method more widely in planning practice is noted in the *Guidelines for the Development of the National Economy of the USSR for 1976-1980*. In recent years, in fact, the problems of developing agriculture in the non-Black Earth zones of the RSFSR, opening up of the oil and gas fields of Western Siberia, and building of the Baikal-Amur railway were resolved on a programmed basis. Integrated programmes combine measures for tackling major macro-economic problems, solution of which calls for the coordinated efforts of many industries, departments, and economic regions.

Programmed methods are also being used in planning heavy industry.

"The elaboration of far-reaching integrated programmes for two or three five-year periods, such as programmes for the development of the fuel and energy complex, metallurgy and leading branches of the engineering industry, is becoming increasingly important for the development of the heavy industry as, indeed, of other branches of the national economy. Such programmes can be drawn up, closely coordinated, provided with resources and linked up in time only on a long-term basis. They must, naturally, take into account the continuous progress of Soviet and world science and technology and the possibilities for economic cooperation with other states," the Report of the Central Committee to the 25th Congress of the CPSU said.[1]

The linkages existing between different sectors for realising ultimate macro-economic targets show up clearly when major investment and construction programmes have to be

[1] L. I. Brezhnev, *Report of the CPSU Central Committee and the Immediate Tasks of the Party in Home and Foreign Policy, XXVth Congress of the CPSU*, p. 51.

implemented. Thus, calculations made by the Chief Computing Centre of Gosplan showed that the starting-up of large-scale production of motor cars at the Volga Motor Works in Togliatti entailed investment in a number of ancillary industries in order to increase the production of electricity, fuel, steel, non-ferrous metals, and chemical products, as well as in housing, municipal services, shops, repair services and amenities, schools, cultural facilities, etc., which added up to 462 per cent of direct capital expenditure. Moreover, major investments had to be undertaken in building and equipping repair workshops and service garages, and building highways, bridges and other structures, etc. which came to 600 per cent of the direct investment in setting up the factory. The total investment in the economy in connection with the production and use of cars from the Volga Works has amounted to more than ten roubles for every rouble of direct capital expenditure.

The task of drafting a whole number of new long-term programmes is a very pressing one at the present time. Among them must be mentioned the programme for development of the industrial base for atomic power engineering, the programme for mechanisation of manual and physically heavy work, and the programmes for building major regional-industrial complexes. The need has arisen to draw up a complex long-term programme for improving the ecological environment (preventing the pollution of inland waters, the sea and the atmosphere, and protecting forest reserves, plants and wild life). The importance of working out such a programme is self-evident since the rapid increase in the scale of industrial production often gives rise to undesirable changes in the surrounding countryside—the despoliation of forests, the pollution of rivers and the atmosphere, and the near extinction of wild life.

Long-Range Forecasting

Forecasting and planning are integrally linked and are stages of a single process. Forecasting is the scientific, analytical premise of planning. The main thing in it is to recognise the objective trends of economic development. Planning as distinct from forecasting is directive in charac-

ter: it issues instructions to specific organisations. The most important thing in planning is to make decisions and search out specific ways of achieving set goals in the perspective period.

Long-term plans and forecasts must be periodically revised. Whenever a new five-year plan is compiled, the long-term perspective must be rolled-on for a further five years.

Several variants for whole series of complex programmes are worked out in these long-range forecasts, completion dates and necessary expenditures are specified, and their immediate and long-term effects are estimated. Not only are different systems of complex programmes compared in these forecast variants but also different completion dates, different orders of priority, and various other aspects. The final choice of a variant is made when work is going ahead on the long-term macro-economic plan.

Experience suggests that forecasts can be classified as follows:

1. Forecasts of Scientific and Technological Developments and Their Impact on Economic Development. The main condition for achieving success in the competition between capitalism and socialism lies in forecasting the basic trends of scientific and technological progress, making a correct selection of these trends and deciding on the main stages in tackling the most important scientific and technological tasks.

The potential for developing science and technology in the forecast or planned period must be fixed with more or less accuracy right from the beginning both at the stage of forecasting economic development and at the stage of compiling the plan, since this forms the basis for economic growth in its entirety.

In deciding the question of the time-scale of forecasts of scientific and technological progress, it is advisable to combine all such problems into three groups as follows:

I. the problems that have already been solved on the scientific and technical plane and been partially introduced into industry; within the first time-scale these results will be widely applied throughout industry and will have a considerable effect on economic development indicators (atomic power stations, lasers, magnetic hydrodynamic generators, artificial diamonds, continuous casting of steel, etc.);

II. problems that have been solved on the scientific plane but have not yet reached final technical solution; tasks belonging to the longer forecast period (the second time-scale) are those that have still to be solved technically and introduced into industry for the first time (electronic computers based on integrated circuits, the production of non-woven fabrics, hovercraft, etc.);

III. scientific research currently being undertaken and clearly of a long-term nature, that has not yet been fully solved at the purely scientific level; in the long-term forecast period (within the third time-scale) this research will attain a broad scale and will presumably be solved theoretically and then technically, and later be put to use (controlled thermonuclear power, the treatment of cancerous diseases, etc.).

2. Demographic and Manpower Forecasts. Demographic forecasts of the increase in total population, including that of working age, forecasts of inter-regional migration and changes in the dispersion of population, etc., provide essential information in planning production and an increase in consumer demand.

It is important, in making long-range forecasts, to study factors likely to affect natural and induced population movements in the period ahead by means of population surveys. It is also essential to work out the scientific basis for a "tactical" and "strategic" demographic policy (covering long- and short-term periods). It is very important to estimate the effect in these forecasts of population and labour growth rates on economic development and the reverse effect of economic growth on demographic processes. It is important in doing this to assess the factors determining the economy's manpower requirements. It is possible by using economic-mathematical methods and sociological surveys to forecast manpower resources for the country as a whole and for particular regions and this in turn makes it possible to plan the use of manpower, the training of cadres for the economy, and the development of the services sector, and so on, with greater certainty.

3. Forecasts of Natural Resources and their Availability for Production. A country's economic potential is determined to a considerable extent by its mineral resources and the scale of its mining production. It is essential to draw up an estimate of potential reserves in good time, ten or fifteen years ahead of use, to do preparatory work on prospected resources and especially any major new deposits, and continue with geological prospecting and exploration. Forecasts of natural resources and their availability for production can be made on this basis.

4. Economic Forecasts. These form a large group and include forecasts of the reproduction of fixed assets and capital investment, economic growth and structural changes, living standards and the generation of consumer demand, and forecasts concerning different branches of material production and the services sector, foreign economic relations, etc. At a time when an important task in the current five-year plan is to raise living standards, research into the generation and trend of social needs, and forecasts of personal consumption come to the forefront.

Once forecasts of manpower resources, fixed assets, and investment—all key factors in economic development—have been completed, an approach can be made to forecasting economic growth, while forecasts of scientific and technological progress, natural resources, and social needs not only lay the basis for forecasts of economic growth rates but also enable structural changes to be predicted in the long-term perspective. The forecasting of different variants of macro-economic growth and structural changes constitutes the final stage in the entire forecasting process.

5. Social Forecasts. These cover social processes and the various ways of deciding fundamental social problems in the course of communist construction (for example, how to bring living standards in town and country closer together, the further development of education and the health services, etc.).

6. Sectoral and Regional Forecasts. Forecasts of development in particular sectors of material production and the services sector, as well as particular economic regions, are a necessary element in any system of long-term planning and forecasting. Forecasts of development in particular

sectors or economic regions either preceding or running parallel with macro-economic forecasts are very important. They proceed from the specific features and regularities of development in the particular sectors or regions and are based on information that has been specially obtained and on the available fund of experience. This type of forecast is used to a certain extent in making a forecast of macro-economic development.

Sectoral and regional forecasts must necessarily be compiled only after the macro-economic forecasts have been made, when it really becomes possible to provide actual data for the sector or region. It should be noted in this connection that multi-level forecasts are made on an iterative basis.

Besides long-range forecasts, both medium-term forecasts (prepared in the form of preliminary data before the five-year plans are compiled) and short-term forecasts regarding the current economic situation are necessary. The main problems in short-term forecasting are those of balance, including short-term forecasting of the balancing of personal income and expenditure, forecasts of crop yields, and plan implementation. In medium-term forecasting the leading role is taken by forecasts of the dynamics of the economy, structural changes, and the reproduction of fixed assets and manpower resources.

Scores of different methods for forecasting economic and technical development are currently being suggested in the literature, but this multiplicity of methods can be reduced to the following few groups:

1. the method of expert estimates which consists in collecting and processing data on the matter under forecast through systematic polling of highly-qualified experts;
2. the method of statistical extrapolation, which consists in studying stable past growth trends and projecting them into the future;
3. the normative method, in which the future state of the matter under forecast is established from the aims of its development and the standard previously set;
4. methods of logical (mainly qualitative) and mathematical modelling of the processes being forecast. Logical modelling, in particular, is done by developing a "scenario", that is a description of the sequence and significance of events in

the development of what is being forecast. Mathematical modelling views the development process in the form of quantitative interconnections between the different elements in the forecast. Mathematical models must be adequate descriptions of the processes being modelled. The general features of all forecasting models are: (a) systems-analysis character, (b) the taking into account of the probability character of many objective processes, and (c) the possibility of using them in shaping the theoretical principles of economic policy.

The following models are used in the course of forecasting: macro-economic models describing the impact of economic growth factors on the process of extended reproduction; inter-sectoral and inter-regional models (both static and dynamic) describing the way in which the sectoral and regional structure of production is formed and inter-sectoral and inter-regional links are developed; models describing demographic processes and the training and deployment of the labour force; models of the reproduction of assets and investments describing the way in which existing assets are used, withdrawn from use, and replaced; and models of consumption trends and structure.

Unlike the system of models used in planning the economy, forecasting models operate at a higher level of aggregation of sectors and industries, and are based on aggregated standards or norms of a preliminary kind.

3. THE LOGIC OF MACRO-ECONOMIC PLANNING

Once an analysis of current economic growth trends has been made, the initial level of planning specified, the economic and social goals for the planned period decided, and different variants of a long-range forecast of economic development been worked out, the economic and political, and scientific and technological concept of the plan can be formulated.

This complex concept of technological and socio-economic development should be reflected in the first outline showing the growth rates and basic proportions of economic development during the perspective period and in the work on the series of complex long-range programmes dealing with vital

problems in the economy, and should also be based on the principles of technological, economic and social policy that have been drawn up for that same period.

At present the need to draw up three types of macro-economic plan is recognised: (1) a long-term plan covering 15 to 20 years; (2) a five-year plan with an annual breakdown, which is the basic form of planning; and (3) an annual plan based on the five-year plan and any adjustments made to it in the course of implementation.

There are many major and complex socio-economic problems that cannot be fully decided in the course of a single five-year plan. For this reason the basic form of forward planning, the five-year plan, must be compiled and treated as part of a long-term plan, since that makes it possible to create the stocks required for further development in each five-year planned period and subsequently to tackle major technical, scientific, and economic problems and carry out large-scale complex programmes. Only with such an approach ensuring the continual coordination of long-term plans with five-year and annual ones can the fundamental problems in economic development be tackled more effectively.

Drafting of the Tenth Five-Year Plan went on simultaneously with development of the ground principles for development of the economy up to 1990. The guidelines for the fifteen years are not so directive in character or so detailed as five-year plans. Their purpose is different, namely, to determine in good time the character and scale of the tasks facing society and to concentrate forces on tackling them, to clarify probable problems and difficulties, and to facilitate the drafting and carrying out of programmes and projects extending beyond the limits of a five-year plan.

It becomes necessary, in the course of compiling a plan, to decide the sequence of particular items of planning work and planning calculations. In other words, it is necessary to validate the logic of economic planning.

Choice of the starting point for planning is a central methodological problem. Let us examine three concepts of macro-economic planning characteristic of the different kinds of logic used in compiling a plan using different starting points:

1. planning on the basis of sectoral projections in which the starting point is given by the targets for the main types of output (chiefly of heavy industry);
2. complex, multi-variant planning on the basis of a series of models including an inter-sectoral input-output table for planning purposes; the starting point for drawing up such a plan is society's final consumption;
3. optimal planning, the starting point of which is the limited availability of resources, while the optimality criterion is the maximisation of the level of prosperity or minimisation of inputs of social labour per unit of final output on condition that the structure of social production corresponds to the structure of demand.

The first concept has been employed in planning practice for a long period of time. The second and third are new concepts formulated in recent years when computers became possible. The second concept is now being introduced experimentally into planning practice. The third concept is still at the research stage (but is being applied experimentally at the sectoral level).

Planning on the Basis of Sectoral Projections

The compiling of economic plans starting from planning targets for the development of particular sectors was first begun at the end of the 1920s. This conception underlay the formulation of the prewar and early postwar five-year plans. Its planning logic corresponded to the possibilities and tasks that existed in the period of industrialisation and of postwar reconstruction of the war-damaged economy.

The centralised assignments for key branches of heavy industry—for expanding the output of steel, fuel, electric power, etc., constituted the starting point for planning in the early years of industrialisation. Any resources left over after tackling tasks that were of prior importance to industrialisation were allocated for the development of other sectors of the economy. During the war years, naturally, attention was focussed on the war industry and branches like heavy engineering and iron and steel that played

a dominant role. In the early postwar years work on restoring the country's production equipment came to the fore.

Until quite recently many economists believed that it was impossible to fix goals for all sectors of the economy simultaneously, that a plan for the whole economy could not be decided in one go, in a complex manner. It was therefore necessary to begin with different sectors, even though this raised a number of difficulties.

If work on compiling a plan starts by drawing up assignments for particular types of output used mainly for purposes of productive consumption (output targets for steel, electricity, etc.), one ends up going round in circles. Say we start drafting a plan by setting targets for electricity generation. In order to decide what the planned output should be, some estimate must be made of the demand for power in the economy; this in turn requires an estimate of the planned volumes of output in all industries using power, that is, compilation of a production programme for all sectors of the economy.

Thus, in order to determine the volume of output in any one sector, the volume of output in all other sectors must be known. It seems at first glance as if this is an insoluble problem. However, in practice this task is tackled in stages. Work on the plan starts by drawing up the first projections for several leading sectors, then assignments for related and other sectors are calculated, and while this is being done adjustments are introduced into the initial assignments, and so on. At the same time, opportunities for expanding capacities and the number of people employed in each sector, for raising labour productivity, and lowering the costs of inputs, are assessed, i.e. all possible resources and reserves for extending production in the sector are ascertained. As a result, the general outlines of the plan, the scale of production, investment requirements, etc., are sketched in. By using this method of variant approximations, the first variant of a balanced plan is worked out.

Sectoral planning projections are essential whatever concept of planning is adopted, for specialists working in the sector know better than anyone else what production reserves exist, what the trends of technological progress are in their sector, etc. It should be noted that sectoral estimates

of demand for the output of a given sector are very important.

However, the outlook for development of the sector as a whole (and in particular, development on account of new construction) cannot be worked out sufficiently accurately within a single sector, since ministry planners are not in a position to determine the demand in all sectors of the economy for the output of their own particular industry and, most important, they do not know what investment they are likely to be allocated in the planned period.

In order to avoid transparently unrealistic variants of sectoral projections being proposed, the work of compiling the national plan begins with macro-estimates that enable the approximate amount of capital investment in the planned period to be fixed and provisionally allocated to the different sectors of the economy. The job of assessing overall investment resources and especially of allocating them to different sectors during the planned period has not so far been put on a sufficiently scientific basis, given current planning methods, and is still substantially empirical.

Planning on the basis of sectoral projections entails complex input-output calculations. But until recently they were done at the final stage of plan compilation for checking purposes and as a consequence only certain corrective adjustments could be made in the sectoral projections. In the last few years synthetic estimates of national income, investment resources and other complex calculations have been made in the preliminary stages and have been used to correct sectoral projections. There is as yet no integral combination of preliminary complex calculations and sectoral projections in practice. As a result plans are not always fully balanced.

No account is taken (nor could it be before computers came into use) of the remote, indirect effects of particular economic measures or changes in plan indicators when planning is done on the basis of sectoral projections. This is another reason why the balance between all elements and parts of the macro-economic plan is not sufficiently fine.

Complex Planning on the Basis of a System of Models

The balanced, overall nature of macro-economic plans, like that of social and economic development plans for the country as a whole, is due to their forming an integral combination of general aims, major programmes and resources, and plans for all sectors and economic regions (sectoral and regional breakdown).

A macro-economic plan should not be regarded as the arithmetic total of individually compiled sectoral or regional plans since each sector, region, and republic is an organic part of a single macro-economic complex.

Thus the compilation of a unified macro-economic plan must be of a composite, overall nature. The plan should simultaneously cover all sectors and all regions of the country. Only when such an approach is adopted is it possible to ensure the integral combination of sectoral and regional breakdowns of the plan.

Inter-sectoral complex programmes designed to tackle major macro-economic problems need to be included in the long-term, perspective plan alongside the sectoral and regional breakdowns.

Planning must also be of an overall, balanced character when sections of the macro-economic plan are being objected.

Thus, for example, the building programme must be known when drawing up the production programme, since the latter must take into account the demand for building materials and construction equipment. It is not possible, moreover, to draw up a plan for the development of production correctly, if it is not known what increase in capacity is feasible as a result of capital investment. On the other hand, an investment plan cannot be made unless information is available about the need for an increment in production capacity during the planned period, i.e. unless a production programme already exists. The input-output table for production capacity should, in turn, take into account the building industry's own demand for such equipment. Clearly, what is needed is the simultaneous, complex compilation

of a production and building programme in the plan. A similar integral link exists between output trends, the size of the production workforce, and workers' income and consumption. In the final analysis, output trends determine the consumption of material goods and services, though on the other hand consumption influences the volume and structure of production.

What sequence should be followed in compiling a plan (what planning logic should be observed) and what system of planning estimates should be adopted at the present stage? Now that a powerful economic potential has already been established in the Soviet Union, society's social needs should become the starting point for planning rather than particular output targets for the most important types of producer goods.

The logic of scientific planning requires that the main parameters and general outlines of the economic development plan should be decided at a preliminary stage so that more detailed planning can then be carried out for all branches of production. At the same time the synthetic planning indicators and general outlines of the plan can be made more precise in the final stage by generalising the detailed projections for different sectors and regions. Consequently, from the general to the particular and concrete, from the particular to the general—such is the logic of complex macro-economic planning due to the unity and interdependence of all parts of the economy.

Complex economic planning requires a whole series of interconnected economic-mathematical models including macromodels of economic development and sectoral input-output tables, models of optimal sectoral plans, and models of optimal enterprise plans.

The conditions are already ripe for adopting the following series of economic-mathematical models in planning practice:

I. macromodels of economic development;
II. inter-sectoral models:
    1. an inter-sectoral, aggregate, dynamic model;
    2. detailed inter-sectoral models expressed in value terms, and input-output tables in physical plus value terms and in physical terms alone;

III. models of optimal plans for the development and location of production in the different sectors;
IV. models of optimal enterprise plans.

Synthetic indicators of economic development and efficiency and the relationship between extensive and intensive methods of economic growth are decided on the basis of macro-economic growth models. Macromodels enable one to calculate such basic indicators as the growth rates of the physical volume of national income, social product and final output, the ratio of the consumption and accumulation funds of departments I and II, of the productive and non-productive spheres, of investment resources, and of manpower resources, and the growth rates of labour productivity and return on assets. Several variant estimates are made for these macro-economic models.

These estimates are made from an analysis of resources, and opportunities for increasing the physical quantities and efficiency of the factors used as inputs. Indicators of final output, national income and non-productive consumption are then used for calculating inter-sectoral models.

The inter-sectoral tables are used to determine the structure of social production and the rates and proportions in the development of the different sectors, and to establish balanced volumes of output in all sectors covered by the inter-sectoral table. The use of inter-sectoral tables at all stages of compiling the plan helps ensure that it is properly balanced.

Final output includes the production of both consumer goods and equipment for extending production capacity and for replacing equipment no longer usable. Personal and public consumption both form an extremely important element in final output, which also includes non-productive accumulation—the building of housing, schools, hospitals, etc., any increase in reserves; and the foreign trade balance.

If a larger quantity of textiles, clothing, and machinery are made from a given quantity of cotton, synthetic fibres, and metal, this provides clear evidence of an improvement in production efficiency since the production of final, not intermediate output constitutes the social goal. Of most interest is the final outcome of social production which excludes any double-counting of goods produced. It is

important to know what society has produced excluding that part of output which it consumed in the course of production.

The starting point for planning the volume and structure of social production may be either total final output, the major, basic part of which is usable national income—consumption and accumulation, or simply consumption and non-productive accumulation (net final output). The latter is especially important for perspective planning. In fact, the production of equipment (part of fixed assets) is ultimately aimed at expanding the production of consumer goods. The scale of production of fixed assets (capital construction) therefore may and should be regarded as arising from the need to increase the production of consumer goods and the building of housing, schools, hospitals, etc., in the long term, as well as from the need to strengthen the country's defence capability.

Once an estimate has been made of final demand, work starts on the second major stage in compiling the planning inter-sectoral table, i.e. on drawing up the coefficients of direct inputs for the plan.

An inter-sectoral table enables one to find a single value for the volume and structure of the gross social product on the basis of the final output. If several variants of final output and input coefficients are worked out, several variants of the volume of gross product can there also be quickly obtained (by using computers).

The drawing of a planning inter-sectoral table amounts in essence to the compilation of a production programme on the basis of final demand and the standard inputs for all major branches of production; this programme forms the skeleton of the plan and serves as a guideline for detailed plan projections for different sectors and regions and then for enterprise plans. The more items there are in the table, the more detailed the indicators that can be obtained for this balanced, overall production programme for the economy.

It is an important matter of principle to determine the volume and structure of the social product and the volume and structure of productive investments on the basis of the share of national income allocated to consumption and

non-productive accumulation, and progressive indicators of the consumption of materials and assets. When that is done, the objectively necessary relation between the production of producer goods and consumer goods can be accurately estimated.

Some economists believe it is incorrect to take society's final consumption as the starting point for planning social production, since they think it means forgetting the basic tenet in Marxist economic theory on the primacy of production. This objection, however, is based on a misunderstanding. The most important elements in final output are consumption and accumulation. Consequently, final output satisfies not only consumption needs but the need to extend production as well. But even when the fund for consumption and non-productive accumulation forms the starting point, the necessary expansion of output of means of production (producer goods) is assured, since the production programme is based on standards of full expenditure of the objects of labour and full capital consumption for final output (see Ch. V). Consequently, it also fully meets society's need for raw materials, supplies, fuel, power, the production of machinery, and the building of mills and factories.

Thus, the plan provides an outline of growth in the output of means of production that is integrally related to the people's needs. Herein lies the very essence of socialist planning, for which an increase in the output of means of production is not an end in itself but a means of tackling the job of building communism. Planning that is based on two fundamental factors, final consumption and progressive standards, fully corresponds to the requirements of the basic economic law of socialism.

Two types of inter-sectoral model are being developed experimentally. At the initial stage an aggregate dynamic inter-sectoral model covering 18 industries is being developed. Given the volume and structure of non-productive consumption (consumption and non-productive accumulation), the volume of production and productive investment for the main sectors of material production and the most important branches of industry can be deduced from it. It is very important in this case to obtain several variants of the aggregate dynamic model differing in growth rates of non-

productive consumption and its various elements laid down in the model.

Static input-output models more detailed in the number of industries covered are being drawn up on the basis of the aggregate, dynamic inter-sectoral model. The inter-sectoral planning tables, expressed in value terms, cover over a hundred different industries.

An attempt has already been made to draw up tables in both physical and value terms which specifically include the economic ministries and thus ensure that they relate directly to the work of the appropriate organisations and approximate to the actual practice of compiling a plan. Physical planning input-output tables cover hundreds of different types of output, i.e. they provide a very detailed description of the structure of social production in physical quantities.

Intra-sectoral, inter-commodity tables for major sectors of the economy, enable a more detailed list of products to be reflected; using them it becomes possible to find a single value for the whole intra-sectoral circulation of commodities from the final output of the sector (which also includes the intermediate output going outside the sector). In some sectors it constitutes a substantial amount (for example, about two-fifths of total gross output in the chemical industry). The compilation of such tables enables the central planning bodies to concentrate their attention on fixing sectoral targets for final output of the sector only.

Parallel with the work on inter-sectoral tables, work needs to be done on compiling major complex programmes designed for varying periods of time, which can be incorporated in whole or in part in actual perspective economic development plans. A major programme includes a complex of more minor programmes, each of which must be analysed and evaluated from the point of view of its efficiency and the expenditure of resources needed to implement it. Next, the entire set of complex programmes should be examined in the light of the importance and sequence of goals corresponding to these programmes. Then on this basis the programmes are ranked in order of priority. The entire series of major complex programmes is integrated into long-term plan. At this stage the set of programmes are analysed

in comparison with available resources (in the light of resource constraints). The dovetailing of programmes and resources is done on an iterative basis.

The next stage is to carry out the calculations for sectoral plans for the development and location of production. Optimal sectoral plans can help in selecting the most economic variants for reconstructing and expanding existing enterprises and building new ones and for deciding the location of new factories, and in fixing the optimal scale and specialisation of newly constructed and reconstructed enterprises, the level of mechanisation and automation, etc.

The first attempt at compiling an optimal sectoral plan was made in 1961, when an outline long-term fuel table to 1980 was drawn up for the whole of the Soviet Union. The calculations revealed that it was possible in principle to reduce total adduced costs by 15 or 20 per cent. Later an optimal plan for the development and location of the cement industry was compiled for 1966-70 (and led to firm recommendations).

In accordance with the instructions of USSR State Planning Committee (Gosplan), work was carried out on optimising long-term plans for the development and location of industry for 1970-75 and 1980 for such sectors as power, rolled steel, pipes, chemical fertilisers, plastics, bearings, etc. In addition work continues on compiling optimal fuel and fuel-and-power tables. Thus, optimal planning methods are being mainly applied in industries primarily producing one product.

Work also continues on optimal plans for approximately 80 sectors and individual industries. The methods necessary for doing this kind of work have been worked out and confirmed in a whole number of ministries.

The minimum of aggregate adduced costs, including transport to the point of consumption, is taken as the criterion for optimal sectoral plans, once the volume of output is taken as given. A number of models also take into account the efficient use of output in the course of consumption.

The demand for a sector's output, broken down by type of goods and region, serves as important initial data for calculating an optimal sectoral plan. So far such data are calculated by traditional methods, but later on, the syste-

matic work being done on perspective inter-sectoral tables for the whole of the Soviet Union, will make it possible to use these tables to determine the data on the demand for a sector's output. In that way it will be possible to integrate macro-economic and optimal sectoral models.

All economic units (ministries, amalgamated enterprises, single enterprises, collective and state farms, research and planning organisations, etc.), as was noted at the 24th Congress, need to have five-year plans with annual targets, and their plans to be tied in with sectoral and macro-economic plans.

Sectoral plans and projections made by ministries and central administrative departments responsible for particular sectors are based on much fuller information about the demand for sectoral output (broken down in greater detail) and about their own production resources. This is even more true of production associations and enterprises. Enterprises operating on a cost accounting basis draw up their own optimal plans independently in accordance with the assignments they have been given, using very detailed information about demand, production capacities, etc.

The complex planning of a production programme for the entire economy is integrally connected with the drawing up of an inter-sectoral complex programme and with sectoral and factory planning. The order that should be followed in compiling a macro-economic plan is to start with synthetic and inter-sectoral models and then go on to complex programmes, sectoral projections and optimal plans for enterprises which give life to the sectoral framework of the plan and correct the initial parameters.

It should be noted that plans for capital construction, utilisation of manpower, improvement in living standards (similarly at first in the form of general and then more concrete indicators) are drawn up at the same time as a production programme. In this way it is possible to make certain that the sectoral version of the plan corresponds with the functional version.

Balanced planning entails drawing up a plan on an iterative basis as a result of which particular indicators are successively revised on the basis of general ones and the general indicators on the basis of particular ones. Now that

economic-mathematical models and computers have been brought into use, plan indicators can be successively corrected in both directions in a comparatively short space of time.

The use of inter-sectoral models and computers ensures that plans are complex, multi-variant, and finely balanced. In other words, inter-sectoral planning models enable one to obtain several properly balanced plan variants within a short period and then to select the most effective one. At the same time neither static nor dynamic inter-sectoral models are fully able to solve the problems of raising efficiency. The mutual correction of macro-economic input-output indicators on the basis of optimal sectoral indicators means that elements of optimality are introduced into the whole system of planning estimates; but this does not ensure that the optimal variant of the plan in the strict sense is selected.

Optimal Macro-Economic Planning

It is natural for planning bodies to try and find the best, optimal variant of a plan at all stages of socialist development. However, in view of the fact that different variants are sorted out empirically, it is not possible to discover the really optimal plan in the strict mathematical meaning of this word. The problem of optimal planning ensuring maximum efficiency of social production in given concrete conditions and the most advantageous proportions in the economy has therefore arisen.

At present the concept of the optimal planning of a socialist economy is at the development stage and several approaches to the problem exist. The basic propositions in the theory of optimal planning are as follows:

1. a socialist economy is regarded as a consciously optimised system based on social ownership of the means of production;

2. there is a single criterion of optimum character under socialism, which can be described as the objective drive of socialist society to obtain maximum satisfaction of its members' needs and which makes it possible to choose the best path of economic development;

3. it is recognised that the availability to society, at any given moment or finite period of time, of manpower and natural resources, production capacities, and scientific and technical knowledge is limited;

4. account is taken of the broad substitutability of technological means of using resources in production and final consumption;

5. a socialist economy is regarded as a complex system comprising a great many diverse elements, which presupposes a hierarchial, multi-level structure of the economy and of management;

6. it is assumed that there must be agreement between local interests and the aims of economic development. In other words, it is necessary to ensure that economic units at all levels, and those working in them, have an economic interest in tackling the jobs facing the economy as a whole. Consequently, it is necessary to evaluate the operational efficiency of different parts of the economy in accordance with the optimality criterion adopted for the economy as a whole.

It is possible in theory to secure the strict optimisation of macro-economic plans by applying mathematical programming methods. Price and resource estimates occupy a special place in optimal planning theory. Optimal prices, i.e. prices formed in calculating an optimal plan, possess some important properties: they establish the conditions for estimating in the plan the opportunity cost or advantageousness of producing substitute goods; assess supply and demand; and stimulate the most efficient production.

The chief merit of an optimal plan is that it combines proportionality (balance) with selection of the most effective plan variant. In theory, there can be no better plan from the point of view of the criterion selected.

Nevertheless, many difficulties of both a theoretical and a practical nature have to be overcome in applying optimal planning. They include: firstly, the decision regarding the criterion for the macro-economic plan; secondly, the problem concerning the scale of the optimal planning task and questions of aggregation and disaggregation; and thirdly, the problem of which standards should be adopted as a basis.

The greatest difficulties arise in deciding the optimality criterion for the whole economic development plan. As noted above, a whole series of social, economic, and political planning aims have to be determined on the basis of thorough-going qualitative and quantitative analysis. Decision-making in this case is mainly a matter of economic policy, though an assumption about the existence of a single objective function in the macro-economic plan and about the possibility of compiling such a plan as the solution of an extremal task underpins all optimal macro-economic planning systems.

Let us now look at four of the macro-economic criteria of optimal resource allocation that have been put forward and discussed in the Soviet economic literature:

1. The attainment of minimum input of social labour for a given volume and structure of final output (gross final output) or consumption and non-productive accumulation fund (net final output); in practice the criterion of maximisation of the social productivity of labour is equivalent to this, assuming as it does that the volume and structure of final output are given outside the optimal plan; what remains unknown is whether the volume and structure of final output will be secured by the available resources, the question of "what to produce" being largely decided outside the plan.

2. The attainment of the maximum physical volume of national income, a criterion that does not take account of the fact that socialist society is interested not in maximum growth rates but in optimum ones, which are determined by the optimal relation between the consumption and accumulation funds; maximising of growth of the physical volume of national income over a long period of time in fact means maximising the proportion of productive accumulation (above all when the effectiveness of accumulation is unchanged); this criterion may channel economic development into "production for production's sake".

3. The criterion of maximising consumption and non-productive accumulation throughout the planning period; it also suffers from a number of shortcomings; some needs, in fact an ever-increasing part of them, being satisfied by non-material goods and services that do not form part of

the national income (in our understanding of it), while shortening of the working day, improving and easing working conditions through technological advance (i.e. through productive accumulation) are also important indicators of rising living standards; it is important to note that the amount of accumulation, i.e. the extent to which future needs will be satisfied, is not a matter of indifference to the members of a socialist society.

These shortcomings are even more evident in the criteria of maximising the physical volume of gross and final output.

4. The criterion of maximising the value of the integral social utility of consumer goods and services, i.e. the criterion of maximising people's welfare (including non-productive services and taking the leisure factor in account) is free of all these shortcomings in the opinion of some advocates of optimal planning theory; but it nevertheless has serious shortcomings, the principal one being that no means of measuring consumer goods and services in terms of their social utility have yet been worked out methodologically or tried out experimentally; nor has an adequate answer yet been found to the problem of constructing weighted functions reducing the social utility of goods and services to a single moment of time, or of weighted functions for different social and income groups, etc.

Given the available resources, it is essential over the long term to ensure (a) a maximum volume and structure of the consumption fund corresponding to needs, and of the fund of non-productive accumulation and non-material services; (b) an improvement in working conditions, and with it high rates of further development of industry in the post-planning period; and (c) the strengthening of defence capacity. How to express all that in a single criterion is still an unresolved question; and since it has not yet been possible to establish a single objective function, many people believe it possible to be content with a less strict criterion of efficiency at the level of the macro-economic plan.

Some economists suggest drawing up so-called effective plans of economic development, each variant of which represents a balanced plan reflecting a particular trend in economic policy. In each such variant an optimum is attained for one of the goals set before the plan, while the remaining aims

are given in the form of constraints. Consequently, using this approach the most effective plan is calculated in accordance with a definite aspect of economic policy with the help of mathematical programming methods. However this is still not an optimal plan which by means of a single criterion would embrace all the aims of economic and social development.

The compilation of this kind of sub-optimising plan presents a certain interest. However it is still unclear on what basis any one of these aims is picked out. A criterion of vectoral optimisation due to a multiplicity of planning goals and thus criteria has been suggested in this connection. A plan which cannot be further improved in terms of any of these criteria without being worsened in respect of another criterion is efficient.

The methodology of optimal macro-economic planning is the subject of intense research at present. This research is important because it is furnishing the guidelines that will determine the main direction in which planning should be improved. There is no doubt, and never has been, of the possibilities of optimal planning for solving partial tasks. Tasks aimed at ensuring the optimal loading of equipment, optimal utilisation of raw materials, optimum freight hauls, the optimum size of enterprises, an optimal plan for the location of industry, etc., have all been successfully tackled. At present, it should be emphasised, there are also growing opportunities for introducing elements of optimisation into macro-economic planning.

CHAPTER III

THE ORGANISATION OF ECONOMIC PLANNING

1. GENERAL PRINCIPLES

In the Soviet Union economic affairs are decided and directed by a state economic plan, on the basis of which the macro-economic plans for the various Union and autonomous republics and plans for ecnomic and cultural development in the various administrative areas (territories, regions, areas, districts and cities) are compiled.

By the Soviet Constitution the USSR Supreme Soviet is responsible for the general direction of planning for the country as a whole, Republican Supreme Soviets are responsible in Union and autonomous republics, and the respective local government authorities in the different administrative areas (in the form of the Soviet of Working People's Deputies).

Draft plans are drawn up and submitted for approval to the supreme state authorities of the USSR, and of Union and autonomous republics by the highest executive bodies, the USSR Council of Ministers and the Councils of Ministers of the Union and autonomous republics. In the lower administrative areas draft plans are drawn up and submitted for approval to the corresponding Soviet by its executive committee.

On the basis of these economic plans for the Soviet Union as a whole, and for the Union and autonomous republics, the respective ministries and government departments draw up plans for each sector and allocate assignments to the production associations, enterprises, and organisations directly subordinate to them.

Planning of the economy is implemented in the Soviet Union by means of perspective and current plans with the leading role being awarded to the former. Work is being done at present on compiling a long-term plan for 1975-90. The long-term plan will be specified in greater detail in medium-term plans covering five-year periods, while these will be broken down into current plans covering a period of a year. Current planning is based on perspective planning.

Perspective and current planning is founded on a combination of sectoral and regional planning with a view to securing the proportional and balanced functioning of the single macro-economic complex and the complex and most effective use of resources in Union republics and economic regions.

There are two aspects to such a combination of sectoral and regional planning. On the one hand, plans drawn up for Union republics and economic regions are compiled for different sectors of the economy, ministries and ministerial departments. On the other hand, plans drawn up for different sectors, ministries and ministerial departments are compiled for different Union republics and economic regions.

The Leninist principle of democratic centralism which entails a combination of centralised planning and the independence of local authorities, production associations and enterprises underpins the organisation of Soviet planning.

The state plan for the economic development of the Soviet Union, which establishes the rates and proportions of economic development, the volume and structure of production, capital investments, the location of productive forces, etc. is compiled with the participation of Union republics, ministries and ministerial departments in which large numbers of working people join. Similar plans for the Union republics, concretising the assignments in the single economic plan, are drawn up in conjunction with the autonomous republics and various local government areas.

Centralised plans drawn up and approved at all levels of economic management on a democratic basis have the force of directives. A plan, approved by an appropriate government body in the form of a directive whose implementation is binding, is used in combination with the economic stimulation of those who are immediately responsible for putting

it into effect and with the use of economic levels—profit, prices, bonuses, credit, interest rates, etc.

Production associations, enterprises and organisations draw up their own five-year and annual plans on the basis of the assignment they have been set by higher authorities.

An extremely important task of planning organised on the principle of democratic centralism is to ensure the managerial independence of socialist enterprises. Given commodity-money relations, enterprises conduct their operations on the basis of full financial autonomy (with profit and loss accounting) which heightens their interest in raising the efficiency of social production.

2. PLANNING AND MANAGEMENT BODIES

Economic planning work is done in the Soviet Union by the appropriate governmental bodies both through a network of special planning bodies and through a network of managerial bodies responsible for different sectors of the economy and industries or for different aspects of the economy (finance, prices, science, standardisation measures, supplies, accounting, statistics, etc.)—by ministries, ministerial departments, committees, etc.

The economic planning bodies are as follows:

(1) the State Planning Committee (USSR Gosplan) of the USSR Council of Ministers;

(2) the state planning committees (Gosplans) of the Councils of Ministers of Union republics, which have a dual subordination: (a) to the appropriate Council of Ministers of the Union republic and (b) to USSR Gosplan;

(3) the state planning commissions of the Councils of Ministers of autonomous republics, which also have a dual subordination: (a) to the appropriate Council of Ministers of the autonomous republic and (b) to the Union republican Gosplan;

(4) the planning commissions of the executive committees of the Soviets of the various local government areas again with a dual subordination: (a) to the executive committee of the relevant Soviet and (b) to the Union (or autonomous) republican Gosplan,

The administrative bodies concerned with economic direction and control are:

(1) all-Union and Union republican committees, and USSR ministries and ministerial departments;

(2) Union republican committees, and the ministries and departments of the Union republic with dual subordination to the republican Council of Ministers and to the appropriate USSR ministries and departments;

(3) the republican ministries and departments of Union republics;

(4) the ministries and departments of autonomous republics;

(5) the administrative departments of the executive committees of territorial, regional, district and city Soviets of Working People's Deputies.

Ministries and government departments and committees have structural sub-divisions in the form of planning departments, which do the work on compiling plans for their economic activities. In the same way there are structural subdivisions in the organisations and enterprises subordinate to these ministries, departments, and committees, which are concerned with compiling plans for them.

A USSR ministry (or department) is the central state management body responsible for the economic sector or industry entrusted to it. Committees that have production enterprises attached to them manage them in the same way as a ministry (department), and can therefore be ranked as ministries (departments).

The bodies responsible for planning the economy can be grouped as follows:

(a) all-Union bodies—USSR Gosplan, all-Union and Union republican committees, ministries, and departments of the USSR;

(b) Union republican bodies—the Gosplans of Union republics, Union republican and republican committees, ministries, and departments;

(c) autonomous republican bodies—the Gosplans, and ministries and departments of autonomous republics;

(d) local bodies—the planning commissions of territories, regions, etc., and the boards and departments of the executive committees of the local Soviets;

(e) production associations, enterprises, and organisations of all-Union, republican, or local importance.

All these planning and management bodies constitute a single system of planning bodies united by the nation-wide planning centre—USSR Gosplan, which works under the general direction of the Central Committee of the Communist Party and the Soviet Government.

The State Planning Committee of the USSR

The State Planning Committee of the USSR Council of Ministers (USSR Gosplan) occupies a particularly important position in the system of planned management.

Its main job is to draft perspective and annual plans which will secure the proportional development of the economy and the steady growth and increased efficiency of social production with a view to creating the material and technical basis for communism, steadily improving living standards and strengthening the country's defence capability, in accordance with the Programme of the Communist Party, directives issued by the Party's Central Committee, and decisions taken by the USSR Council of Ministers.

There are both consolidated and sectoral departments inside USSR Gosplan. The chief of these is the consolidated department of the macro-economic plan which coordinates the work of all Gosplan's departments under the supervision of its collegium and chairman, and combines all the departmental drafts into a single draft plan for the economy. Other consolidated departments exist alongside it: for regional planning and the distribution of productive forces; for physical input-output tables and plans for the distribution of output; for capital investments; for labour productivity and wages, etc.

Plans for developing particular sectors of the economy are compiled by the appropriate sectoral departments. Matters relating to the supply of materials and technical equipment and to inter-sectoral deliveries of output are decided by the departments that deal with physical input-output balances and plans for the distribution of output. Plans for developing the non-productive sphere are drawn up by the departments for culture, education, health, trade, etc.

USSR Gosplan includes the State Appraisal Commission, which examines general schemes for the development of industries and the siting of enterprises, for the specialisation and overall balanced development of economic regions, and the drafts of major integrated programmes.

There is also an Interdepartmental Commission, which guides the work on studying and generalising experience of application of the new system of planning and economic stimulation and on improving it.

USSR Gosplan's Chief Computing Centre calculates the plan indicators, using electronic computers. Gosplan also has an Economic Research Institute, a Planning and Standards Research Institute, a Research Institute for Complex Transport Problems, and a Council for Study of the Productive Forces of the Soviet Union.

The Central Statistical Board of the USSR provides Gosplan with necessary scientifically processed data on plan fulfilment, available resources, existing economic proportions, and reserves for future growth and improving production efficiency.

In the work of planning a whole series of complex problems concerning economic development, USSR Gosplan relies on various State Committees: for Science and Technology; for the Construction Industry (Gosstroy); for Prices; for Labour and Wages; for Supply of Materials and Technical Equipment, etc.

USSR Gosplan influences the formulation of plans by ministries, departments, and Union republics, examining them from an all-Union point of view and so helping to prevent a narrowly-departmental or parochial solution of economic questions.

Much attention was paid at the 25th Congress to improving the work of USSR Gosplan. Taking the new tasks posed in the draft on the main lines of economic development, USSR Gosplan should pay more attention to working out the basic proportions of economic development; to the balancing of plans, the compilation of complex programmes, the resolution of problems of economic regionalisation and location of the productive forces; and to determining ways of improv-

ing the efficiency of social production. To do that, and in order to cope with this work in a far-reaching and creative way, Gosplan needs to be freed of many current problems that could be dealt with by USSR Gossnab, ministries, and other organisations.

USSR Ministries and Departments

USSR ministries and departments study demand in the economy for the output of their sectors, plan their development region by region in accordance with the tasks of developing the economy as a whole and the tasks confronting the Union republican economies and the economic regions with regard to the specialisation and combination of production.

Ministries are responsible for the current position and further development of their industries, for the quality of output at a minimum expenditure of social labour, and for the fullest possible satisfaction of the country's needs or all types of the output of that sector.

USSR ministries and departments prepare drafts of perspective and current plans for the development of their sectors with the participation of the bodies subordinate to them, following the directives of the Communist Party and Government using forms and indicators confirmed by USSR Gosplan.

The economic and planning boards of ministries organise the drafting of perspective plans in all sub-divisions of the ministry and in the various institutions and enterprises belonging to that sector. In particular they draw up the methodological instructions, forms, and indicators to be used in compiling development plans for sub-sectors and the technical-industrial-financial plans of enterprises.

Union republican ministries and departments draw up perspective and current plans for the development of the sectors of the economy and industries for which they are responsible in conjunction with the corresponding ministries and departments of the Union republics. All-Union ministries and departments present their drafts of perspective and current plans to the Councils of Ministers of the Union

republics, consider the latter's proposals, and present final conclusions to the USSR Council of Ministers with a copy to USSR Gosplan.

All-Union and Union republican ministries and USSR departments compile the drafts of perspective and current plans for the various sectors broken down by Union republic and economic region.

The State Planning Committees of Union Republics

The role of the State Planning Committees (Gosplans) of Union republics in planning the integrated development of their republics and economic regions has grown considerably now that the economy is directed on the sectoral principle. They draft perspective and current plans for the economic development of the republic as a whole, independently of departmental subordinations, and in addition plans for that part of the economy for which the republic is directly responsible. Plans are drafted by the republican Gosplans jointly with the ministries and departments of the republic, and the planning commission of autonomous republics, territories, and regions (if any) in collaboration with the interested USSR ministries and departments.

The Gosplan of a Union republic vets the planning drafts prepared by USSR ministries and departments for enterprises and organisations of all-Union importance, submits its own proposals for amendments to the appropriate higher authorities, and compiles a plan for the overall, balanced economic development and distribution of the productive forces for the autonomous republics, territories, regions, and economic regions (if any) located in their republics.

One of its main tasks is to check the various schemes for the development and location of industry of a particular sector prepared by all-Union and Union republican ministries and departments and to look at the assignments regarding projects for new enterprises or the reconstruction and expansion of existing ones in the republic and present proposals concerning them to the appropriate higher authority.

The draft plans of a Union republic prepared by its Gosplans are studied by the republic's Council of Ministers and submitted by it for approval to the USSR Council of

Ministers, with a copy to USSR Gosplan. Once the macro-economic plan for the whole of the Soviet Union has been approved, the draft for the Union republic is amended and submitted by the Council of Ministers for adoption by the Supreme Soviet of the republic. Developed plans are compiled by the ministries and departments in the republic and the respective enterprises on the basis of the plan adopted for the Union republic.

The State Planning Committees of Autonomous Republics; Local Planning Bodies

The Gosplans of autonomous republics and the planning commissions of territories, regions, districts and towns draw up plans for integrated economic development of their own particular area and dovetail them in with the plans for those areas of economic activity on their territory that come under all-Union and republican ministries. They study the draft plans of USSR and Union republican ministries and departments for enterprises for which these authorities are responsible that are sited in their territory and prepare their own proposals for presentation to the appropriate higher authorities; they also present their conclusions regarding district planning schemes, urban development plans, and projects for the planning and building of new towns and urban areas.

The Gosplans of autonomous republics and local planning commissions coordinate the planning activities of all local management bodies and prepare drafts of the following plans:

(1) perspective and current economic plans and plans for the construction of social and cultural facilities in the respective republics and local government areas;

(2) a production plan for local building materials;

(3) a fuel plan and a plan for the production of consumer, cultural and leisure, and domestic appliance goods by local industrial enterprises and enterprises coming under the jurisdiction of USSR and Union republican ministries and departments;

(4) aggregate plans for the building of housing, and municipal services;

(5) plans for state purchases of agricultural produce;

(6) manpower tables on the employment of manpower;

(7) balance sheets of personal-sector money income and expenditure;

(8) plans for developing trade broken down by towns and districts.

Town and district planning commissions draw up perspective and current plans for developing their own particular areas for the construction of social and cultural amenities; they lay down assignments for enterprises, institutions and organisations under their control and make plans for their location.

They also have the task of examining plans for the location and development of local industrial enterprises, the provision of services, trade, and public catering facilities, and cultural, educational and health organisations and institutions which come under all-Union or Union republican control and make their suggestions to the higher authorities through the appropriate local executive committees.

They vet draft plans for enterprises and organisations in charge of the construction of social and cultural facilities and for the production of consumer goods and local building materials within their area and compile the necessary aggregate planning indicators for inclusion in the plan for economic, social and cultural development of the town or district.

Draft plans for autonomous republics, territories, regions, and areas are vetted by the Councils of Ministers of the autonomous republics and by regional or territorial executive committees and submitted by them to the Council of Ministers of the Union republic concerned with a copy to the Union republican Gosplan. The draft plans of towns and districts are examined by the local executive committees and submitted by them to the appropriate higher regional or territorial executive committee with a copy to the higher planning commission, so that they can be coordinated with, and taken into account in, the plans adopted by the higher governmental authorities at Union (or autonomous) republican level, etc. They are then submitted for approval to the Supreme Soviets of the autonomous republic or to the appropriate Soviet of Working People's Deputies.

3. THE SYSTEM OF PLANS

USSR Gosplan draws up the state plan for the development of the whole economy and fixes the assignments for USSR ministries and departments and for Union republics in the form of aggregate indicators. USSR ministries and departments compile more detailed centralised plans for the development of pirticular economic sectors and industries. The Gosplans of Union republics compile plans for the complex development of the republic's economy as a whole and plans for the areas of economic activity under republican control which contain assignments for the various ministries, autonomous republics, regions, etc., and serve as the starting point for the drafting of similar plans by Union republican ministries, the Gosplans and ministries of autonomous republics, and the planning commissions, boards, and departments of local authorities.

Thus, the following planning system operates at the present time:

(1) the state plan for the development of the Soviet economy;

(2) plans drawn up by USSR ministries and departments for their economic sectors and industries;

(3) plans compiled in the Union republic regarding the republic's economy as a whole and those areas of economic activity under republican control;

(4) plans drawn up by Union republican ministries and departments for the sectors for which they are responsible;

(5) the plans of autonomous republics regarding their economy as a whole and those areas of economic activity directly in their control;

(6) the plans drawn up by the ministries and departments of autonomous republics for their own sectors;

(7) the economic plans of territories, regions, towns, etc.;

(8) the plans drawn up by boards (departments) of local executive committees;

(9) the plans of amalgamated enterprises, single enterprises, organisations, and institutions.

All these plans—the united state plan of the USSR, the plans compiled by the USSR ministries and departments, the plans made by Union and autonomous republics and all the other areas of the economy—are closely interconnected and form a single system. This single planning system ensures centralised planned management of the economy and the development of initiative on the part of local bodies together with the economic independence of enterprises.

Structure of the Macro-Economic Plan

The macro-economic plan of the USSR determines the development of the economy by sector and region (by Union republic and economic region), and for each Union republic by sector. It comprises the following sections:

aggregate economic indicators describing the development of the economy as a whole;

the main indices for the development of science and technology; indices on nature conservation and the rational exploitation of resources;

the main assignments for production of industrial output;

indicators of agricultural and forestry development;

the targets for developing transport and communications;

assignments in regard to capital construction;

indicators of the development of geological prospecting and exploration;

indicators on employment and the training and deployment of personnel;

targets relating to profits, and costs of production and distribution;

targets relating to the expansion of trade and public catering;

targets relating to the development of household and other services, amenities, and public utilities;

targets relating to education, culture, and health;

aggregate targets for improving the standard of living;

targets for developing the economies and cultures of Union republics;

indicators of the development of foreign trade relations;

physical input-output tables for the main types of output.

The consolidated section contains synthetic indicators showing the development of the economy as a whole—the growth rates of aggregate social product; the ratio between

departments I and II of social production; national income and its allocaion between accumulation and consumption; the growth rates of group A and group B industrial output, agriculture, etc.

The growth of social production, the solution of social problems and the systematic improvement of living standards depend to a great extent on the development of science and technology. One of the most important sections of the plan, therefore, is the section on the development of science and technology. It includes assignments for mastering the production of new types of industrial output, for making rapid use of the latest scientific and technological discoveries, applying advanced technology, mechanisation and automation in production, setting up automated control systems, etc. These asignments are fixed by indicators in all sections of the plan.

The production programme for industry and agriculture, each of which has its own section, forms the backbone of the plan. There is an additional section which lays down assignments for developing transport and communications and related tasks concerning the growth of output and development of inter-sectoral linkages in the economy.

Building of the material and technical base of communism calls for vast investment in the economy. It is therefore exceptionally important to commission new enterprises and reconstruct existing ones on the basis of the latest advances of science and technology. Work on plans for capital construction includes the planning of investments, of project and experimental research and the work of project-planning organisations, as well as of the construction industry and the expansion of capacity in building and installation organisations. This section is followed by one on the planning prospecting and exploration.

A special section of the plan is devoted to questions of employment and vocational training, the use of manpower resources and the raising of labour productivity in different sectors of the economy and industry, the regulation of wages, bonus schemes, and the fixing and correct allocation of the total wage bill.

There can be no improvement in the efficiency of social production unless profits and profitability are correctly

planned, production and distribution costs reduced, and the system of economic stimulation in production improved.

A whole number of sections in the plan deal with questions relating to improving the standard of living. Besides a section that specially sets indicators for the rise of living standards and the structure of satisfying people's needs broken down by town and country, social groups, etc., there are special sections dealing with the development of trade, services and amenities, municipal services and public utilities, education, culture, and health.

There is a special section in the plan for the planning of foreign economic ties.

Finally, the compiling of the macro-economic plan is concluded by input-output tables and plans for the allocation of key types of output, the supply of materials and equipment for industry and capital construction, culture and the health service, etc., with a plan for building all-Union stocks, and for inter-republican deliveries from these stockpiles, and a plan for allocating output to state stockpiles.

All sections of the plan are relayed in the form of overall assignments for complex economic development to each Union republic which then draws up its own plans as a continuation and development of the macro-economic plan.

The structure of the plan is such as to require further specification of its targets in the plans drawn up not only by USSR ministries and departments but also by the Union republics, and in the case of the latters' plans—in plans compiled by autonomous republics and all local government areas.

Targets which, if reached, will ensure an advance in all sectors of the economy, an increase in the efficiency of social production, high growth rates of national income, an improvement in macro-economic proportions, and the fullest possible satisfaction of society's needs form the basic content of a macro-economic plan.

The whole group of assignments for making the best possible use of fixed assets and production capacities, for accelerating growth of labour productivity in all sectors of the economy, for correct utilisation of the country's manpower resources and for supplying the economy with skilled workers

and technically qualified specialists occupies a central position of the macro-economic plan.

The Soviet Union's economic plan includes assignments for ensuring the complex development of Union republics and economic regions. The set of assignments dealing with the specialisation and cooperation of production, and improving inter-republican, inter-regional, and inter-sectoral connections holds a special place in the plan.

The plan includes assignments for increasing the profitability of production, applying validated standards of expenditure of raw materials, fuel, power, industrial materials, and labour; for reducing production and distribution costs; and for increasing profits and improving the use of financial funds.

The whole purpose of socialist extended reproduction is to ensure the continual growth of materials and cultural living standards. The plans provide for a steady increase in real personal income; increased production of consumer goods; an improvement in the quality and range of such goods; an expansion of output in sectors of material production and the services sector; and an improvement in cultural and health facilities.

The expansion of international economic cooperation and foreign economic relations and raising of the effectiveness of foreign trade occupy an important place in the plan. The set of assignments for developing cooperation with socialist countries has a special position in the plan of foreign economic relations. The extension of such relations with developing countries is dealt with in the macro-economic plans. In accord with the policy of peaceful coexistence of states with different social systems, provision is also made in the plan for developing trade with all countries on mutually advantageous terms.

The Structure of Planning Indicators

Planning assignments are given in the form of magnitudes of economic development which must be reached by the end of the planned period. They are expressed in absolute values (volume of output, average monthly earnings, per

capita real income, level of consumption, etc.) and in relative terms (growth percentage, increments). Indicators in each section of the plan for a particular sector of the economy have their own special features depending on the specific nature of that sector (industry, agriculture, transport, education, etc.) and take a more general form when incorporated into the synthetic indicators in the consolidated section of the plan. In this section indicators from all the differet sectoral sections are coordinated and constitute a single system of indicators for the macro-economic plan in its entirety.

Production plan targets are established by both value and physical indicators. The volume of output, national income and its allocation between consumption and accumulation, the growth rates and proportions of the economy, the productivity of social labour, investments in the economy, the movement of fixed production assets, the return on assets, the economic effectiveness of capital investment and industry, profits, profitability, etc., are all planned in value terms. All targets regarding the production of actual types of output are planned in physical quantities, while some, such as those regarding productivity in different industries (for example, in coal-mining) or regarding trade turnover and the supply of goods, are planned in both value and physical terms.

Planning indicators expressed in terms of value form the basis for self-reliance and financially autonomous relations between amalgamations, enterprises, and organisations, the basis of all the activity of management bodies as regards raising the economic efficiency of production. The planning of prices reflecting as accurately as possible the socially necessary outlays on the production of commodities is decisive in increasing the role of value indicators in the plan, as they are calculated in the current prices used in actual transactions and in constant (comparable) prices for measuring the physical volume of production and consumption.

A large number of accounting indicators are calculated in the course of planning; for example, standard expenditure on production; standard output per unit of raw material; unit capital investment, etc. Accounting indicators are needed to substantiate the assignments laid down in the plan. Amalgamations, enterprises, and organisations, which

have been given the incentives to raise production efficiency and to adopt taut plans, use them in order to work out measures for mobilising reserves to increase production and productivity by reducing outlays, increasing output, and improving quality.

On the basis of the macro-economic plan for the Soviet Union and the plans for Union republics, autonomous republics, territories, regions, etc., the appropriate management bodies lay down the following industrial planning indicators for their enterprises, etc.:

total volume of realised output;

production of the main types of output in physical quantities;

total profits and profitability (in relation to fixed production assets and standardised circulating assets);

budgetary payments and allocations;

total wage fund;

volume of centralised capital investment, including volume of building and installation work;

the commissioning of fixed assets and production capacities financed from centralised capital investment;

assignments for mastering new technological processesand complex mechanisation and automation of special importance to the development of an industry;

volume of deliveries of raw materials, industrial materials, supplies, and equipment to customers, allocated by higher organisations.

Each sector has additionally its own sub-system of indicators, adopted for its enterprises.

In the services sector there is a sub-system of planning indicators and assignments set for the various enterprises and institutions operating in this sector; these in turn are divided between free and chargeable productive and non-productive services.

The system of plan indices and indicators is not immutable but is being constantly added to and improved. It is especially important, for example, for production amalgamations and enterprises in light industry to allow for the changing requirements of the market. Centralised planning of the schedule of articles paralysed their intiative in renovating the range of goods and product-mix so as they cover effective

demand more fully. Since 1975 they have been given the right to determine the volume of production themselves in physical terms (except for items for children and fabrics) on the basis of orders from trade organisations and agreements with suppliers. In addition all-Union and republican ministries of light industry are permitted to amend works plans for sales (within a 2 per cent volume limit) if the change in range of production calls for it.

Changes have been made in the composition of the planning indicators for the gas industry. From 1976 volume of sales and profit will no longer be confirmed for gas-marketing undertakings, and these indices will be calculated. Their work will be appraised in accordance with their uninterrupted supply of consumers, breakdown-free operation, and observance of estimated operating expenses.

The *Guidelines for the Development of the National Economy of the USSR for 1976-1980* call for: "To improve the system of plan indicators and make them more effective in raising the technological standards of production, improving the quality of output, accelerating the rise of labour productivity and saving material and financial resources."[1]

Special attention needs to be paid in the plan to major problems of social-economic, technical, and scientific development, to inter-sectoral and inter-regional problems, and questions regarding the specialisation, cooperation and combination of production on the basis of all-round intensification.

4. THE ORDER OF WORK ON A MACRO-ECONOMIC PLAN

The compilation of perspective five-year plans with an annual breakdown of assignments over the planned period is, as already noted, the basic form of Soviet planning. The targets of a five-year plan are laid down for the various USSR ministries (or departments) and Union republics, which pass them down in the established way to amalgamations, enterprises, and organisations.

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[1] *Guidelines for the Development of the National Economy of the USSR for 1976-1980*, p. 23.

Drafting the Main Lines of Development of the Economy

Work on compiling a perspective plan begins with an analysis of the current economic situation and an evaluation of how successfully the current five-year plan is being implemented. Next the main economic rates and proportions and the principal tasks and direction of technological and economic development in different sectors of the economy are decided; the basic trends of scientific and technological development are ascertained and the main scientific technical and economic, and social problems that have to be tackled in the plan period are assessed (see Chs. II, IV).

Ministries, departments and the Councils of Ministers of Union republics draw up proposals for the main lines of development for the sectors of the economy and the economies of the republics, special attention being paid in doing so to preliminary calculations for indicators of scientific and technological progress. The Council of Ministers of Union republics also comment of the technological and economic reports and proposals of the all-Union and Union republican bodies. At the same time the State Committee of the USSR Council of Ministers for Science and Technology, and the USSR Academy of Sciences, together with interested USSR ministries and departments and the Councils of Ministers of Union republics, work out the main lines of development for science and technology and their application to the economy.

The USSR Ministry of Geology, the State Forestry Committee of the USSR Council of Ministers, the USSR Ministry of Agriculture, the USSR Ministry of Power and Electrification, and the USSR Ministry of Amelioration and Water Supplies draw up proposals on the use of natural resources in each economic region.

Research and design and planning institutes working on problems of price formation, scientific and technological progress, the efficiency of social production, and so on, are also fully involved in this work.

All the proposals of ministries, departments and Union republics, and of scientific institutions are submitted to USSR Gosplan, which uses them to draft the main lines of development in the economy over the long term, and in turn presents it for consideration to the Soviet Government.

As soon as the Central Committee of the CPSU and the USSR Council of Ministers have approved the main lines of development for the economy over the long term, USSR Gosplan, the USSR ministries and departments, and the Councils of Ministers of Union republics fix the assignments for the technological and economic development of the various groups and branches of industry and of the various Union republics and economic regions over the long term following the same procedure as with draft of the main lines of development.

The Central Committee and the USSR Council of Ministers then consider these draft assignments and any differences of opinion, among the various ministries, departments, and Union republics, and decide them in the same way as with the draft of the main lines of development.

After USSR Gosplan has studied the proposals made by the various ministries, departments, and scientific institutions, it prepares a draft of the main lines for the five-year plan, and of the principal growth indicators, which it then presents to the Central Committee and the USSR Council of Ministers. These bodies study the draft and make any necessary amendments and changes. Then the draft is published in the press and broad public discussion is organised at Communist Party congresses in the Union republics, at Party conferences and meetings of Party organisations (branches), and meetings of workers, employees, and collective farmers. The Central Committee reports on the draft and on the results of pre-Congress discussion to the Congress of the CPSU, which discusses the report on the draft and the amendments made to it during the pre-Congress discussions, and approves the main lines for the perspective plan. The plan is then drawn up on their basis.

Drafting the Perspective Plan

The long-term plan is drawn up on behalf of the Central Committee of the CPSU and of the USSR Council of Ministers by USSR Gosplan in conjunction with USSR ministries

and departments, the Councils of Ministers of Union republics, the USSR Academy of Sciences, and the all-Union Central Council of Trade Unions. The USSR ministries and departments and the Councils of Ministers compile their own draft plans for the different sectors and Union republics in collaboration with lower-level bodies, and with production units. Long-term plans covering ten or fifteen years broken down into five-year targets, and the five-year plans broken down into annual ones, are drafted at these levels. The draft plans of enterprise are submitted to the ministries, local executive committees, and other organisations to which they are subordinate. The key indicators are then communicated to the regional (territorial) planning commissions, which use them to compile integrated regional plans.

The ministries and Union republics summarise the proposals they receive from enterprises and local planning bodies and draft five-year plans for the development of sectors and republics in accordance with the forms and indicators sent to them by USSR Gosplan. The draft plans drawn up by the State Planning Commissions of Union republics are approved by the respective Councils of Ministers.

USSR ministries and departments and the Councils of Ministers of Union republics send the draft five-year plans to the directive bodies with a copy to USSR Gosplan. USSR Gosplan in turn makes any necessary amendments to the drafts submitted, and submits the final perspective plan for the country as a whole to the USSR Council of Ministers, which considers it in conjunction with the USSR ministries and departments and the Councils of Ministers of Union republics.

Once the draft has been accepted and endorsed by the Central Committee and the USSR Council of Ministers, it is submitted to the USSR Supreme Soviet, where it is first examined by the planning and budget commissions of the Council of the Union and the Council of Nationalities, which hear reports from USSR Gosplan, the USSR ministries and departments and ministries and departments of Union republics concerning it. The various parts of the draft plan are then studied by the commissions of the Council of the Union and the Council of Nationalities responsible for

particular sectors, namely, industry, transport and communications; construction and the building materials industry; agriculture; protection of the environment; health and social security; education, science and culture; trade and the services sector.

The USSR Supreme Soviet discusses the draft plan and the various comments on it made by its planning, budget, and sectorial commisions, and passes a Law on the State Plan for the Development of the Soviet Economy.

It also instructs the Supreme Soviets of Union republics to adopt similar laws on their own five-year plans including the key economic indicators for the whole republic. Plans are correspondingly confirmed by the Supreme Soviets of Union and autonomous republics, and by Soviets of Working People's Deputies of territories, regions, cities, etc.

These plans so adopted are passed on to the corresponding administrative bodies, which in turn pass them on to the enterprises, etc., subordinate to them. The last then put the final touches to their own perspective plans in accordance with the one handed down to them.

The Compilation of Annual Plans

The compiling of the annual plan is preceded by a comprehensive analysis of the way the economy is developing which provides a basis for specifying the tasks of the five-year plan in terms of the key indicators for the planned period. USSR Gosplan informs the various ministries and departments, and the Councils of Ministers of Union republics of possible changes in the planning indicators for the forthcoming year as well as of any alterations in the forms and indicators of the annual plan.

Ministiries and departments compile draft annual plans, allocating assignments to particular production associations and enterprises with due regard for USSR Gosplan's proposals and any projections made by lower planning bodies. The Gosplans of Union republics compile plans for the development of industries under republican control and make proposals for expanding production at enterprises that come under all-Union ministries. USSR Gosplan, which prepares

the draft of the annual State Plan for Economic Development, studies the proposals put forward by ministries and departments, and Union republics concerning it. After the USSR Council of Ministers and the Central Committee of the CPSU have examined this draft, it is submitted to the USSR Supreme Soviet. The draft is studied in the standing commissions of the Supreme Soviet with the participation of ministries, departments and USSR Gosplan, and is then discussed at a session of the USSR Supreme Soviet.

After it has given consideration to corrections and additions inserted by deputies, the Supreme Soviet passes the Law on the State Plan for Economic Development of the USSR.

A similar procedure for examining and approving annual plans is followed in the Union and autonomous republics.

In this way the annual plan is not simply a duplicate of the annual breakdowns of the five-year plan, since it takes into account fresh reserves for increasing economic growth and raising production efficiency, recent achievements in science and technology, a growth in labour productivity and national income. It is used for correcting the five-year plan.

5. IMPROVING THE TECHNOLOGY AND TECHNIQUES OF PLANNING CALCULATIONS

The organisation of planning requires the accurate and smooth functioning of planning departments in analysing and processing information, and in calculating different planning variants by means of economic-mathematical models, algorithms, and computers. How to improve the organisation of planning, how to reduce labour intensiveness of the calculations and the time spent on compiling a plan, and with what technical aids—these are matters that are now acquiring great importance.

The switch-over to an automated system of planning calculations (ASPC) is the main form of improving the technology of planning. It is not a previously determined system but a process. Its specific feature is that economic-mathematical methods and computers are used systematically, in a complex and interconnected manner.

The basic aims of the system are to prepare information for planning, compile macro-economic plans, and check on the way they are being implemented. The ASPC covers the whole system of macro-economic planning including USSR Gosplan, the Gosplans of Union republics, and the ministries and departments involved in drawing up particular sections of the national plan.

Several sub-systems (or blocks) can be distinguished in the automated system of plannig calculations, as follows:

I. Macro-economic:
   1. consolidated macro-economic planning;
   2. planning of increased prosperity;
   3. planning of external economic relations;
   4. defence and defence industry planning;

II. Industrial:
   1. planning of the fuel and power complex;
   2. planning of raw material industries;
   3. planning of the engineering industries;
   4. planning of the building and civil engineering industries;
   5. planning of the light and food industries;
   6. planning of agriculture;
   7. planning of transport and communications;

III. Regional:
   1. regional planning.

The complex sub-systems are further subdivided into sub-subsystems within which the separate problems of planning a given complex are resolved. These sub-subsystems are the basic elements in the forming of a plan; and they are broken down in turn into blocks in which the concrete tasks of homogeneous character composing them are grouped.

This structure of the automated system of planning calculations reflects the way the macro-economic plan is drafted in the central link of planned direction, i.e. in USSR Gosplan.

The ASPC structure envisages the drafting of the following macro-economic programmes: directed, inter-sectoral, and inter-regional, which are integral constituents of the drafting process.

The automated system of planning calculations contains the following kind of elements:

(a) provision of methods for the ASPC, including a complex of methods and techniques for tackling planned targets, mutually tied up in accordance with planning logic;

(b) provision of information, including the system of planning and reporting indices and other types of information, forms of planning documentation, and also methods of organising information (classification, coding, storing, etc.);

(c) technical supply, including computers, accounting and business machinery and communications, and technical information carriers;

(d) provision of programs, including a set of the machine programs needed for efficient operation of the ASPC;

(e) organisational supplies, including a collection of the legal norms and enforceable enactments regulating the structure and operation of the ASPC;

(f) provision of staff, including planning workers and other personnel concerned with the solution of planning tasks.

The planner holds a central position in this system, for it is his function to make the final choice as to the best variant. The selection of such a variant by the computer is a preliminary procedure but does not amount to the taking of a decision. The planning official responsible must evaluate the results and either accept them or (having made changes in the initial data, criteria, constraints) return the material for new calculations on the computer.

An important requiremet is that the ASPC should have a proper work regime. It should be sufficiently operational for it is to act as a partner in the planning system. Up till now almost all calculations using economic-mathematical methods have been mainly done outside the regime for drafting a plan. For this reason while they are being made, the planning bodies have themselves had to make the comparisons, change the initial data, and even at times the objective principles, and obtain new analytical material. As a result computations are not infrequently made using data and methodological instruction which are not longer applicable and thus they can only be used as reference material. Only

if the ASPC has an operational work regime coordinated with the regime of work on the plan will it be able to become a real basis for planning work.

Two trends may be noted in the development of the ASPC: intensive and extensive. Extensive development is reflected in an expansion of its sphere of work, in an extension of its scope to new functions and new planning bodies. Intensive development is connected with an improvement in the actual technology of planning: an improvement in the technical base, the introduction of new types of computers and means of communication, an improvement in the system of models and programming methods, etc. In the course of such developments the ASPC will switch over from working on autonomous automated system of planning calculations to the gradual synthesis of these sub-systems into bigger blocks and eventually of the ASPC as a whole. Then the ASPC will be finally integrated with the system for drafting a plan.

Thus the ASPC is a stage in the process of automating the technology of planning calculations characterised by the complex use of economic-mathematical methods and computers for the purpose of transforming planning information throughout the planning system.

The creation of the ASPC is having a substantial impact on several organisational aspects of the process of preparing a plan. At present a huge network model of this process is being worked on, and efforts are being made to use the network charts and schedules (methods of network planning and management) that have proved effective in other areas of management, to direct the drawing up of the macro-economic plan. This will make it possible to cut down the time spent on drafting the plan and will ensure more effective and operational control.

The network schedules constructed for the separate jobs undertaken by Gosplan's different divisions can be integrated into a single network for the USSR Gosplan as a whole or for the Gosplans of Union republics. A network time-table for fulfilment of the work being done in all the various sectoral and functional departments of USSR Gosplan in the course of drawing up macro-economic plans makes it possible:

(1) to link up the flow of work in the different departments and sub-departments;
(2) to set objectively necessary time limits for each department to pan materials to the consolidated department for the macro-economic plan and to other departments;
(3) to pick out from among the whole set of tasks carried out by USSR Gosplan the most urgent ones on which attention must be concentrated;
(4) to exercise day-to-day control by means of computers over carrying out of the calculations to plan.

The use of economic-mathematical methods and computers still does not mean that management and planning will improve automatically. Computers only offer the possibility of new ways of doing planning calculations. Whether these possibilities are taken up depends not on the computers but on the ability of the planners to ascertain the regularities operating in a socialist economy, on the work of the people responsible for formalisation and algorithmisation, etc. The need to adopt a comprehensive approach to all aspects of planning in the course of improving will therefore increase.

CHAPTER IV

THE PLANNING OF ECONOMIC GROWTH RATES

The basic indicators of socialist extended reproduction, which reflect in a generalised form both the main tasks of economic growth and the objective possibilities for an increase in production and consumption during the planned period, are fixed at the preliminary stage of compiling a perspective macro-economic plan. These basic indicators are determined in the light of the principal social and economic tasks of the perspective period, on the basis of a generalisation of scientific-technical, demographic, foreign-trade, and other forecasts, and with due regard for the objective trends, new phenomena, and unsolved problems that have currently developed in the economy. Naturally, in the initial stages of compiling a plan, calculations take the form of hypotheses and forecast estimates which must be checked further and made more valid. Later on, when the fully macro-economic plan is being compiled, these hypotheses are specified more closely and corrected, especially in the case of drafting sectoral plans, and in the final stages of compiling the plan the tasks connected with the basic indicators of overall economic growth during the perspective (five-year) period with annual breakdown are laid down.

Macro-economic modelling methods are mainly employed in the preliminary stages of work on a plan, when there are as yet no detailed projections for the different sectors. These methods, like planning inter-sectoral tables, are

fairly recent and have not yet taken their final form. A fully extended planning table for the whole economy is used in the concluding stages of compilation (see Ch. X, Vol. 2). In recent years the inter-sectoral table has become an instrument for summarising and coordinating the elements of the macro-economic plan.

1. THE CONCEPT OF ECONOMIC GROWTH RATES

The results of socialist extended reproduction can be evaluated by means of various indicators characterising the scale of production, the available production potential, and the standard of living. The main indicator summarising the level and dynamics of social production used in planning is the physical volume of the annual national income as the sum of the material goods and services comprising consumption and accumulation.

The indicator of national income available for consumption and accumulation shows the results of material production in the course of a year and at the same time those resources which can be allocated by society for the people's consumption needs, for the expansion of production, and for the development of the non-productive sphere. The physical volume of social production can be estimated by calculating this indicators in constant (comparable) prices of a particular year (usually the base year of the planning period).

The change in the physical volume of the national income characterises the dynamics of social production. The relative indicators of its dynamics are growth (incremental) rates of the national income. By that is meant the relative annual growth (increment) of the physical volume of the national income used for consumption and accumulation. The rates of economic development can also be calculated from the dynamics of other indicators, i.e. aggregate social product (total gross output of the sectors of material production), the national income produced (total net output of the sectors of material production), and final social product (the sum of the consumption fund and all productive and non-productive investments). The planning of growth rates, however, is mainly based on the indicator of available national income.

The dynamics of social production can also be measured by means of indicators of the absolute increment of national income or final social product. An increase in the scale of production then results in the same relative increment of social production masking an increasing absolute increment. Thus, whereas the value of a 1 per cent rise in the physical volume of the national income in 1961-65 was 1,400 million roubles, 1,900 million roubles in 1966-70, and 2,700 million roubles in 1971-75, under the plan for 1976-80 it should rise to 3,600 million roubles.

The results of social production can be expressed as follows by using the indicator of available national income:

$$Y_t = C_t + A_t, \qquad (1)$$

where Y—volume of national income;

C—total consumption including personal consumption, current social consumption and the accumulation of basic non-production assets;[1]

A—productive accumulation including the accumulation of fixed production assets, circulating assets, stocks, and reserves;

t—time.

The dynamics of the physical volume of the national income can be shown by means of indicators of the rates of growth (or increment). If its physical volume for two successive years is compared, then $Y_{t+1} : Y_t = 1 + y$ represents the annual rate of growth of the national income, while $\Delta Y_{t+1} : Y_t = y$ is the annual incremental growth rate of national income. In this case the base value is unity; the calculation can also be done in percentages.

Besides annual growth (increment) rates, average (mean) annual rates are also used in planning and economic analysis. They are obtained by comparing the volumes of the national income several years apart. The average annual growth rate is expressed as $1 + y = \sqrt[t]{Y_t : Y_0}$, while the average annual

[1] Normally the consumption fund includes only personal and social consumption; in the present case the accumulation of basic non-production assets is included with them since all three elements have the same economic function, i.e. are material goods earmarked for non-productive consumption. This makes it possible to separate out productive accumulation as the source for expanding production.

rate of increment is given by $y = \sqrt[t]{Y_t : Y_0} - 1$. Thus the volume of national income at the end of the planning (or accounting) period can be expressed as: [1]

$$Y_t = Y_0 (1 + y)^t. \qquad (2)$$

High, stable growth rates are typical of the Soviet economy; nevertheless changes can be observed in the rates of growth for individual years and over certain periods. Several such periods having different average annual incremental growth rates can be distinguished:

		in percentages
1922-27	the period of the New Economic Policy and restoration of the economy after the First World War and the Civil War	19.5
1928-40	the prewar five-year-plan periods of socialist economic reconstruction	14.1
1946-50	restoration of the economy after the Second World War . . .	14.6
1951-70	the period succeeding economic reconstruction	8.5

During the Ninth Five-Year Plan (1971-75) the national income employable for consumption and accumulation increased by 28 per cent, and its total volume was 34 per cent higher than during the Eighth Five-Year Plan period. In 1976-80 there should be a 24 to 28 per cent increase in national income, i.e. the growth rates of the Soviet economy will remain stable and high.

In planning the growth rates of extended reproduction for different periods, a comparative evaluation is made not only of annual volumes and growth rates of national income, industrial output or some other indicator but of volumes of output for a whole number of years and the corresponding indicators showing trends from one period to another. Thus, for example, total available national income for the whole of the five-year plan period (in 1965 prices) amounted to 840,000 million roubles in 1961-65; 1,166,000 million in

[1] In conditions of continuity equation (2) can be written: $Y_t = Y_0 e^{yt}$.

1966-70; and to 1,563,000 million in 1971-75. If national income for the period 1961-65 is taken as 100 in the next two five-year periods it stands at 139 ad 186 respectively. This approach makes it possible to eliminate annual fluctuations and establish with greater accuracy the scale of extension in production during the period.

Breaking away from the limits of annual periods has practical importance in long-term planning for characterising the growth rates of social production. Given the same increase in the annual volume of the national income over the whole planned period (e.g. over five years), but with changing annual growth rates within it, the total cumulative volume of the national income for the whole period can vary depending on whether growth rates were higher than the average at the beginning or at the end of the period (see Table 2).

Table 2

Base year = 100

Plan Year	Growth rate as a percentage of the preceding year		Volume of national income in conventional units	
	variant I	variant II	variant I	variant II
First	110	106	110	106
Second	109	107	119.9	113.4
Third	108	108	129.5	122.5
Fourth	107	109	138.6	133.5
Fifth	106	110	146.9	146.9
Total over five years	146.9	146.9	644.9	622.3

It so happens that, although there is a similar increase in the amount of national income over the period as a whole (146.9 per cent in both variants) and a similar level in the final year (146.9 units), the volumes for the period as a whole are different (644.9 and 622.3 units). Consequently, calculation of average annual (incremental) growth rates of

social production should be supplemented by comparison of the totals of production over the relevant accounting or planned periods. This makes it possible to establish how the plan is being fulfilled not only in the last year of the planned period (in comparison with the base year) but over the period as a whole. From the point of view of the economy it is important not only for the planned growth rates of national income to be achieved but for the plan targets as to its amount also to be completed successfully.

The dynamics of social production can also be shown by the per capita growth of national income. This indicator reflects the level of economic development; in countries where population growth rates are close to the rate of growth of social production, the level of economic development rises slowly. For this reason absolute increments and growth rates per capita are an important additional characteristic of the trend of social production. The absolute per capita increment of national income in 1971-75 was planned at 82 roubles, compared with 66 roubles in 1966-70 and 40 roubles in 1961-65.

2. BASIC FACTORS DETERMINING NATIONAL INCOME GROWTH RATES

The dynamics of social production, as measured by the rates of growth of national income, depend on the input of aggregate social labour (both living and that embodied in the means of production) and on changes in its economic efficiency. These two factors in the growth of national income, being forms of the existence of aggregate social labour, do not under socialism contradict each other but form a single production process proceeding on the basis of social ownership. "Whatever the social form of production, labourers and means of production always remain factors of it. But in a state of separation from each other either of these factors can be such only potentially. For production to go on at all they must unite. The specific manner in which this union is accomplished distinguishes the different economic epochs of the structure of society from one another."[1]

[1] Karl Marx, *Capital*, Vol. 2, p. 36-37.

Proceeding from the Marxist understanding of the factors of production, the effect of the dynamics of the two forms of social labour—the inputs both of living labour in the sphere of material production and of production assets, fixed and circulating—are taken into account in planning the growth rates of the physical volume of national income. But this is only one aspect of their impact on national income growth rates. Another aspect is the efficiency with which they are used, as shown by output per unit of input. The macro-economic indicators of economic efficiency most frequently used in planning practice include the following:

(1) the productivity of living labour, i.e. production of national income per worker employed in the sphere of material production (or per man-hour worked in this sphere);

(2) return on production assets, i.e. production of national income per unit of production assets (or most frequently, per unit of fixed production assets);

(3) the efficiency of productive investment unit (capital outlay), i.e. the productive capital investments required per unit of increment in national income (or of gross product);

(4) the efficiency of productive accumulation, i.e. the ratio of the increment of national income and volume of productive accumulation; similar in content is the ratio of the annual rate of increment of national income and the proportion of productive investment in the national income.

There are other indicators showing the economic efficiency of factors of production connected in the main with the application of macro-economic models in planning (see Section 3 of the present chapter).

The efficiency of social labour, however it is measured, itself depends on change in the objective conditions of reproduction, above all on scientific and technological progress, the volume and quality of natural resources used in production, the quality and level of skill of living labour, the scale of production, the level and forms of wage payments, etc. The job of economic analysis and planning consists in assessing the impact of the basic objective processes taking place in the economy on the dynamics of the indicators of economic efficiency and in securing an increase in the efficiency of production at all levels.

The principle of a steady rise in the efficiency of social production means that planning the growth rates of national income should proceed from the need for (1) maximum satisfaction of social needs at a given level of output, and (2) achieving high, stable rates of growth of national income with the least possible expenditure of living and embodied labour per unit of output, in the given objective conditions.

All the diverse factors affecting the growth rates of national income can only be taken into account in the course of compiling the full national plan. At the preliminary stage, growth rates are fixed after the basic factors of production—living labour and production assets, and their economic efficiency—have been analysed, each factor being examined separately and as art of the whole. Growth rates are therefore determined by different methods in their combination on the basis:

(a) of a change in the number of people employed in material production and their labour productivity;

(b) of the dynamics of production assets and any change in the efficiency with which they are used; this method is directly connected with the problem of allocating national income to consumption and accumulation, since accumulation is the source of growth for production assets:

(c) of the trend in aggregate expenditure of living and embodied labour and changes in their total efficiency.

It should be specially emphasised that calculations using different methods are made in parallel, mutually interwoven and correcting. Extrapolations and temporary hypotheses must be made during the calculating process and then specified more closely or rejected in the course of further projections. One and the same indicator is fixed at different stages from different points of view: either in view of the need to attain a certain level for some indicator, or in the light of the economic possibilities of achieving this task. Consistency is finally achieved, by successive approximation, between the different aspects of production over the planned period, between plan assignments and the possibilities of carrying them out.

The sequence of the calculations varies with the length

of the planned period. In planning production indicators over a long period ahead, for example, indicators showing the standard of living it is hoped to reach by the end of the period can be chosen as initial data; the final results, however, can only be obtained by combining the selected methods and aspects of planning calculations into a single whole.

Dynamics of Living Labour

Among the most important factors affecting economic growth rates are population trends, the amount of manpower available, and above all the number of workers employed in material production. Man is society's main productive force. The scale and level of a country's economic development depends to a great extent on the amount of manpower available. At the same time population growth directly affects the level of economic development (i.e. per capita indicators of production and consumption) and expenditure on caring for and educating the rising generation, necessary for bringing fresh labour into production.

As already noted, total manpower and the size of the labour force engaged in material production reflect the quantitative aspect, the amount of living labour affecting economic growth. The productivity of living labour indicates the effectiveness of its use. The method of calculating possible national income growth rates on the basis of the dynamics of living labour entails estimating its quantity and productivity as factors of extended reproduction:

$$Y_t = P_t L_t \qquad (3)$$

where P is the productivity of living labour ($P_t = Y_t : L_t$), and L is the number engaged in material production.

National income can also be expressed through productivity per man-hour and number of man-hours worked in the sphere of material production.

When national income growth rates are planned on the basis of an even increase from year to year in the same way

as the productivity of labour and numbers employed in material production, then

$$Y_0 (1 + y)^t = P_0 (1 + p)^t L_0 (1 + l)^t, \qquad (3a)$$

where p and l are the average annual rates of increment of the respective indicators. Hence the dynamics of national income can be expressed by means of indicators of average annual rates of increment:

$$y = p + l + pl. \qquad (3b)$$

Thus this method consists in resolving two problems, namely, estimating (a) the average annual rate of increment of the numbers engaged in material production (l), and (b) the average annual rate of increment of the productivity of living labour (p).

High growth rates of labour productivity with continuous increase in the number employed are typical of the Soviet economy.

The decisive share of the increment of national income will come from growth of labour productivity. For the economy as a whole this will provide 85 to 90 per cent of the growth of national income in 1976-80 as against 80 per cent in 1971-75.

The size of the labour force in material production is estimated from long-term demographic calculations and by planning the use of labour reserves (see Ch. V). The demographic calculations, and certain projections concerning the use of manpower, are made in the early stages of compiling a perspective plan and normally precede the work on planning national income growth rates.

On the whole, plan calculations of labour inputs in the sphere of material production can be divided into four stages.

The first stage comprises a forecast of the natural increase in population, based on forecasts of birth and mortality rates which in turn are drawn from forecasts of the composition of the population by sex and by age with separate classification of women of fertile age and of fertility coefficients for each age group.

The second stage consists in defining the able-bodied population, i.e. the population of working age (men between 16 and 60, women between 16 and 55).

The third stage consists in establishing the possible size of the employed population. This calls for additional planning calculations regarding the number of full-time students of working age (not engaged in production), the number of housewives, and the number of persons of pensionable age continuing to work (and in certain cases the number of adolescents working). An estimate of the number of servicemen in the period ahead must also be made. One of the chief problems in planning is to produce a reasonable estimate of the level of participation in employment. It can only be fully worked out when drafting plans for the location of the productive forces since employment is largely a regional question.

The fourth stage comprises projections concerning the distribution of workers between the productive and non-productive spheres. At this stage of making long-term calculations, both the demand for labour in the main sectors of the productive and non-productive spheres and the general trend towards increasing the number of people employed in the non-productive sphere are taken into account.

Finally, possible trends in the size of the labour force engaged in material production are estimated even at the preliminary stage of working out a plan.

In establishing the possible increase in labour productivity, current trends in this indicator are analysed and forecasts are made for the planned period which are then given in greater detail as the calculations are made.

An increase in labour productivity as a factor of national income growth is affected by a whole number of objective and subjective conditions at work (the level of equipment, the organisation of the production process, the stability and reliability of the links between different sectors and enterprises, and material and moral incentives). Analysing the effect of labour productivity on economic growth rates means to clarify the factors determining growth of labour productivity itself.

In the preliminary stage of compiling a plan it is possible to distinguish the following factors affecting the level and dynamics of the productivity of living labour: structural changes in the sectoral distribution of labour power; the amount of power and equipment available per worker;

and the standard of education and skill of the workers. It is not possible at present to measure all these factors accurately nor to establish their connection with the growth of labour productivity, but experience of long-term estimates is gradually bringing solution of this complex problem closer.

The effect of structural changes on distribution of the labour force is apparent in changes in the relative weight of particular sectors in the total numbers employed in material production, which may lead to changes in the average productivity of living labour in a particular sphere of production, given constancy of this indicator in different sectors. This structural factor is especially important during the period of full-scale industrialisation, when labour is being redistributed from agriculture to industry, construction, and transport, which in itself causes a rise in average productivity throughout the economy. For example, the number of people employed in industry, construction, transport, and communications rose from 28 per cent of the total in 1940 to 45 per cent in 1972, while the numbers in agriculture (including forestry) fell from 54 to 26 per cent. If one realises that productivity in industry (in relation to value added) was double that in agriculture in 1972 (in 1960 it was three times higher), then the significant effect that such a redistribution of labour has on growth of productivity becomes obvious. This process continues to play an important role in the developed socialist economy. But opposite structural influences begin to come into play here; there is an increase in the relative numbers employed in the sphere of circulation (trade, public catering, supply of materials and technical equipment, state purchases of farm produce), in which, because of the features of production, the possibilities for mechanising labour are substantially less than in other branches of production and the dynamics of productivity is therefore lower.

An important physical factor in the growth of productivity is an increase in the amount of power and equipment available, i.e. the ratio of power capacities or fixed production assets to the size of the labour force engaged in the sphere of material production. Obviously, the better living labour is equipped with means of production in which the most active

role is played by machinery and power, the higher the level of labour productivity. In 1961-70 every 1 per cent average annual increase of power per worker in Soviet industry yielded a 0.8 per cent increase in productivity; a similar calculation made for electricity alone gave an increase of 0.9 per cent. Consequently, in order to raise productivity in industry by 1 per cent, it is necessary to increase the amount of power available per worker by 1.2 per cent (or, in the case of electricity, by 1.1 per cent).

The amount of capital per worker calculated for the whole economy describes the level of equipment of living labour with fixed production assets. In 1970 there were around 6,000 roubles of production assets per worker in material production, and the productivity of labour (in relation to annual national income produced) was 3,200 roubles. Consequently, in order to produce one rouble of national income, each worker needed on average two roubles of fixed production assets. Moreover, in order to raise labour productivity by 1 per cent, the amount of equipment available per worker had to be increased by about 1.2 per cent. This ratio is quite stable and can successfully be used in long-term calculations.

Another factor having a growing effect on increase of productivity is the rise in workers' standards of education and skill. In the conditions of the scientific and technological revolution, production cannot be successfully expanded or its efficiency improved unless there is a continuous rise in the level of education and skill and a strengthening of the workers' creative and intellectual capacity. At the beginning of the 1970s the average standard of education in the Soviet Union exceeded eight years and was increasing by 3 or 4 per cent a year.[1] If that trend continues, the average standard will exceed ten years by the beginning of the 1980s. It is difficult at present to quantify the effect this factor has on increase of productivity. One may suppose, however, that, as the general level of economic development in the country rises, growth of productivity will depend

[1] A. I. Anchishkin, *Forecasting Growth in a Socialist Economy* (in Russian), Moscow, Ekonomika, 1973.

more and more on the training and skill of each worker, since man and his creative capabilities, and their application, are the chief source of progress.

The Dynamics of Production Assets and Productive Accumulation

As a socialist economy develops, a growing part of the aggregate social labour is embodied in the form of production assets, especially fixed assets. National income growth rates are increasingly determined by the volume and technical level of production assets, which are becoming an important factor in socialist extended reproduction. The total value of production assets in real terms exceeded 600,000 million roubles in 1970, while that of fixed assets alone was 460,000 million roubles by the end of that year; and at the end of 1975 had reached 800,000 million roubles (in current prices).

It is therefore very important in planning national income growth rates to pay heed to the dynamics, amount, and economic efficiency of this vital factor of production.

In any one year the size of the national income may be represented as the product of two elements, namely, the amount of production assets and their efficiency (return on assets):

$$Y_t = K_t E_t, \tag{4}$$

where K is the amount of production assets (in particular, fixed assets); and E is the efficiency of assets utilisation $E_t = \frac{Y_t}{K_t}$.

In conditions of uniform growth expression (4) can be written as

$$Y_0 (1+y)^t = K_0 (1+k)^t E_0 (1+\varepsilon)^t \tag{4a}$$

or, using indicators for average annual rates of increment, as

$$y = k + \varepsilon + k\varepsilon \tag{4b}$$

where k and ε are the average annual incremental growth rates of the respective indicators.

Figures are given in Table 3 showing the average annual rates of incremental growth for the indicators in equation (4b) over the past 20 years (k and ε are average annual incremental growth rates of fixed production assets and of return on assets respectively).

Table 3

Years	y	k	ε	$k\varepsilon$
1951-55	11.4	10.1	1.2	0.1
1956-60	9.1	9.4	0.3	—0.03
1961-65	5.7	9.7	—3.7	—0.3
1966-70	7.2	8.2	—0.9	—0.1

A continuous, stable increase in fixed production assets, which is one of the main factors in the generally high growth rates of extended reproduction, is normal in the Soviet economy. For 1926-70 the average rate of increment of these assets was approximately 7 per cent, or excluding the Second World War years, about 8 per cent.

The uniform expansion of fixed assets was accompanied with fluctuations in the growth of national income, which led to changes in the indicator of return on assets. In 1926-40 return on assets increased by nearly 6 per cent per annum, and in 1951-59 by 0.7 per cent, but dropped slightly in 1959-65. Over the whole period from 1926 to 1970 the return on assets increased by roughly 150 per cent, i.e. rose on average by 2 per cent a year. The return on assets increased particularly fast between 1936 and 1940 (7.8 per cent a year), in the period when the production assets created in the initial period of industrialisation were being brought into use.

The lowering of this indicator that has occurred in the past 15 years is explained by a number of reasons: the main ones are such objective circumstances as the process of replacing manual labour by machines and mechanical aids, and structural changes towards more capital-intensive branches of industry. There were also, however, major shortcomings in the field of capital construction and the utilisation

of existing assets, which led to a lowering of the indicator. This trend was more or less stabilised in the course of the Ninth Five-Year Plan for 1966-70, and in 1970 was constant.

In 1971-75 there was a drop in return on assets for the economy as a whole and in its most important sectors (industry, building, and agriculture). The Tenth Five-Year Plan sets the task of improving the use of existing industrial capacity, intensifying the shift schedule of manufacturing equipment, and so providing the conditions for growth of return on assets.

With the present approval of planning national income growth rates two tasks have to be solved: (a) determining the possible dynamics of production assets and (b) evaluating changes in the return on assets indicator.

The most difficult job is to determine the dynamics of the latter. The difficulties are connected with the need to take numerous factors into account that frequently operate in opposite direction. Certain of them are not amenable to strict quantitative estimation and for this reason long-term estimates of the return on assets made at the preliminary stage of compiling a plan inevitably take the form of hypotheses. It only becomes possible to make a more accurate estimate of the planned return on assets at the final stage of plan compilation when detailed calculations of production capacities and their use by sector have been completed.

Let us consider only the main macro-economic factors affecting the trend in this indicator, namely:

(1) the application of the achievements of scientific and technological progress to production; this factor can be quantified at the initial stage of drawing up a plan on the basis of a technical and scientific forecast;

(2) changes in the composition of fixed production assets due primarily to the progressive trend towards increasing the share of equipment, prime movers, and control instruments in total assets; an increase in the share of active assets gives rise to an increase in the return on assets;

(3) shifts in the sectoral and regional structure of production; the existence of different returns on assets in different sectors of the economy and different regions is connected

with objective differences in the nature of production and in the conditions of its location (the extractive industries, for example, are the most capital-intensive, the manufacturing branches of heavy industry, especially engineering, less so, and the food and light industries least of all);

(4) the level of utilisation of newly commissioned and existing assets; fixed production assets can be operated at different loadings, and the higher the loading, the higher the return on assets; while inter-sectoral links in production, achievement of a proper balance between capacities in different sectors, improvement in the supply of materials and equipment and the organisation of production all have a combined effect on this factor;

(5) the ratio between fixed production assets and inputs of living labour; since these two forms of aggregate social labour are interconnected and to a considerable degree substitutable one for the other, the efficiency of the one depends on inputs of the other (thus mechanisation of production leads to an increase in labour productivity but may also result in a temporary lowering of the return on assets); consequently it is necessary to make a joint analysis and do planning calculations of the trend of both production assets and living labour, and the return on assets and labour productivity, which suggests a change-over to multi-factor methods (see Section 3 of this chapter).

The second aspect of the current method of calculating national income growth rates is determining the dynamics of the physical volume of production assets (indicator K_t in equation (4) or k in equation (4b)).

That part of national income earmarked for productive accumulation (A_t in expession (1)) is the source of the increase in the physical volume of production assets. The greater the volume of productive accumulation, the faster production assets grow; since

$$K_{t+1} = K_t + A_t, \text{ then } 1 + k = \frac{K_{t+1}}{K_t} = \frac{K_t + A_t}{K_t} = 1 + \frac{A_t}{K_t}.$$

Consequently, the average annual growth rate of production assets is equivalent to the ratio of productive accumulation

to production assets $\left(k = \frac{A_t}{K_t}\right)$[1]. This also means that the greater the proportion of productive accumulation in national income, the faster is the rate of growth of production assets and of national income. This causal relationship can be expressed by modifying expression (4) slightly:

$$\Delta Y_t = E'_t \Delta K_t, \tag{5}$$

where the increment in national income (ΔY_t) is expressed by means of the increment in production assets (ΔK_t) and the indicator of the incremental return on assets ($E'_t = \Delta Y_t / \Delta K_t$). Dividing both parts by the amount of national income, we obtain $y = E'_t \Delta K_t : Y_t$; but since $\Delta K_t = A_t$, as has already been established above, then

$$y = E'a \tag{5a}$$

or

$$Y_t = Y_0 (1 + E'a)^t, \tag{5b}$$

where a is the share of productive accumulation in national income ($a = A_t : Y_t$), which in this case is regarded as a constant.

It should, of course, be realised that the amount of productive accumulation affects the growth of national income indirectly, through the trend in production assets.

Analysis of data on the development of the Soviet economy shows that an accelerated growth of national income is directly due to a rise in the share of productive accumulation which is one of the principal results of socialist industrialisation. Whereas in 1925-26 the share of productive accumulation amounted to 12.5 per cent of the national income, it was already 24.6 per cent by 1929-30.

A high proportion of productive accumulation remains one of the principal features of the Soviet economy and the basis for the rapid extension of social production. In 1960-70 it fluctuated around 20 to 22 per cent of the national

[1] In the present case we abstract two important factors that are taken into account in planning the dynamics of production assets: (1) the role of part of the depreciation changes in the formation of productive accumulation; (2) the existence of a time lag between productive investment and the increase in the physical volume of production assets (e.g. given a lag of one year $K_{t+1} = K_t + A_{t-1}$).

income, while the growth rates of consumption and accumulation drew closer together. The accelerated rise in living standards during the Ninth Five-Year Plan has been reflected in a certain increase in the share of consumption, from 74 per cent in 1970 to 75 per cent in 1975. If account is also taken, along with the fund of current consumption, of those accumulated resources that were directed to the building of housing, schools, hospitals, cultural and educational institutions, sports facilities, public utilities and service enterprises and facilities, then more than 80 per cent of the national income was employed directly for purposes of public welfare in 1971-75. In the Tenth Five-Year Plan period there will be a further increase in the proportion of the consumption fund in the national income. With a 24 to 28 per cent increase in the physical volume of national income in 1976-80 there will be a 27 to 29 per cent rise in the consumption fund, and a 17 to 23 per cent rise in the accumulation fund. Raising of the weight of the consumption fund is an index of growth of the end result of social production and of its increasing efficiency, and is convincing evidence of the peace policy of the Soviet state.

The connection shown above between the dynamics of national income and the proportion of productive accumulation can be illustrated by the accounting data for the 1966-70 five-year plan. During these years actual national income increased on average by 7.2 per cent a year, the proportion of productive accumulation being 20 per cent (0.2) of national income on average while the average increment in national income per unit of productive accumulation was 0.36; thus, equation (5) had the following numerical value:

$$y = E' \cdot a = 0.36 \cdot 0.2 = 0.072.$$

This means that, given the current level of efficiency of productive accumulation, the share of productive accumulation had to be increased to 22 per cent in order to achieve an average annual growth rate of national income equal to 8 per cent, and to 25 per cent to achieve one equal to 9 per cent, etc.

It should be borne in mind that expansion of the total of production assets is a direct factor in growth of the national

income, while productive accumulation is only the source for their expansion. Thus equations (5) and (5a) reflect the intermediary form of the link between the dynamics of national income and productive accumulation.

Long-term calculations of the reproduction of fixed production assets is a special part of planning and forecasting work. At the macro-economic level the main task consists in fixing the volume and trend of productive investments in coordination with the relevant indicators regarding the commissioning and withdrawal of fixed production assets, the increase of building in progress, and the increase in fixed production assets. Underlying these calculations is the following balance equation:

$$K_t = K_0 + \sum_t \Delta K_t = K_0 + \sum_t (V_t - W_t) =$$

$$= K_0 + \sum_t (J_t - W_t - \Delta S_t),$$

where V—annual commisioning of fixed production assets,
W—their annual withdrawal,
J—productive investment,
ΔS—increase in building in progress.

With a given volume of productive investments

$$V_t = \frac{J_t}{(1+i)} \tau_1, \quad \Delta S_t = J_t \left(1 - \frac{1}{(1+i)\tau_1}\right),$$

$$W_t = \frac{V_t}{(1+U)} \tau_2,$$

where τ_1—investment lag (average investing period for productive investments, service life of fixed production assets),
τ_2—average annual growth rate of productive investment and commissioning of fixed production assets.

The shorter the investment lag, obviously the higher is the commissioning of fixed production assets (at a given volume of investment) and the lower the increase of construction periods, which makes it possible to reduce the proportion of capital investments tied up in work in hand.

A change in the service life of fixed production assets alters the allocation of productive investments for increasing and replacing these assets. Speeding-up of the rate of scientific and technological progress stimulates faster renewal of these assets, shortens their life, and increases the share of investments going to replace withdrawn assets. It is this trend that is taken into consideration in long-term calculations of the production of fixed production assets.

The planning of national income growth rates by fixing the share of productive accumulation in national income presupposes that some estimate must also be made of consumption trends. Since national income is divided into productive accumulation and consumption, any increase in the share of accumulation causes a reduction in the share of consumption, and vice versa. An increase in the share of productive accumulation will, other things being equal, lead to an increase in the volume of production assets and speed up the growth rates of national income which is the source of consumption. However, the share of accumulation may grow to such a degree that an absolute reduction in consumption occurs or else it is frozen at a particular level which, given an increase in population, is inadmissible.

In order to throw light on the internal contradiction of this problem, let us look at the very simple connection between consumption and the proportion of productive accumulation in national income. Since $Y_t = C_t + A_t$, whence the proportion of productive accumulation (a_t) is defined as $A_t : Y_t$, the share of consumption will be $1 - a_t$. Making use of equation (5) above, we get

$$C_t = Y_0 (1 + E'a_t)^t (1 - a_t). \qquad (6)$$

It can be seen from expression (6) that planned consumption will be the greater the bigger the factor $(1+E'a_t)$, whose value, given E', depends on a_t. In other words, consumption is the greater, the higher the rate of growth deter-

mined by the share of productive accumulation. On the other hand, any increase in a_t reduces the factor $(1 - a_t)$, i.e. the share of consumption, and therefore its amount. In this connection one of the main problems of perspective planning arises, i.e. search for the optimal relation between consumption and accumulation.

The complexity of the solution of this problem is that the optimal relation between accumulation and consumption depends simultaneously on three conditions: (1) maximum possible growth of both consumption and production (since, in increasing production today, we increase consumption tomorrow); (2) an increase in consumption over the whole period under review and not in some final year (total consumption and not annual must be maximised); and (3) a steady, year-by-year increase in consumption.

The task of seeking an optimal allocation of national income between productive accumulation and consumption, using expression (6) on the condition of uniform (exponential) growth in both consumption and national income can be formulated as maximisation of the functional:

$$\int_0^t e^{ct}\,dt = \int_0^t e^{E'at}\,dt\,\frac{1-a}{1-a_0}, \qquad (6a)$$

where $\int_0^t e^{ct}\,dt$ — the total resources for consumption over the planned period (in indices of growth rates)[1] given their uniform increase (average annual incremental rate c) in the course of the period;

$\int_0^t e^{E'at}\,dt$ — total amount of national income over the planned period (in indices of growth rates) given its uniform increase (average annual rate of growth $E'a = y$) in the course of the period and a constant norm of productive accumulation;

$1 - a$ — the share of consumption in national income.

[1] Multiplication of this quantity by the absolute value of the initial level gives the total absolute value for the period.

The task consists in finding that proportion of productive accumulation in the national income (a) which, given the law of change in E', yields the maximum resources for consumption over the whole of the planned period.

The rates between productive accumulation and consumption can also be determined in the course of the independent planning of consumption on the basis of per capita consumption norms and projections regarding development of the non-productive sphere. This calculation arises from the tasks in the field of raising living standards. Personal consumption budgets over a number of accounting years provide the basis for calculating per capita norms over the planned period. A planned personal consumption budget is worked out by analysing family budgets and using coefficients of the elasticity of demand for staple foods and other (non-food) goods, and the standards for providing housing and the services of social, cultural, and service establishments.

The most difficult problems in determining the consumption fund are connected with substantiating changes in its structure, as it requires thorough economic investigation of consumer demand and its structure, and especially the elasticity of demand. Research of this kind makes it possible to raise the standard of planning of the material structure of consumption and to take account of actual trends in consumer demand.

Once the relationship between productive accumulation and consumption has been determined, it then becomes possible to decide the possible dynamics of production assets:

$$(1+k)^t = \left[K_0 + \frac{C_0 \int_0^t e^{ct}\,dt}{(1-a)}\,a\right] : K_0, \qquad (7)$$

where $\frac{C_0 \int_0^t e^{ct}\,dt}{(1-a)}\,a$ is the volume of productive accumulation in sum over the planned period.

In combination with the hypothesis regarding the change in the return on assets, this makes it possible to estimate the growth of national income over the planned period.

3. THE INTERCONNECTION OF THE BASIC FACTORS OF NATIONAL INCOME GROWTH. MULTI-FACTOR METHODS OF PLANNING THE DYNAMICS OF NATIONAL INCOME

The methods of planning the rates of socialist extended reproduction as a function of an increase in the amounts and productivity of living labour or of the dynamics of the volume and efficiency of production assets cannot be isolated from one another. Living labour and embodied labour, the two forms of social labour, are interconnected and a single entity.

The process of social production is based on the simultaneous participation of living labour and production assets in certain definite quantitative relationships. If fresh manpower is drawn into production, then fixed production assets must be extended and circulating assets correspondingly increased. At the same time newly created production capacities cannot be used at the existing technical level of production unless fresh living labour is drawn in.

In a developed economy there is practically no living labour not connected with the use of production assets. The amount of assets per worker (the ratio between fixed production assets and the number of workers engaged in the sphere of material production) largely decides the level of labour productivity. This dependence is also taken into account in the multi-factor approach to planning national income growth rates. The dependence of the dynamics of labour productivity on the dynamics of assets per worker, i.e. $Y_t : L_t = f(K_t : L_t)$, is one form in which living and embodied labour are interconnected. Economic analysis indicates that this dependence can best be described by means of a power function:

$$\frac{Y_t}{L_t} = a\left(\frac{K_t}{L_t}\right)^{\mu}, \qquad (8)$$

where a and μ are the parameters of the function, both positive, since labour productivity is an increasing function of the supply of assets per worker. The parameter μ quantifying this dependence is specially important; if $\mu > 1$, then the return on assets $Y_t : K_t$ rises; if $\mu < 1$, then it falls; while if $\mu = 1$, it is stable. Given uniform (exponential) growth in labour productivity and assets per worker, the parameter μ gives the average annual percentage growth of labour productivity due to a 1 per cent increase in the supply of assets per worker. This indicator can also be viewed as a criterion of the effectiveness of the growth in assets per worker.

In 1961-65 the parameter μ was roughly 0.6, and in 1966-70 around 0.8. Although it still remained less than unity, which indicated a lowering of the return on assets and a lagging of the growth of labour productivity compared to the increase in assets per worker, its absolute value increased and a favourable shift is occuring bringing the rates of growth of labour productivity and of assets per worker closer together; in 1971-75 the value of μ has risen to 0.85.

Now that the link between labour productivity and assets per worker has been established, it is possible to pass to the planning of national income growth rates in relation to the aggregate effect of living labour and the instruments of labour, while bringing out the role of each.

We can present the volume and the growth rates of national income as a function of two simultaneously operating variables, i.e. as $Y = f(L, K)$.

The causal relationship between national income growth rates and the trend in individual factors can be ascertained by calculating their incremental efficiency, i.e.

$$\Delta Y_L = f(L + \Delta L, K) - f(L, K)$$

or

$$\Delta Y_K = f(L, K + \Delta K) - f(L, K).$$

If we denote the respective indicators of incremental efficiency as F_L and F_K, then the increment in national income can be presented as the result of the aggregate effect of living labour and the instruments of labour:

$$\Delta Y = \Delta Y_L + \Delta Y_K = F_L \cdot \Delta L + F_K \cdot \Delta K.$$

If national income can be presented as a function of two variables (living labour and fixed production assets) $Y = f(L, K)$, then the factor growth of Y as a function of

L and K is a total differential of this function:

$$dY \frac{\partial Y}{\partial L} dL + \frac{\partial Y}{\partial K} dK.$$

In practical calculations of national income growth rates as a function of both types of social labour—living and embodied—it is better to use a simpler form of expression for this same relationship

$$y = F_L \cdot l + F_K \cdot k, \qquad (9)$$

where y, l, k are average annual rates of growth of national income, size of the labour force in material production, and production assets respectively.

An approximate estimate of the role of living labour and production assets in forming the growth rates of extended socialist reproduction can be obtained as a result of the joint mathematical manipulation of three dynamic series, national income, production assets, and the numbers employed in material production. On the whole indicators of factor productivity are estimated by using correlation methods.

The "production-function method" used in bourgeois econometrics is based on the vulgar theory of factors of production which holds that the productivity of a factor is determined by the income obtained from its use. Thus the parameters of productive function are determined on the basis of the market prices of factors of production. Such an approach is inapplicable in a socialist economy; but it is both necessary in practice and theoretically valid to construct multi-factor relationships showing the volume and dynamics of production as a function of the volume and dynamics of different types of productive resources. This approach is used in both macro-economic models and inter-sectoral tables. In macro-economic calculations the multi-factor approach is based on constructing regression equations of extended reproduction.

The simplest of these multi-factor relationships is a function of the type of

$$Y_t = aK_t^{\mu} L_t^{1-\mu}, \qquad (9a)$$

which is simply another form of equation (8). What is special about function (9a) is that the sum of the indicators of factor productivity is equal to unity: $\mu + (1 - \mu) = 1$; this means that an n-increase in inputs of fixed production assets and living labour also given an n-increase in the volume of national income. Thus function (9a) rests on the assumption that growth of national income is due solely to an increase in the physical volume of the input of social labour, i.e. is due to considerable extension of reproduction. This assumption, of course, is wholly arbitrary, especially in conditions of technological progress, but is quite admissible as a step towards a more complex form of inter-relationship as it makes it possible to illustrate the relative role of living labour and instruments of labour as factors of extended reproduction.

The simplest type of expression (9) linking national income rates of growth with rates of growth in fixed production assets and the size of the labour force in material production by means of the parameters of efficiency μ and $(1 - \mu)$ takes the form[1]

$$y = \mu k + (1 - \mu)\, l. \qquad (9b)$$

If the two-factor function of national income described above is used, it is fairly easy to determine the planned rates of growth of national income arising from different combinations of trends in fixed production assets and the size of the labour force in material production. In order to do this it is necessary to determine the range of possible values of k and l and with the help of the known coefficients μ and $(1 - \mu)$ to immediately find the probable rate of growth of national income. This calculation is shown in Table 4 on the assumption that $\mu = 0.4$.

Table 4 shows, for example, that if $l = 1.0$ and $k = 7.0$, then $y = 0.4 \cdot 7.0 + 0.6 \cdot 1.0 = 3.4$, i.e. there is a 3.4 per cent increase in national income every year. It is also important to note that the same increase in national income can be obtained with a different combination of k and l. For example, $y = 3.0$ per cent can be obtained if $k = 3.0$

[1] The quantitative value of parameter μ and therefore of $(1 - \mu)$ is also found by manipulating dynamic series using correlation methods.

Table 4

Annual Average National Income Growth Rates for Different Variants of the Average Annual Growth Rates of Fixed Production Assets and Numbers Employed (in Percentages)

l \ k	3.0	4.0	5.0	6.0	7.0	8.0	9.0
1.0	1.8	2.2	2.6	3.0	3.4	3.8	4.2
1.5	2.1	2.5	2.9	3.3	3.7	4.1	4.5
2.0	2.4	2.8	3.2	3.6	4.0	4.4	4.8
2.5	2.7	3.1	3.5	3.9	4.3	4.7	5.1
3.0	3.0	3.4	3.8	4.2	4.6	5.2	5.4
3.5	3.3	3.7	4.1	4.5	4.9	5.5	5.7

per cent and $l = 3.0$ per cent; or if $k = 6.0$ per cent and $l = 1.0$ per cent; or if $k = 4.0$ per cent and $l = 1.5$ per cent, etc. This feature of the method makes it possible to compare variants of economic development—either more labour-intensive or more capital-intensive—in the course of planning calculations.

Naturally, in the course of economic development, there is a change in the relative role of living labour and instruments of labour, just as there is in their incremental efficiency. This means that parameters F_L and F_K and their ratios $F_L : F_K$ should be regarded as variables depending on an increase in the scale of social production and on scientific and technological progress.

The very simple example we have just looked at suggests that the sum of the powers on the right-hand side of the function is equal to unity. The meaning of this constraint was explained above. An assumption more in keeping with conditions of scientific and technological progress is that production growth rates outstrip growth rates of inputs of living labour and fixed production assets, i.e. if for example K and L increase by 1 per cent then national income (Y)

increases more than 1 per cent. In the latter case it is assumed that the function $Y = f(L, K)$ takes the form

$$Y_t = aK_t^{\alpha}L_t^{\beta}, \text{ where } (\alpha+\beta) > 1. \tag{10}$$

Thus in analysing and planning national income growth rates account must be taken of the rise in the total efficiency of social production primarily as a result of scientific and technological progress. In this case the type of function shown above $Y_t = aK_t^{\alpha}L_t^{\beta}$ can be presented in the form

$$Y_t = aK_t^{\mu}L_t^{1-\mu}e^{\lambda t} \tag{10a}$$

or in conditions of uniform growth

$$y = \mu k + (1 - \mu)\, l + \lambda, \tag{10b}$$

where λ is the average annual growth rate of national income as a result of the rise in the total economic efficiency of living labour and instruments of labour.

Obviously in the case that $\lambda > 0$, national income grows at a faster pace than inputs of living labour and production assets which is a reflection of an increase in their total economic efficiency. For example, if $\lambda = 3.0$ per cent, then given that $\mu = 0.4$ per cent, $k = 7.0$ per cent, and $l = 2.0$ per cent, the national income growth rate will be, in accordance with equation (10b),

$$y = 0.4 \cdot 7.0 + 0.6 \cdot 2.0 + 3.0 = 2.8 + 1.2 + 3.0 = 7.0,$$

which roughly corresponds to the actual quantitative relationships in the dynamics of Soviet national income.

However, the multi-factor macro-economic function (10) and the functions (10a) and (10b) which are its transforms still do not fully reflect the process of national income growth. The size of national income is effected not only by increasing inputs of living labour and production assets and by changes in their efficiency, but also by other factors that are not taken into consideration (for example, the amount and quality of natural resources, the level of organisation and planning of production, structural shifts, etc.). The effect of these neglected growth factors can be conventionally represented as the influence of time on the process of economic growth; then national income becomes a function of three

variables: $Y = f(L, K, t)$. Using a three-factor function the equation of national income growth takes the form

$$Y_t = aK_t^{\mu} L_t^{1-\mu} e^{(\lambda+\gamma)t} \tag{11}$$

or in conditions of uniform growth

$$y = \mu k + (1 - \mu)\, l + \lambda + \gamma, \tag{11a}$$

where γ is the average annual growth rate of national income as a result of the influence of neglected (unidentified) factors.

The indicators of labour productivity and of the return on assets used in the first and second methods of planning national income growth rates can always be obtained from multi-factor macro-economic functions. Moreover, these indicators will appear in multi-factor functions due to their connection with other macro-economic indicators.

Using functions (9a), (10a) and (11), labour productvity can be presented as

$$\frac{Y}{L} = a\left(\frac{K}{L}\right)^{\mu}; \quad \frac{Y}{L} = a\left(\frac{K}{L}\right)^{\mu} e^{\lambda t}; \quad \frac{Y}{L} = a\left(\frac{K}{L}\right)^{\mu} e^{(\lambda+\gamma)t},$$

and the return on assets

$$\frac{Y}{K} = a\left(\frac{L}{K}\right)^{1-\mu}; \quad \frac{Y}{K} = a\left(\frac{L}{K}\right)^{1-\mu} e^{\lambda t}; \quad \frac{Y}{K} = a\left(\frac{L}{K}\right)^{1-\mu} e^{(\lambda+\gamma)t}.$$

Equations showing the change in labour productivity and the return on assets can be obtained in similar fashion by means of indicators of average annual incremental growth rates.

If multi-factor models are used, not only can the possible trend of national income over the planned period be quantitatively determined but the basic sources of economic growth can also be singled out. The analysis and forward calculation of extensive and intensive ways of extending production are especially important here.

The all-round intensification of social production, i.e. the achievement of high rates of economic growth not so much on account of an increase in the volume of inputs as of an increase in the efficiency of living labour and production assets is one of the main tasks facing the Soviet economy at its present stage. The present scientific and technological revolution has created the objective possibility and necessity

of intensive development of the Soviet economy, and the planning of growth rates of socialist extended reproduction is based on these objective conditions. Greater intensification of the whole of social production and improving its efficiency by accelerating scientific and technological progress is one main feature of the Tenth Five-Year Plan (1976-80). This trend will remain the general line of development of the Soviet economy over the long-term period ahead.

One of the main tasks in improving planning methodology is to work out methods of analysis and perspective calculations for extensive and intensive means of economic growth. Multi-factor models and related concepts and indicators enable an approach to be made towards tackling this complex problem successfully.

Concepts of extensive and intensive means of extending production arise from a comparative evaluation of the aggregate results of social production and its total inputs which has been adopted in Soviet economic theory and practice. By results we mean the physical volume of annual national income, and by inputs we mean the living labour and production assets which take part in production. Under this approach an increase in production commensurate with an increase in inputs can be viewed as *extensive* economic growth, while an expansion of production that outstrips the dynamics of the aggregate inputs should be regarded as *intensive* growth. Different approaches can be adopted for describing the extensive and intensive paths of growth based on comparison of the dynamics of output with some factor or other of production or of their totality. If the dynamics of output is compared solely with that of living labour, then extensive growth will be characterised by the increase in the quantity of output produced resulting from the increase in the amount of living labour, while intensive growth will appear as an increase in output due to a rise in labour productivity. A similar approach can be adopted in the case of production assets or any other factor of production taken in isolation. None of these one-factor approaches, however, can disclose a relationship between extensive and intensive means of growth close to reality. The fact is that an increase in the efficiency of any one factor of production, i.e. an increase in output by intensive methods, from the point

of view of using this factor, can be achieved to some extent or other by an extensive increase in some other factor. Thus, for example, the productivity of living labour rises because of an increase in the quantity of production assets used, i.e. through an increase in the supply of assets per worker.

An economically more valid approach consists in comparing the trend in the physical volume of output with the aggregate trend in production assets and living labour. Then an increase in the quantity of output produced due to an expansion in the physical amount of all factors of production will serve as a measure of extensive economic growth, while an increase in the quantity of output produced due to a rise in the total efficiency of the factors of production will be a measure of intensive economic growth. Such an approach requires a multi-factor analysis of economic growth, i.e. use of the method of macro-economic multi-factor production functions.

The growth equation makes it possible to determine the basic elements giving rise to economic growth rates and to pick out the relationship between extensive and intensive methods of expanding production. It is simplest to present these elements in relation to the indicator of the average annual incremental growth rate of the final social product, as the "contribution" made by the different elements to the overall increase in final product:

1. **the share of extensive growth factors** (increase in the physical volume of inputs of living labour and production assets) . . . . . $\frac{\mu k+(1-\mu)\,l}{y}$
2. **the share of intensive growth factors** (increase in the total efficiency of labour and assets) λ/y
3. **the share of fixed production assets** . . . . . $\alpha k/y$
   including the physical volume of fixed production assets . . . . . $\mu k/y$
   increase due to efficiency . . . . . $(\alpha-\mu)\,k/y$
4. **the share of living labour** . . . . . $\beta l/y$
   including the physical volume of inputs of living labour . . . . . $(1-\mu)\,l/y$
   increase of efficiency of living labour . . . . . $[\beta-(1-\mu)]\,l/y$
5. **the share of unidentified growth factors** γ/y

A high proportion of intensive sources of economic growth is characteristic of the Soviet economy. On average over the last twenty years over 40 per cent of the increase in social production has been secured by an increase in the aggregate economic efficiency of inputs of living labour and embodied labour. The average annual incremental growth rate of the indicator of total efficiency amounted to 3.3 per cent between 1951 and 1970, and it nearly doubled over the whole of the twenty years.[1] If high and stable growth rates are to be maintained in the Soviet economy at a time when the flow of labour into material production is diminishing and the proportion of consumption in national income is rising, there must be a change-over to primarily intensive methods of extending production.

All the methods of planning national income growth rates described above can be used even at the preliminary stage of compiling a macro-economic plan to show how the resources of a socialist economy can validly be allocated both for extending production and increasing consumption. Once the dynamics of national income has been decided, work can begin on planning the structure of the economy.

Finally the following important indicators are fixed in planning economic growth rates: the volume and growth rates of national income and its allocation between productive accumulation and consumption; the size and growth rates of the labour force engaged in material production; the growth rates of labour productivity; the volume and growth rates of production assets; changes in the efficiency of production assets; the relationship between living labour and production assets and between intensive and extensive sources of economic growth.

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[1] Detailed analysis and calculations are given in A. Anchishkin's book *Forecasting Growth in a Socialist Economy* (in Russian), Ch. X, Moscow, Ekonomika, 1973.

CHAPTER V

PLANNING THE STRUCTURE OF SOCIAL PRODUCTION

Planning of the sectoral and regional structure of social production is a vital stage in the drawing up of a plan of economic development. This section of the plan is the connecting link between the planning of growth rates and the key synthetic proportions of the economy and the detailed plans for developing the different sectors and economic regions of the country. It provides a sectoral and regional breakdown of such synthetic planning indicators as the volume of national income and of final and aggregate (gross) social product, the volume of investment in the economy and of manpower resources, the ratio between consumption and accumulation in national income and between departments I and II in social production, etc.

The planning of sectoral and regional structure also serves as a starting point for compiling detailed plans for the development and location of different economic sectors and the complex development of production in Union republics and different economic regions.

This sequence of events in drawing up a macro-economic plan should however be regarded as only a very general and, in a certain sense, formal description of the real planning process. Planning an economy is a complicated, iterative process in the course of which planning calculations that are being made simultaneously at all levels of plan compilation have continually to be corrected and coordinated until such time as a balanced, optimal variant of the plan has been obtained.

Planning the structure of social production essentially entails working out the basic indices for a macro-production programme. It is inseparably linked with all sections of the economic development plan: with the plan for capital construction, the labour plan, the plan for raising standards of living, the foreign trade plan, etc. The sectoral and regional structure of social production is determined in the course of the multiple, many-sided coordination of all sections of the national plan when each indicator is both a starting point and the result of various planning calculations. This process ends when proportional growth has been achieved at both the sectoral and the regional level and optimal use has been made of production resources.

1. FACTORS AFFECTING THE SECTORAL AND REGIONAL STRUCTURE OF SOCIAL PRODUCTION

Changes in the sectoral and regional structure of a socialist economy, reflecting the pattern of development of the social division of labour, are determined by a whole set of very diverse factors; and it is one of the main jobs of structural planning to assess them both qualitatively and quantitatively. The direction in which all these factors affecting the structure of social production operate is determined by the nature of the socialist economy, by the objective need to ensure that material, labour, and natural resources are used in such a way as to satisfy the needs of its members to the maximum. The most effective or optimal structure for socialist production is that which uses the production resources of socialist society to secure the maximum possible satisfaction of its members' needs.

In talking about the goal-directed planning of a socialist society, Engels stressed that socialist society "... will have to arrange its plan of production in accordance with its means of production, which include, in particular, its labour-power. The useful effects of the various articles of consumption, compared with one another and with the quantities of labour required for their production, will in the end determine the plan".[1]

[1] Frederick Engels, *Anti-Dühring*, Moscow, 1975, p. 367.

Since maximum satisfaction of people's needs is the optimality criterion adopted in a socialist society's economic plans, the task of measuring the social values, the "useful effects" of consumer goods and services, is one of the most vital and complex ones in macro-economic planning.

In planning the structure of production of consumer goods and services, account should be taken of the laws governing the generation of personal income and demand, the way in which the structure of consumption depends on the level of incomes, relative prices of goods and services, the sex, age and social composition of the population, etc. It is of great importance, especially in perspective planning, to fix valid dietary standards and rational consumption standards for various products.

Factors Determining Sectoral Structure

The following are among the most important factors determining the sectoral structure of social production.

(1) *The structure of the needs of the members of socialist society.* Given the existence of commodity-money relationships in a socialist economy, this finds direct expression in the structure of the public's effective consumer demand and in the structure of social consumption funds.

(2) *Economic growth rates.* Other things being equal, the share of productive accumulation in national income must be increased in economic growth rates are to be speeded up and this requires much higher rates of output growth in those sectors producing the means of production. Any lowering of the share of productive accumulation and raising of the share of consumption in national income will lead, other things being equal, to relatively higher rates of growth in the volume of output in those sectors producing consumer goods.

(3) *The nature and pace of technological progress in the economy.* Technological progress may be accompanied by an increase in either the assets or the materials intensity of production. In both cases faster growth is evident in those sectors producing means of production, though in the first case those sectors producing the implements of labour show

the fastest growth rates, and in the second those supplying the sphere of material production with the objects of labour. Technological progress in the economy is expressed through improvement of the implements of labour, the development of more economic objects of labour, improvement of the fuel and power base, etc. This leads to continuous change in the standard inputs of different types of material resources in production, to the emergence of new branches of production and to different output growth rates in different sectors of the economy.

If higher-than-average growth rates are achieved in progressive sectors producing advanced equipment, raw and other industrial materials, and fuel and power resources, then social production will reach its maximum efficiency.

(4) *The availability of natural resources* (minerals, land, etc.).

(5) *The country's position in the world system of the social division of labour.* The planning of foreign economic relations and the specialisation of domestic production must take account of the advantages offered by the international division of labour and should help increase the efficiency of the socialist economy to the maximum extent possible.

(6) *The need to maintain defence capacity at the appropriate level in conditions of capitalist environment.*

Each of these factors plays a different role at different stages of economic development. The planners' job is to decide on the relative importance of the factors affecting the sectoral structure of social production in the particular planned period and to provide an accurate quantitative estimate of their joint impact.

A law of the development of a socialist economy is higher growth rates of production in those sectors making advanced implements of labour, objects of labour, and sources of power which form the necessary base for steady rapid improvement of the effectiveness of social production.

In group A industries those sectors are developed at accelerated growth rates that ensure the maximum acceleration of scientific and technological progress in the economy, reduce the aggregate expenditure of resources on production, and improve the social productivity of labour. This explains why the growth rates of the engineering, chemical and power industries are higher than the average for industry and the

economy as a whole, and why the weight of oil and gas in the fuel and power balance is rising, and other progressive changes are taking place in the structure of social production.

Factors Affecting Regional Structure

The distribution of the productive forces over the country is an important aspect of the social division of labour. The specific factors determining the regional structure of socialist production include the following:

the distribution of effective personal demand throughout the country and the need to equalise living standards in different economic regions;

the location of sources of raw materials, fuel and power;

the distribution of the labour force throughout the country and the need to ensure full employment, taking into account possible migration;

the need to ensure comprehensive development of the various economic regions; and

ensuring of defence capacity.

2. METHODS OF PLANNING THE SECTORAL STRUCTURE OF SOCIAL PRODUCTION

The continuing pace of technological progress, the increase in the social division of labour and the scale of a socialist economy makes the task of ensuring the proportional development of different sectors and economic regions increasingly difficult and increasingly important. At the present time proportionality in macro-economic development plans is mainly achieved through the wide-scale use of input-output planning methods in compiling them.

These methods have largely been improved through the application of economic-mathematical methods and models and modern computers. This has made it possible to express the complicated quantitative interrelationships arising in the course of social reproduction with a considerably greater degree of accuracy in the plan, to evaluate the effect of a whole complex of factors on the trend of economic growth indices, and to make a comprehensive review of the different alternatives for economic development.

The Static Inter-Sectoral Input-Output Model

The static economic-mathematical model of inter-sectoral tables of the production and distribution of output is the most methodologically advanced and experimentally tested model used in the practical work of making planning calculations.

A static inter-sectoral model is made up of a combination of input-output relationships describing the distribution of output in the economy and functional relationships expressing the relationship between volume of output and inputs required for its manufacture.

The output of a sector can be divided into two parts, each playing a different role in social production—intermediate and final output.

Intermediate output is that part of sectoral output which is sent to other branches of material production for further processing and which comprises the current material inputs for production in those sectors and the stock of current productive consumption.

Final output is that part of a sector's output which finally leaves the field of current production and is used for personal and social consumption, the replacement of assets withdrawn from use, capital repairs and the accumulation of fixed assets, the accumulation of circulating assets, stocks and stockpiles, and the formation of a favourable balance of foreign trade.

Output is divided into intermediate and final not in accordance with the physical form in which it is produced in a particular sector but exclusively in accordance with those economic functions it fulfils in social reproduction.

For example, the coal used to fire thermal power stations is an intermediate product forming part of the current material inputs required for the production of electricity. Coal that is sold as fuel to the general public or stockpiled leaves the sphere of current material production and is counted as final output. Textiles used for productive consumption in the clothing industry are intermediate goods; fabrics sold to the public are final goods.

The total volumes of intermediate and final output in all branches of production throughout the economy comprise respectively the intermediate and final product of social production.

The quantitative proportions between intermediate and final output in different sectors of the economy are important in ensuring the proportional development of the socialist economy and in making a proper assessment of the main factors affecting growth rates in some or other sector.

It is possible to describe the country-wide allocation of output from any branch of material production by the following input-output relationship:

$$X_i = x_{i1} + x_{i2} + \ldots + x_{ij} + \ldots + x_{in} + Y_i \quad (i, j = 1, 2, \ldots, n), \tag{1}$$

where X_i—the volume of gross output in the ith sector;
x_{ij}—the volume of output in the ith sector destined for productive consumption in the jth sector;
Y_i—the volume of final output in the ith sector.

An input-output relationship showing the way that the social costs of production are generated in each branch of material production can be established at the same time:[1]

$$X_j = x_{1j} + x_{2j} + \ldots + x_{ij} + \ldots + x_{nj} + D_j \quad (j, i = 1, 2, \ldots, n), \tag{2}$$

where X_j—the social costs of production in the jth sector (coinciding in value terms with the volume of gross output);
D_j—the volume of standard-net output produced in the jth sector.

The volume of standard-net output is equal to the total depreciation charges on fixed productive assets and the net output produced in the sector. The total standard-net output in all branches of material production constitutes the value of the final social product:

$$\sum_{i=1}^{n} Y_i = \sum_{j=1}^{n} D_j. \tag{3}$$

[1] These equations are worked out in value terms during the compiling of inter-sectoral tables.

Table 5

Basic Scheme of the Inter-Sectoral Input-Output Table of the Production and Distribution of the Economy's Output

(in value terms)

Inputs for production \ Distribution of output		Allocation of output for productive consumption (intermediate output): 1, 2, . . ., j, . . ., n	Total	Final output	Gross output
Value of current material inputs	1	$x_{11}, x_{12}, \ldots, x_{1j}, \ldots, x_{1n}$	W_1	Y_1	X_1
	2	$x_{21}, x_{22}, \ldots, x_{2j}, \ldots, x_{2n}$	W_2	Y_2	X_2
	.	.	.	.	.
	.	.	.	.	.
	.	.	.	.	.
	i	$x_{i1}, x_{i2}, \ldots, x_{ij}, \ldots, x_{in}$	W_i	Y_i	X_i
	.	.	.	.	.
	.	.	.	.	.
	.	.	.	.	.
	n	$x_{n1}, x_{n2}, \ldots, x_{nj}, \ldots, x_{nn}$	W_n	Y_n	X_n
	Total	$C_1, \ldots, C_2, \ldots, C_j, \ldots, C_n$	$C=W$	Y	X
Value of final output	Standard-net output	$D_1, D_2, \ldots, D_j, \ldots, D_n$	D	Incomes in the non-productive sphere	
	Gross output	$X_1, X_2, \ldots, X_j, \ldots, X_n$	X		

A scheme for an inter-sectoral table can be compiled by using relationships (1) and (2) which provide a characteristic of the distribution of output in the economy and the structure of the inputs on its production (Table 5).

This scheme is really two superimposed tables, one, the "horizontal" (quadrants I and II), shows how output is used in the economy and the other, the "vertical" (quadrants III and IV), describes the formation of current material inputs

and the inputs of primary productive resources for the production of output.

Each quadrant in the table reflects organically interconnected moments in the process of social reproduction.

The inter-sectoral links of current production are reflected in quadrant I. The allocation of output from each sector for the needs of productive consumption in the various branches of material production is shown along the rows in quadrant I, while the columns show the formation of current material inputs (raw and other materials, fuel and electric power) for production in any given sector. Thus quadrant I of the inter-sectoral table describes the productive circulation of raw materials and other industrial supplies in the economy.

Quadrant II shows the way that final social product is used for meeting personal and social consumption needs, replacing fixed production assets that have been withdrawn, generating funds for extending production and developing the non-productive sphere of the economy, and implementing foreign economic relations.

Quadrant III gives the sectoral breakdown for the distribution of national income—the generation of primary incomes in material production (workers' income; profit and other forms of the net income of enterprises in the state and collective farm (cooperative) sectors; and turnover tax). The amortisation of fixed production assets is shown in the same quadrant.

The incomes of enterprises, institutions, and persons engaged in the non-productive sphere of the economy, obtained through the redistribution of national income, are shown in quadrant IV.

The USSR Central Statistical Board first compiled an accounting inter-sectoral input-output table of the production and distribution of output in the Soviet economy for 1959. It described the country-wide production and distribution of output for 83 branches of material production, including 73 industries, two branches of agriculture, the timber industry, construction, transport, trade, procurement of farm produce, supply of materials and technical equipment, and other branches of material production. The Board also compiled a similar input-output table for the

same year, covering 157 industrial items in physical terms.

The Central Statistical Boards of the USSR and Union republics also drew up such accounting inter-sectoral input-output tables for the Soviet Union as a whole and the Union republics separately for 1966 and 1972. The table for the Soviet Union, expressed in value terms, covered 110 branches of material production, which naturally raised its analytical value and the possibility of using it in planning. Along with the table in value terms, the USSR Board also compiled a commodity table in physical terms in which 237 product groups were identified. Experimental planning calculations are being undertaken using economic-mathematical input-output models at the Economic Research Institute attached to USSR State Planning Committee (Gosplan), the Central Economic-Mathematical Institute of the USSR Academy of Science, the Institute of the Economics and Organisation of Industrial Production, of the Academy's Siberian Branch, and research organisations in the Union republics.

USSR Gosplan compiled an inter-sectoral input-output table for 1970-75 in physical and value terms, and with an annual breakdown (covering 257 products, 25 industrial ministries and 20 economic sectors and industries), and an aggregate inter-sectoral table in value terms for the same period (using a dynamic model).

The planning bodies and research organisations employed models of inter-sectoral input-output tables to determine the growth rates and structure of social production for the period 1976-90, with fundamental treatment of the problems of economic development during the Tenth Five-Year Plan period. For the long-term outlook a set of physical and value tables for 120 products and types of product was adopted, and for 1976-80 tables for 260 items. To check the calculations and estimates, Gosplan's Economic Research Institute and the sectoral institutes of ministries and departments, worked out more than 12,000 input coefficients.

When inter-sectoral input-output tables are used for the planning calculations of the sectoral structure of social production, it is usually assumed that the volume of current productive consumption of output from the ith sector in sector j (x_{ij}) is directly proportional to the volume of

production in the jth sector:

$$x_{ij} = a_{ij}X_j \quad (i, j=1, 2, \ldots, n), \tag{4}$$

where a_{ij} are the coefficients of direct current material inputs for production in the ith sector per unit of output in the jth sector.

In the light of equation (4), the intput-output relationships shown by (1) on p. 154 can be written as

$$X_i = \sum_{j=1}^{n} a_{ij}X_j + Y_i \quad (i=1, 2, \ldots, n) \tag{5}$$

(Similar equations form an input-output model of the production and distribution of output in physical and physical plus value terms.)

The system of equations (5), containing n linear equations and $2n$ variables (n values of the volumes of output X_i and n values of the volumes of final output Y_i), forms a static inter-sectoral input-output model of the production and distribution of output in the economy.

Use of a static model makes it possible, given n values from $X_1, \ldots, X_n$ and $Y_1, \ldots, Y_n$, to find the remaining n values. Thus, if the volumes of output in sectors X_i ($i = 1, 2, \ldots, n$) are given in the economic development plan, then according to the formula

$$Y_i = X_i - \sum_{j=1}^{n} a_{ij}X_j$$

the volumes of final output Y_i are determined in all n sectors.

If the values of final output Y_i in the different sectors are given,[1] then the set of equations

$$X_i = \sum_{j=1}^{n} a_{ij}X_j + Y_i \quad (i=1, 2, \ldots, n)$$

makes it possible to determine the volume of production of gross output in sectors X_i, required by the planned level of material inputs in order to achieve the planned final

[1] In order to solve certain planning problems the input-output model can be used in such a way that k values of final product and $n - k$ values of gross output are given so that, as a result of solving the equations, $n - k$ values of final output and k values of gross output are determined.

output in sectors Y_i. The volumes of sectoral output are found from the formula

$$X_i = \sum_{j=1}^{n} A_{ij}Y_j \quad (i=1, 2, \ldots, n), \tag{6}$$

where A_{ij} are the coefficients of the total inputs for production in the ith sector per unit of final output in the jth sector.

The system of linear equations (6) in the static input-output model is written in matrix form as

$$(E - A)\, X = Y,$$

and its solution, when the vector of gross output volumes in sectors $X = (X_1, X_2, \ldots, X_n)$ is unknown, as

$$X = (E - A)^{-1}Y,$$

where E—a unity matrix;
$(E - A)^{-1}$—the inverse of the matrix $(E - A)$.

The elements of matrix $(E - A)^{-1}$ are the coefficients of total inputs (A_{ij}) for production in the ith sector per unit of final output in the jth sector. The coefficients of total inputs, unlike those of direct inputs, are taken as both direct and indirect inter-sectoral linkages arising in production.

In planning the sectoral structure of social production on the basis of a static inter-sectoral input-output model in the light of the known volume of final output in the sectors of material production ($Y_1, Y_2, \ldots, Y_n$) and planned coefficients of direct material inputs for production of output (a_{ij}), the planning indicators of the volumes of output in sectors ($X_1, X_2, \ldots, X_n$) needed to secure the planned volume of final output are determined.

The process includes the following stages:

(1) fixing the planned values of final output in sectors of material production that will satisfy society's final needs for consumption and accumulation;

(2) fixing the coefficients of current material inputs for production, taking into account the results of scientific and technological progress during the planned period;

(3) computing the coefficients of total inputs for producing a unit of final output;

(4) fixing the planned volumes of sectoral output necessary to ensure the planned volume of final output.

A quantitative estimate of those factors determining the sectoral structure of social production is also made in the course of planning the sectoral structure of final social product and the coefficients of direct material inputs for production.

The Sectoral Structure of Final Social Product

As has already been pointed out, final output from the different branches of production satisfies the following social needs: personal consumption; social consumption; the replacement of withdrawn assets and capital repair of fixed production and non-production assets; the accumulation of fixed production and non-production assets; the accumulation of circulating assets; an increase in stocks of goods and stockpiles; and the foreign trade balance.

The final social product, which is the sum total of the final output in all sectors, exceeds the volume of national income used by the amount of replacement of withdrawn assets and capital repair of fixed production-assets.

The overall volume and principal components of final social product are calculated in the early stages of compiling a macro-economic plan when such synthetic indicators of socialist economic growth as the volume of national income and final social product, the amount of personal and social consumption, productive and non-productive accumulation, etc., are set.

These synthetic calculations are based on a planned hypothesis concerning the number employed in material production and the increase in social labour productivity; the dynamics of production assets and changes in the return on them; the share of productive accumulation in national income and its probable effectiveness; the need for a maximum possible rise in people's living standards; strengthening of the country's defence capacity; the development of foreign economic relations, and so on. Thus, in planning the structure of final social product, attention is paid to the

need to tackle vital socio-economic tasks in economic development over the planned period.

Once the overall volume and principal components of final social product have been fixed, calculations must be made regarding its sectoral structure.

Aggregate consumption—both personal and social—forms the largest share of final social product. The Soviet economy has now reached the stage in its development when both growth rates and structure are increasingly determined by the task of raising living standards, by the trend and structure of consumer demand, and by the need to satisfy non-production needs in socialist society.

Aggregate consumption falls into two: personal consumption and social or collective consumption which is equal to the volume of material inputs in the non-production sectors providing services to the general public either free or on a paying (or concessionary) basis.

Personal consumption constitutes that part of available national income which is partially paid for out of individual incomes earned according to the quantity and quality of work done and partially from social consumption expenditure which is not directly connected with the distribution of income according to work done.

In dividing income fund of the general public into funds for personal incomes and social consumption, socialist society proceeds from the need (a) to stimulate growth of labour productivity and the effectiveness of social production, (b) to create the most favourable conditions for satisfying people's educational, health, and other needs, and (c) gradually to equalise the living standards of the various socio-economic groups.

Planning the sectoral structure of personal and social consumption especially that part which is met out of social consumption expenditure has its own specific features.

The sectoral structure of personal consumption is estimated under the following headings: purchases in state and cooperative retail trade; purchases on the collective farm market, both in town and country; consumption in kind (own production); and the domestic consumption of water, gas, and electricity.

In planning the sectoral structure of personal consumption indirect methods play an important role. Thus, in determining the structure of consumer demand account has to be taken of its dependence on levels of income, the relative prices of consumer goods and services, the regional distribution of population, and its sex, age, and social composition, etc.

While taking these factors into account in planning the sectoral structure of personal consumption, especially when compiling perspective macro-economic plans, it is important to work out valid dietary standards and rational consumption standards for non-food products as well as standards regarding the provision of various services to the general public. These methods for formulating the structure of consumption on a social basis rely on fixing the degree of social usefulness of various consumer goods and services which is a necessary condition for producing valid development plans for a socialist economy. An essential factor determining the sectoral structure of the personal consumption fund, especially when drafting current development plans of the economy, is the production potential of a number of sectors.

The sectoral structure of the social consumption fund is estimated for the following sectors of the non-productive sphere of the economy: housing and communal services and utilities; passenger transport; communications (that part serving the non-productive sphere); education and culture; health services; science and scientific services; and administration.

Attention should be paid to the specific nature of planning the sectoral structure of material inputs in non-production sectors providing free, chargeable and concessionary services to the general public. In planning the structure of material inputs in those sectors providing services that have to be paid for, in which case the consumer bases his choice on their price and his own income level, wide-scale use should be made of indirect methods establishing the dependence of the structure of consumer demand on the relative prices of goods and services and the level of per capita income. In planning the structure of material inputs in those sectors which provide the public with free services (for example, in the health service), the decisive role belongs to the principle of fixing objective standards, since the level of demand for these services is mainly determined by the existing level of need and the country's social policy.

Planning calculations of the sectoral structure of the replacement of withdrawn fixed production assets and their accumulation have to reflect (a) the need to increase the weight of plant and machinery in investments, and continually to renew production equipment and achieve the most efficient ratio between the reconstruction of existing enterprises and the building of new ones, and (b) the need to increase, through investment, the output of those sectors that ensure technological progress in the economy. Special attention should be paid to planning the introduction of new advanced types of machinery, equipment and installations which form the basis for an increase in the economic efficiency of social production.

The sectoral structure of exports and imports in the planned period is determined by the place of the country in the world division of labour, the coordination of economic development plans between socialist countries, and the tasks involved in improving the effectiveness of foreign trade.

The sectoral structure of the final product in the planned period is obtained as a result of calculating the sectoral structure of each of its components. In doing that the data provided by accounting inter-sectoral input-output tables is very useful, especially when several such tables are available and together present a fairly long-run dynamic series of indicators.

When planning inter-sectoral input-output tables are being drawn up, it is usual to calculate several variants, differing in the component and sectoral structure of the final social product. Analysis of these variants enables an all-round assessment to be made of the whole complex of social and economic factors affecting the choice of economic development plan.

The Coefficients of Direct Material Inputs

The coefficients of direct material inputs for production describe the inter-sectoral relations in current production. Their level is a factor which determines the volume of

production of raw materials and other industrial supplies, necessary to ensure the planned volume and sectoral structure of the final social product. These coefficients reflecting the pace and character of technological progress in the economy constitute, together with final social product, a key factor affecting the sectoral structure of social production.

In value terms these coefficients are an aggregated norm of the expenditure of output in one sector per rouble of gross output in another. When the table is compiled in physical terms, the coefficients describe the inputs of one product per unit output of another product.

The level of these coefficients during the planned period depends on the level of development of technique and the technology of production, its forms of social organisation, the distribution of the productive forces throughout the country, the proportions of different products in the gross output of a sector, and the efficiency of the technological means of producing them, the development of new types of materials and sources of fuel and power, etc.

These coefficients are calculated in the same way as the sectoral structure of the final product, in accordance with the sectoral coverage of the planning inter-sectoral input-output table for the national production and distribution of output.

The tables now being compiled in value terms describe the country-wide production and distribution of the output of more than 100 different sectors, which makes it possible to take fairly effective account in the coefficients of direct material inputs of any vital changes in the technique and technology of production, and which corresponds to the needs of sectoral planning and macro-economic direction and management. The physical tables include roughly 500 product groups.

The main criterion for combining different products in a sector, that is a major structural component of the planning input-output table is the homogeneity of the structure of their inputs. Consistent observance of this principle enables the effect of changes in the proportion of products made in a particular sector on sector-average coefficients of direct material inputs to be eliminated. The functional purpose of

different products, the types of raw materials, the technologies used, etc., of course, must be taken into account.

There are two basic methods of determining the planning coefficients of direct material production inputs:

(1) the method of direct calculation of these coefficients in value terms on the basis of coefficients of physical inputs; use of this method is most appropriate when the sector produces a fairly small quantity of products;

(2) the method of correcting base input coefficients.

In the first case planning coefficients of the direct material inputs of the sectoral output of the ith sector per unit of gross output in the jth sector are calculated from the formula

$$a_{ij} = \frac{k_i}{k_j} \sum_{k=1}^{m} \sum_{l=1}^{n} W_{kl} d_{lj} \frac{p_k}{p_l} a_{kl} \qquad (7)$$

where a_{ij}—the coefficient of direct inputs of the output of branch i per unit of gross output of branch j in value terms;

W_{kl}—the proportion of product k obtained from elsewhere in the total inputs of product k on product l;

a_{kl}—the coefficient of input of product k per unit of product l in physical terms;

d_{lj}—the proportion of product l in the input of sector j;

p_k—the price per unit of product k;

p_l—the price per unit of product l;

m—the number of products k going to sector i;

n—the number of product l going to sector j;

$k_i k_j$—the coefficients for converting the enterprise's wholesale prices into final consumer prices.

Thus the level of the coefficients of direct inputs in value terms depends on the magnitude of the corresponding coefficients of direct inputs in physical terms, on the ratio of the prices of materials and output, on the product mix or structure of the sector's gross output, and on the degree of combination, specialisation, and cooperation in the branches concerned.

When calculating these planning coefficients of direct material inputs by correcting the base coefficients, the principal factors determining their trends are quantified.

When dynamic series of accounting coefficients are available, wide use can be made of mathematical statistical methods to determine the value of the planning coefficients.

These coefficients of direct material inputs have a different degree of importance from the angle of their effect on determining the values of the planned volumes of output in the different sectors needed to ensure the planned volume and sectoral structure of the final social product. For example, when changes greater than 100 per cent were made in 3,677 separate coefficients (86.3 per cent of the non-zero coefficients) used in the inter-sectoral input-output matrix for the Soviet economy in 1959, the volume of gross output in a sector, given final sectoral output, changed less than 1 per cent.

From what has been said it follows that a key principle in organising planning work on determining coefficients of direct material input for the planned period is that only those major coefficients playing a decisive role in the planning calculations of sectoral structure of social production using an inter-sectoral input-output table (several hundred coefficients) need be validated in detail technically and economically. The remaining ones can be drawn from the accounting inter-sectoral input-output tables compiled by the statistical boards or corrected on the basis of expert appraisals.

The Concept of a Sector and the Evaluation of Output in a Value Inter-Sectoral Input-Output Table

The concept of a sector or industry in planning the structure of social production using an economic-mathematical inter-sectoral input-output model differs from that adopted in statistical and planning practice. A "pure" sector is taken as the aggregate of the products that are classified as belonging to a particular sector.

In statistical and planning practice an economic sector is regarded as the aggregate of the enterprises mainly producing goods belonging to a particular sector. Thus, in statistical and planning practice a sector is distinguished on the basis of a combination of administrative, economic, and

functional-production principles, while in planning calculations for an inter-sectoral input-output model, the concept of a sector is formulated solely on the basis of the functional-production principle.

This is principle of decisive importance in medium- and long-term macro-economic planning, while the concept of an economic sector is important in the current planning of social production. Economic-mathematical inter-sectoral input-output models that distinguish economic sectors directed by ministries are an instrument of current production management but not a tool for perspective planning, for which the identification of needs and products, and of the production resources necessary to meet them, are of decisive importance.

The evaluation of output in an inter-sectoral table is very important for accurate planning calculations of the structure of social production on the basis of an inter-sectoral model.

Output can be evaluated for an inter-sectoral table, as for the economy as a whole, in one of two price systems: in producer prices or in final consumer prices.

Producer prices are those in which the volume of the output produced by the separate production units of the economy are calculated. They include the prime costs of output (costs both of production and distribution) and profits, the scale of which is determined in accordance with the principles of price fixing adopted in the economy. The following types of producer prices exist at the present time: wholesale prices of industrial enterprises, delivery prices for state farm produce, purchasing prices for collective farm output, estimated costs of construction, and tariffs for freight and communications serving material production.

Final consumer prices are those under which goods enter into productive or non-productive use. Final consumer price is equal to the producer price plus turnover tax and supplementary charges for transport and trading connected with the sale and distribution of the various sectors' output.

Accounting inter-sectoral input-output tables of production and distribution for 1959, 1966 and 1972 compiled by the USSR Central Statistical Board were drawn up in

final consumer prices; and because of that the planning inter-sectoral tables were also compiled in these prices.

It is, however, preferable to use producer prices to estimate output for planning calculations of the structure of social production, using economic-mathematical inter-sectoral input-output models. This is because:

(a) the output of particular enterprises is calculated and planned in producer prices; and the sectoral growth rates in the national plan are determined on their basis; labour productivity, the capital intensity of production, and other economic parameters are all calculated in these same prices;

(b) producer prices enable one to discern inter-sectoral production relations more accurately whereas final consumer prices reflect changes in the conditions affecting the transportation, distribution, and sale of the output of sectors. These conditions, it must be remembered, are less stable than production links, which is an important consideration since direct input coefficients taken from accounting input-output tables have to be used in planning calculations.

Coefficients of Total Input

The coefficients of total input of gross output per unit of final output are indicators linking the volume and sectoral structure of the final and gross social product. They are used as an efficient economic instrument for ensuring proportionality in the development of the different sectors of the economy and as interconnections between various planning indicators. They are calculated by computer using coefficients of direct material input.

Unlike coefficients of direct material input, the coefficients of the total input of the output of one sector per unit of final output in another sector characterise indirect input along the entire production chain as well as direct inputs.

For example, the coefficient for total inputs of fuel used in the mechanical engineering industry reflects not only the direct inputs of fuel but also the inputs for the metal required for producing engineering goods, the fuel inputs

for generating the electricity used in producing the metal consumed in the engineering industry, and so on.

Now that total input coefficients can be calculated on computers, planning calculations regarding the sectoral structure of social production can take into account all actually existing linkages in production. And this is of the utmost importance in establishing proportionality in the development of the economy.

In certain instances total input coefficients exceed direct input coefficients several times over (on average by 1.5 to 2 times). Thus, according to data in the inter-sectoral accounting input-output table for 1972, the total input of coal for producing ferrous metals was nearly four times (3.8) the direct input, and for the generation of heat and power by 40 per cent; the total input of ferrous metals in the production of tractors, farm machinery, and spare parts was 90 per cent greater than the direct input; in the production of forge and press equipment it was 60 per cent greater.

The matrix of the coefficients of current direct material input contains a significant number of null coefficients, which signifies the absence of direct production links between the sectors and products concerned. There are no such coefficients in the matrix of total input coefficients, implying complete production interdependence between the sectors quantitatively expressed by the level of the total input coefficients.

In addition to this type of total input coefficient, coefficients of the total input of living labour and production assets per unit of final output are calculated from the static planning model of the inter-sectoral input-output table; they serve as a planning instrument for securing a proper balance between final and gross social product, manpower, and assets.

Coefficients of total inputs of living labour per unit of final output in sectors (T_j) are calculated by solving the following system of linear equations:

$$T_j = t_j + \sum_{i=1}^{n} T_i a_{ij} \quad (j = 1, 2, \ldots, n), \tag{8}$$

where T_j—the total input of living labour per unit of final output in the jth sector;

t_j—the direct input of living labour (labour expenditure per unit of product) per unit of output in the jth sector;

a_{ij}—the coefficients of direct material input of the output of the ith sector per unit of output of the jth sector.

As is evident from equation (8), total inputs of living labour per unit of output T_j are made up of direct inputs of living labour for producing output in a given sector (t_j) and inputs of living labour embodied in the means of production used up in producing output j $\left(\sum_{i=1}^{n} T_i a_{ij}\right)$.

The unknown quantities—the coefficients of total inputs of living labour per unit of final output—are determined as a result of solving these equations:

$$T_j = \sum_{i=1}^{n} t_i A_{ij} \quad (j = 1, 2, \ldots, n), \tag{9}$$

where A_{ij} are the coefficients of total inputs for output in the ith sector per unit of final output in the jth sector.

The coefficients of total input of production assets per unit of final output are calculated in the same way as those of total input of living labour:

$$F_j = f_j + \sum_{i=1}^{n} F_i a_{ij} \quad (j = 1, 2, \ldots, n) \tag{10}$$

where F_j—the coefficients of the total input of production assets per unit of final output in the jth sector;

f_j—the direct input of production assets (assets per unit of output) per unit of output in the jth sector.

The solution to the system of equations (10) is

$$F_j = \sum_{i=1}^{n} f_i A_{ij} \quad (j = 1, 2, \ldots, n). \tag{11}$$

Table 6 shows the total input coefficients calculated for the input-output table of the Soviet economy for 1966.

Table 6

Coefficients of Total Material Inputs, Production Assets and Manpower per Unit (Rouble) of Final Sectoral Output in 1966

Sector (or industry)	Coefficients of material inputs	Coefficients of inputs of fixed production assets	Coefficients of labour input (average annual number of workers per million roubles of output)
Ferrous and non-ferrous metallurgy	1.444	2.641	263
Fuel industries, including:	0.936	2.380	250
coal-mining	1.101	2.115	383
oil-extracting	0.812	1.998	159
heat and power	0.738	4.032	178
Chemical industry	1.359	2.016	244
Timber, paper and wood-working industries	1.221	1.764	410
Building materials industry	1.197	2.408	324
Light industry	1.509	0.782	309
Food industry	1.320	1.103	371
Agriculture and forestry	0.536	1.314	568
Building and construction	1.159	1.355	387
Transport and communications	0.476	2.656	297
Trade, procurement of farm produce, and material and technical supply	0.318	1.494	488
Average for the economy	1.147	1.331	379

The coefficients of labour (t_j) and assets (f_j) per unit of product together with the coefficients of the direct material input on producing output (a_{ij}) form the normative basis of a static inter-sectoral planning input-output model of production and distribution. A change in these coefficients characterises one of the most important aspects of economic development and is determined by the pace and character of technological progress in the economy and the relative shortage of manpower and investments and other factors which should be quantified when fixing their level in the planned period.

Planning coefficients of total inputs of labour and production assets per unit of final output can be used to link the planned volume and sectoral structure of final social product with the quantity of labour and production assets needed to produce it:

$$F = \sum_{j=1}^{n} F_j Y_j, \tag{12}$$

$$T = \sum_{j=1}^{n} T_j Y_j, \tag{13}$$

where F—the total of production assets in the economy during the planned period;

T—the total quantity of living labour that must be expended in the sphere of material production during the planned period;

Y_j—the final output in the jth sector.

Coefficients of total material inputs per unit of final output (A_{ij}) can be used for determining what volume of gross social product and output in each sector should be produced in order to ensure the planned-for volume and sectoral structure of the various components of final social product—consumption, productive and non-productive accumulation, and export.

This calculation can be done using the formula

$$X^p = (E - A)^{-1} Y^p, \tag{14}$$

where $Y^p = [Y_1^p, Y_2^p, \ldots, Y_n^p]$ is the vector of output in the different sectors constituting a certain component p of final social product.

Thus, the possibility is created for macro-economic planning calculations to take into account what correctives should be made in planning indicators of the development of different branches of production, if changes occur in planning projections of the volume and sectoral structure of personal consumption, investments, exports and imports, etc. It is important to emphasise that full account is thereby taken of the interconnections between all sectors in the process of production.

Coefficients of the total macro-economic consumption of materials, labour, and assets per unit of product of certain economic-functional components of the final social product are very important in drawing up plans for developing the economy and correlating the relevant synthetic and sectoral calculations. They are calculated in the following ways:

(i) coefficients of the total materials per unit of component p of the final social product (B^p)

$$B^p = \sum_{j=1}^{n} B_j y_j^p \tag{15}$$

(ii) coefficients of the total labour per unit of component p (T^p)

$$T^p = \sum_{j=1}^{n} T_j y_j^p \tag{16}$$

(iii) coefficients of the total assets used per unit of component p (F^p)

$$F^p = \sum_{j=1}^{n} F_j y_j^p \tag{17}$$

where $B_j = \sum_{i=1}^{n} A_{ij}$—coefficients of total input of the gross output of all sectors per unit of final output in the jth sector;

T_j, F_j—coefficients of the total input of labour and production assets respectively per unit of final output in the jth sector;

y_j^p—the relative weight of output from the jth sector in component p of the final social product.

The coefficients of the total inputs of gross product, labour, and production assets per unit of sectoral and economic-functional components of final social product can be used to coordinate the sectoral, physical, and functional structure of final product (the bulk of which constitutes the national income employed with the demand for living labour and production assets (which are the basic factors of socialist reproduction). They serve as an important instrument for making synthetic calculations of growth rates and proportions in the development of a socialist economy consistent with plan projections regarding sectoral development

Table 7

Coefficients of Total Material Inputs, Production Assets and Labour per Unit (Rouble) of the Economic Functional Components of Final Product in the Soviet Union in 1966

Coefficients	Consumption fund			Capital investments	Accumulation of circulating assets, commodity stocks, and stockpiles
	Total	Personal	Social		
Total material input (B^p)	1.188	1.195	1.135	1.155	0.942
Input of fixed production assets (F^p)	1.205	1.148	1.805	1.456	1.419
Input of labour (average annual number of workers per million roubles (T^p)	379	385	319	372	443

and inter-sectoral production linkages. In this way it becomes possible to increase the degree of balance in plans for a rise in people's living standards, capital investments, foreign trade, the use of manpower and production assets and the production plan whose main task is to fix the volume

of output in different sectors, i.e. to show the structure of gross product in the planned period.

Table 7 presents coefficients of the total inputs of the economic-functional components of the final product, calculated from data of the inter-sectoral input-output table for 1966.

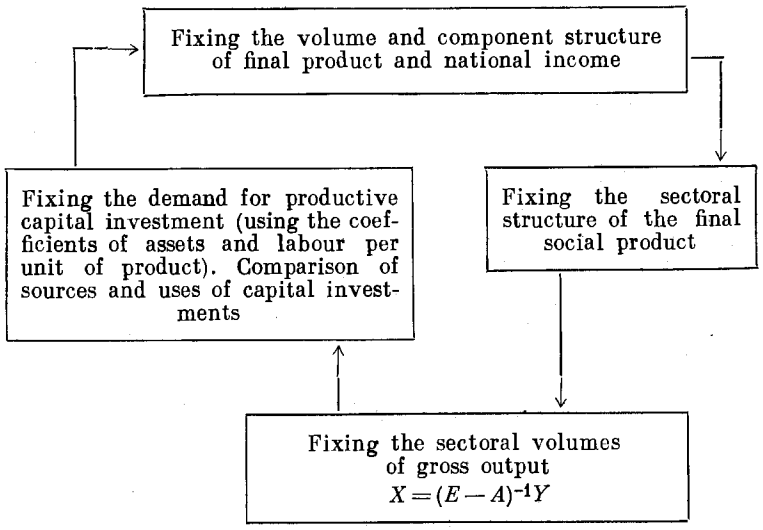
The use of coefficients of total input of gross product and primary production resources per unit of the sectoral and economic-functional components of the final social product characterising the inter-sectoral production links in the development of sectors, increases the complexity of resolving important macro-economic problems.

A Dynamic Inter-Sectoral Model

The main disadvantage in using a static inter-sectoral input-output model for planning the sectoral structure of social production is that it does not ensure internal consistency and balance of the production plan for the final and gross social product of the capital investment plan. In a state model the volume and structure of productive capital investment are regarded as planning indicators known before the model is solved, i.e. as exogenous economic variables. Along with other components of final social product, productive capital investments are assumed to be quantities that are fixed for the whole of the planned period.

In principle a static model can be used to determine the volume and structure of productive capital investments necessary for ensuring production of the planned volume and sectoral structure of final social product but it does not allow the sources and uses of capital investments to be integrally linked in the course of modelling. For this reason when a static model is used, sectoral output must be balanced in the plan with the sources and uses of productive capital investments with the help of additional planning calculations.

The main outlines of a block diagram showing how consistency can be achieved in such a case is shown on the following page:



When the sources and uses of investment do not balance the economic-functional and sectoral structure of the final product must be revised. The process for doing so has not yet been successfully formulated on the basis of the static model of the inter-sectoral input-output table.

Not all productive capital investments obviously can be regarded as exogenous variables. Their volume and sectoral structure must to a considerable extent be determined by the rates of expansion of production, which in turn are governed by the pace at which people's living standards are rising and by the extent to which the non-productive sphere of the economy is developing. These interconnections in the process of social reproduction are also quantified in a dynamic inter-sectoral model. A dynamic inter-sectoral model of the production and distribution of output in the economy is a development of the static model. The main difference between the two is that productive capital investment for expanding production can be determined in the dynamic model by solving the model's equations.

A dynamic model shows how production is linked over a period of years, and how it reflects the development of the economy in time.

The basic structure of a dynamic model that can be used in very different variants in planning practice is given below:

$$X_i(t)=\sum_{j=1}^{n} a_{ij}(t)\,X_j(t)+\sum_{j=1}^{n}\sum_{r=1}^{\tau} b_{ij}(t)\,k_j^r,$$

$$\Delta X_j(t+r)+Y_i^*(t) \quad i=(1, 2, \ldots, n;\ t=1, 2, \ldots, T), \quad (18)$$

where $X_i(t)$—the volume of output in the ith sector in year t of the planned period;

$a_{ij}(t)$—coefficients of the current direct material expenditure of output of the ith sector per unit of output in the jth sector in year t;

$b_{ij}(t)$—coefficients of the net capital intensity of the increment of output, showing how much output from the ith sector needs to be sent to the jth sector in year t in order to increase its per unit production in year $t+r$, these coefficients can also be calculated with reference to a unit of productive capacity;

τ—the maximum time lag in obtaining a return on capital investments (the length of time from first making the investments to obtaining the output from it);

k_{ij}^r—the amount of capital investment in sector j for increasing output in the ith sector r years before construction is completed, as a proportion of the total volume of investment in the ith sector for increasing output in sector j;

$\Delta X_j(t+r)$—the increment in output in sector j in year $t+r$;

$Y_i^*(t)$—the final output in sector i in year t, excluding net productive investment for expanding production; $Y_i^*(t)$ consists of output designated for personal and social consumption, non-productive accumulation, replacement and major repair of fixed production and non-production assets, the increase of circulating assets, stocks of goods, and stockpiles, and formation of the balance of foreign trade.

The equations of a dynamic model are compiled for each year of the planned period. Sectoral output volumes for each year of the planned period and the productive investments needed to expand production, broken down by sector and year, are determined by solving the equations.

Productive investments not connected with expanding production but earmarked for replacing used-up fixed production assets are usually known for the planned period and are a component part of $Y_i^*(t)$. The fact is that it is virtually impossible to establish a functional connection between the volume and structure of capital investments for the replacement and major repair of fixed production assets, and output volumes and their growth rates. That, however, does not in any way imply that economic-mathematical models cannot be used in planning them. Many models describing the obsolescence and scrapping of fixed assets are now being developed and the results of calculations based on them should be used in dynamic models.

The value of net productive investment ensuring an increase in output beyond the planned period is also fixed in the dynamic model before the system of equations is solved.

A Closed Inter-Sectoral Model

The static and dynamic models we have considered above are closed models incorporating exogenous, autonomous economic variables determined outside the model in the macro-economic plan.

A static model is open as regards the total final social product (Y), while the dynamic model is open as regards the final social product less net productive investment (Y^*). In both models the volume and structure of personal consumption are regarded as exogenous variables whose value during the planned period must be fixed outside the model calculations. Consequently, no attempt is made to relate the volume and physical structure of production to those of personal income and demand. Additional calculations similar to those set out above when the problem of coordinating sources and uses of investments was examined in the

static model have to be used to coordinate these indicators when open inter-sectoral input-output models are used.

A more consistent solution of this problem is to close the model by adding a system of equations describing the generation of personal money income and reflecting the structure of personal expenditure.

In the simplest case a static model which is closed in respect of a part of personal consumption will be described by the following system of equations:

$$X_i = \sum_{j=1}^{n} a_{ij}X_j + a_{id}X_d + \hat{Y}_i, \quad [(i = 1, 2, \ldots, n);$$

$$X_d = \sum_{j=1}^{n} a_{dj}X_j + Y_d, \qquad (19)$$

where a_{id}—the proportion of expenditure on product i in the total volume of personal money incomes;
$\hat{Y}_i$—the final output of sector i, excluding the volume of consumption of the ith product from personal income;
X_d—the sum total of personal money incomes;
a_{dj}—coefficients of personal income per unit of output in the jth sector;
Y_d—the total personal money income independent of the volume of output.

When such a model (closed in respect of personal consumption) is used in macro-economic planning practice, the population naturally has to be divided into different social groups and income brackets, account being taken of the way consumer demand depends on level of income, prices, the sex and age composition of the population, and many other factors, and equations describing the generation of consumer demand for services being introduced, etc.

3. PLANNING THE REGIONAL STRUCTURE OF SOCIAL PRODUCTION

A main task of macro-economic planning is to ensure the closely coordinated development of both sectors and economic areas. The complex system of inter-sectoral and inter-regional production links and of both intra- and inter-

regional economic proportions has to be taken fully into account in planning calculations concerning the regional structure of development in social production. This complex group of planning problems has to be resolved with regard to the need:

(a) to ensure rational proportions in the levels of development of the productive forces in different economic areas;

(b) to ensure the complex development of the productive forces within a region;

(c) to secure a rationl distribution of output in each sector in the different economic areas with regard to the availability of raw materials, supplies, power, and manpower, and to differences in production conditions, profitability, etc.;

(d) for the rational organisation of the inter-area exchange of goods, having regard to the demand of each area for the output of each sector, transport costs, the availability of transport facilities, and so on.

One of the planning instruments that can be used to solve several of these problems is an inter-area inter-sectoral input-output table, which is a further development of input-output methods.

Such a table is a complex system of area input-output tables coordinated with a set of indicators describing the inter-regional exchange of goods. One possible simplified variant of this model is given below.

The initial data for this kind of input-output model are the following: the vectors of the final consumption of output in each economic area (Y^s), i.e. the final consumption of the area being less than the final product by the amount of the import-export balance of the area; matrices of the coefficients of current direct material inputs for the production of goods in each economic area (A^s); matrices of coefficients of the inter-regional exchange of goods characterising the weight of deliveries of all types of these goods from the rth area to the sth area in their total consumption in area s (s^{rs}).

Planning calculations for inter-regional inter-sectoral input-output models are based on the following assumptions.

(1) The volume of production of product i in area r (X_i^r) is equal to its total consumption in all areas:

$$X_i^r = \sum_{s=1}^{m} X_i^{rs}, \tag{20}$$

where X_i^{rs} is the amount of product i produced in area r and consumed in area s.

(2) The consumption of each product from area r by area s is a function of the total consumption of output by sector i in area s (Z_i^s);

$$X_i^{rs} = s_i^{rs} Z_i^s \quad (i = 1, 2, \ldots, n;\ r, s = 1, 2, \ldots, m). \tag{21}$$

By substituting (21) into (20) it is possible to express the volume of production in each area as a function of the consumption of this output in all areas:

$$X_i^r = \sum_{s=1}^{m} s_i^{rs} Z_i^s. \tag{22}$$

(3) The consumption by each area of the output of all sectors is equal to the sum of productive and final consumption:

$$Z_i^s = \sum_{j=1}^{n} a_{ij}^s X_j^s + Y_i^s. \tag{23}$$

By substituting the value of Z_i^s from (23) into (22) we obtain

$$X_i^r = \sum_{s=1}^{n} s_i^{rs} \sum_{j=1}^{n} (a_{ij}^s X_j^s + Y_i^s), \tag{24}$$

or in vector-matrix form

$$X^r = \sum_{s=1}^{m} s^{rs} A^s X^s + \sum_{s=1}^{m} s^{rs} Y^s, \tag{25}$$

where $X^r = \{X_1^r, X_2^r, \ldots, X_n^r\}$ is the vector describing the volumes of production of products in all sectors in area r during the planned period.

Equations of this kind can be compiled for all the economic areas of the country. Altogether there are mn equations in the model (m areas and n sectors) and mn unknown quan-

tities—volumes of the output of each sector in each economic area X_i^r.

Let us use T^{rs} to denote the matrix

$$T^{rs} = s^{rs}A^s.$$

After substituting T^{rs} into (25) we obtain a system of equations for determining the planned volumes of production by sectors in all areas in the light of the indicators of final consumption planned for each area, regional coefficients of direct material inputs for production, and coefficients of inter-regional exchange of goods.

This system of equations takes the following form (as a block):

$$\begin{bmatrix} (E-T^{11})-T^{12}, \ldots, -T^{1m} \\ -T^{21}\,(E-T^{22})-, \ldots, -T^{2m} \\ \cdots\cdots\cdots\cdots\cdots \\ -T^{m1}-T^{m2}, \ldots, (E-T^{mn}) \end{bmatrix} \begin{bmatrix} x^1 \\ x^2 \\ \cdot \\ \cdot \\ \cdot \\ x^m \end{bmatrix} =$$

$$= \begin{bmatrix} s^{11}s^{12}, \ldots, s^{1m} \\ s^{21}\,s^{22}, \ldots, s^{2m} \\ \\ \\ s^{m1}s^{m2}, \ldots, s^{mm} \end{bmatrix} \begin{bmatrix} Y^1 \\ Y^2 \\ \\ \\ Y^m \end{bmatrix}$$

or, if we denote the general matrices and vectors by the same letters but without indices:

$$(E - T)\,X = SY.$$

Its solution is

$$X = (E - T)^{-1}SY.$$

In making the calculations for this kind of model it is extremely important to validate its basic planning indicators—final consumption, regional coefficients of direct material inputs, and coefficients of the inter-regional exchange of goods for the planned period.

In fixing regional indicators of final consumption, priority must be given to assessing the specific features of the structure of personal consumption in each area and measures

designed to further improve standards of living and to ensure a proper distribution of investment among the various areas. Regional coefficients of direct material inputs have to take account of the specific features of the structure of inputs for production in each economic area in the light of production conditions, the nature of raw and other materials, fuel and power, and the technological processes to be used. The coefficients of inter-regional exchange have to reflect the need for rationalising inter-regional links and reducing long-distance and cross-haulage of goods, etc.

There are a number of difficulties involved in planning inter-regional inter-sectoral relations using dynamic models. For one thing the scale of the model grows considerably. The dynamic model has to include indicators of the capital intensity of production in the different sectors in an area breakdown so that productive investments may be allocated by area and by sector. This can be done in accordance with the principles set out above in discussing the dynamic inter-sectoral model.

4. PLANNING THE OPTIMAL STRUCTURE OF SOCIAL PRODUCTION

The most important task in planning is to compile a development plan that does not simply secure balanced development of the socialist economy but also achieves the economically most efficient use of material, labour, and natural resources.

The inter-sectoral models we have just looked at are a quite effective planning instrument for drawing up balanced national plans. The effectiveness of planning decisions is also, to a certain extent, ensured by selecting progressive standards for inputs of materials, labour, and production assets per unit of output and for the economic-functional and sectoral structure of final product. But these models do not provide a consistent solution of the problem of finding the optimum variant for a macro-economic plan. This can only be done by using the optimal planning methods on which intensive research is at present being done in the Soviet Union, and which are being increasingly introduced into planning practice.

In a socialist economy an optimum development plan is that variant of a macro-economic plan which ensures the best use of society's material, labour, and natural resources from the point of view of the optimality criterion selected. Optimal planning methods enable the most efficient variants to be chosen as regards the technology of production, the regional location of industries, and the best possible structure for satisfying social needs.

The compilation of an optimum plan is a process of improving the balanced variants of a plan in the light of the values of the optimality criterion selected, until such time as the best, optimum variant has been found. Thus optimal planning methods incorporate input-output methods, which facilitates the drafting of a proportional, balanced plan of development of the economy.

An example of a very simple static model for deciding the optimum structure of social production is given below.

The task is to maximise (minimise) the objective function (optimality criterion) of the plan:

$$\sum_{j=1}^{n} c_j X_j \rightarrow \max\,(\min) \qquad (26)$$

subject to

$$\sum_{j=1}^{n} a_{ij} X_j \leqslant b_i \quad (i = 1, 2, \ldots, m) \qquad (27)$$

with

$$X_i \geqslant 0 \ (m < n), \qquad (28)$$

where c_j—coefficients of the plan's objective function, the nature of which is determined by the selected optimality criterion;

a_{ij}—coefficients of inputs of production resources of type i per unit of product j;

X_j—volume of output of product j;

b_i—available quantity of production resource i.

The model as formulated assumes the multi-variant use of production resources b_i. For each variant there is a corresponding set of indicators X_j, which also determines the structure of social production. The optimum variant of the plan is that variant $(X_1, X_2, \ldots, X_n)$ in which the extreme

(maximum or minimum) value of the optimality criterion (objective function) is achieved, given that conditions (27) and (28), which are the plan constraints, are observed.

The main differences between an optimal planning model and the economic-mathematical input-output models examined above are as follows:

(1) an optimal planning model is based on the assumption of multi-variant development of the economy and admits the possibility of systematic selection of the best economic planning decision;

(2) in its explicit form an optimal planning model contains, as one of its integral components, an optimality criterion or objective function on the basis of which the best, optimum variant of the economic development plan is selected;

(3) this choice of an optimum plan in such a model is made in the light of the constraints on available primary production resources or on the levels of satisfying certain social needs.

Besides making it possible to calculate the optimum structure of social production, optimal planning models also help tackle another key problem, that of the integral link between physical and value proportions in the development of a socialist economy.

An intrinsic part of an optimum plan is a set of prices for production resources and products reflecting the objective function of the plan and its constraints, i.e. corresponding to the optimum proportions for the development of socialist production. This set of prices is obtained by solving what is called the dual problem in relation to the direct problem of drawing up an optimal macro-economic plan. Let us formulate a direct and a dual optimal planning problem.

Direct problem

The task is to maximise the objective function of the plan

$$\sum_{j=1}^{n} c_j X_j \rightarrow \max$$

subject to

$$\sum_{j=1}^{n} a_{ij} X_j \leqslant b_i \quad (i = 1, 2, \ldots, m)$$

with

$$X_j \geqslant 0.$$

Dual problem

The task is to minimise the objective function

$$\sum_{i=1}^{m} b_i p_i \to \min \tag{29}$$

subject to

$$\sum_{i=1}^{m} a_{ij} p_i \geqslant c_j \quad (j = 1, 2, \ldots, n) \tag{30}$$

with

$$p_i \geqslant 0,$$

where p_i is the dual estimate (shadow price), or the price of production resource i.

It has been mathematically proved that in an optimal plan the values of the objective functions in a direct and a dual problem coincide:

$$\sum_{j=1}^{n} c_j X_j^0 = \sum_{i=1}^{n} b_i p_i^0 \tag{31}$$

where X_j^0 and p_i^0 are the values of the corresponding variables in an optimal plan.

In view of the equality of the objective functions in the direct and the dual problem in an optimum plan (but only in an optimum one), it follows that if a product j in the optimum plan is to be produced (i.e. $X_j > 0$), then the corresponding jth constraint in the dual problem changes into a strict inequality. For example, if product 2 in the optimum plan should be produced, i.e. $X_2 > 0$, then constraint 2 in the dual problem will take the form

$$a_{12}p_1 + a_{22}p_2 + a_{32}p_3 + \ldots + a_{m2}p_m = c_2. \tag{32}$$

But if product j, for example, product 3, is not a direct problem in the optimum plan, i.e. $X_j > 0$, then the jth constraint in the dual problem as a rule (if the optimum plan is singular) will into a strict inequality,

$$a_{13}p_1 + a_{23}p_2 + a_{33}p_3 + \ldots + a_{m3}p_m > c_3. \tag{33}$$

Thus, only the production of those products that form part of optimum plan prove to be economically justified: their price covers all the expenditure of resources on their production. Those products, production of which does not promote maximally efficient use of resources, so that they are not included in the optimum plan, are loss-makers, unprofitable, i.e. are worth less than the resources used up in producing them.

Obviously the concept of optimal use of production resources contradicts the requirement:

$$a_{1j}p_1 + a_{2j}p_2 + \ldots + a_{mj}p_m < c_j. \tag{34}$$

If the product has already gone into the optimal plan, then condition (34) would imply that it was necessary to increase its production since this is economically beneficial and would increase the value of the objective function (optimality criterion) of the plan. If relationship (34) was correct in relation to product j which had not gone into the optimum plan, then it would be necessary to start its production and include it in the plan since it would be more efficient than producing other products. But both cases would imply that the plan that had been obtained was not optimal for it could also be changed towards increasing the value of the objective function. But an optimum plan is one that uses production resources in such a way as to maximise (minimise) the value of its objective function. Any changes in it may in the best case not increase (decrease) the numerical value of its optimality criterion.

Another extremely important conclusion emerges from the optimality conditions of the plan: if the ith constraint in the direct problem in the optimum plan becomes a strict inequality, for example

$$a_{41}x_1 + a_{42}x_2 + \ldots + a_{4n}x_n < b_4, \tag{35}$$

then the ith variable in the objective function of the dual problem is accordingly equal to 0, i.e. in our example $y_4 = 0$. The economic interpretation of this fact is quite clear: the estimates (prices) of production resources which are not fully used in the optimum plan (are surplus) are equal to 0; only the dual estimates (shadow prices) of those production

resources (reproducible and non-reproducible) which are fully used in the optimum plan are positive.

The most important problem in using optimal planning models is the choice of the optimality criterion. This criterion is determined by the basic economic law of socialism, which characterises the immediate and final goal of socialist economic development. It can be formulated in principle as the attainment of the maximum integral fund of resources for satisfying the needs of the members of socialist society. Translation of this formula into the strict language of mathematics, however, is a highly complex methodological problem, solution of which lies primarily in the working out methods for ascertaining the social usefulness of goods that describe their contribution to satisfying people's needs. The adoption of optimal planning methods in planning also calls for the collation of a vast amount of statistical, project-planning, and economic planning information. broad use and improvement of the quality of computers.

CHAPTER VI

THE PLANNING OF SCIENTIFIC AND TECHNOLOGICAL PROGRESS

1. TASKS OF PLANNING SCIENTIFIC AND TECHNOLOGICAL PROGRESS

The speeding up of scientific and technological progress is a key problem of Soviet economic development at the present stage, whose significance was specially underlined in the report of the Central Committee of the CPSU to the 25th Congress. "...The end objectives of the social revolution, the building of a communist society," said L. I. Brezhnev, "can only be attained on the basis of accelerated scientific and technical progress...."[1] It is precisely by virtue of this that the stepping up of scientific and technological progress is defined in the *Guidelines for the Development of the National Economy of the USSR for 1976-1980* as a component of the main task of the Tenth Five-Year Plan and a decisive means of raising the people's material and cultural living standards.

The key link in scientific and technological progress in 1976-80 will be technical re-equipping of the sectors of the economy by consistent transfer to production and broad application of high-efficiency systems of machinery, equipment, instruments, and technological processes ensuring mechanisation and automation of all production processes (especially auxiliary, transport, and warehousing operations), instead of individual machines and technological processes. Such systems must have higher technical and

[1] L. I. Brezhnev, *Report of the CPSU Central Committee and the Immediate Tasks of the Party in Home and Foreign Policy, XXVth Congress of the CPSU*, p. 56.

economic indices per unit of productivity and other indices of efficiency than the best home and world achievements. They must involve maximum unification and standardisation, while their consumption of materials per unit of output and cost per unit of capacity must be lowered.

With the stepping up of rates of progress the significance of science as a direct productive force will grow. This role of science is reflected in the *Guidelines for the Development of the National Economy of the USSR for 1976-1980* in which a special section is devoted to it. This section defines the most important trends of research in the social, natural, and technical sciences, and in fact outlines in concentrated form a programme for the scientific forces of the country. It proposed, as items for research and treatment, theoretical problems linked with the tasks of technological development and industrial organisation, that would make it possible to tie up the work plans of scientific institutions, enterprises, amalgamations, and industries, and to pass from thematic planning to planning of the end results of research.

The achievements of science, as the Central Committee's report noted, must be embodied more quickly in thousands and thousands of new products, beginning with unique machines and ending with everything linked with improving people's working and living conditions, as well as in individual—however brilliant—experiments and exhibition models.

In order to speed up the movement of new ideas along the whole chain, from inventions to mass production, a further improvement of planning and of economic incentives is necessary. This should include the working out of plans and complex programmes, choice of the system of planning indicators, appraisal of the work of production and scientific collectives, the building up of incentive funds, the awarding of bonuses to inventors of developed equipment and determination of its effectiveness, and the fixing of wholesale prices.

The system of planning scientific and technological progress includes the following:

(a) a long-term forecast, taking in the main trends in the development of science and technology;

(b) a five-year plan (broken down into years), containing specific scientific and technical problems and tasks;

(c) an annual plan defining more precisely and in greater detail the tasks laid down in the five-year plan, taking into account any additional opportunities and needs of economic development that have become evident.

The task of long-term forecasting of scientific and technological progress consists in validating the key problems of science and technology, and predicting the time needed to solve them. Such forecasting has now become quite reliable as practically all fundamental and applied research is concentrated in research institutes and higher educational establishments, so that forecasting can consequently be based on the thematic time-table of research.

The main lines of development of science and technology, and scientific and technical problems of national economic importance, are worked on by the State Committee of the USSR Council of Ministers for Science and Technology, jointly with the USSR Academy of Sciences; USSR ministries and departments and the Union republics draw up forecasts and projects for developing science and technology in individual sectors and republics.

2. DETERMINING EXPENDITURE ON SCIENTIFIC RESEARCH AND EXPERIMENTAL DESIGN

The distinguishing feature of scientific and technological advance at present is that science is becoming a directly productive force and is developing into a branch of material production, a process that is reflected in the increasing strength of the links between fundamental theoretical research, applied research, and industry.

The development and deepening of scientific and technical knowledge and its practical application have mainly become accessible at the present stage to teams of scientists supplied with complicated, costly equipment. Expenditure on theoretical and applied science has been rising from year to year, while the network of research institutes has been expanding, and the number of scientific workers growing (Table 8).

Table 8

Expenditure on Science, Numbers of Establishments and Numbers of Scientific Employees in 1940-74

	1940	1950	1960	1970	1974
Total expenditure on science and research:					
in '000 million roubles	0.3	1.0	3.9	11.7	16.5
as percentage of national income	0.9	1.8	2.7	4.0	4.7
Number of research institutes and their branches and departments	786	1,157	1,728	2,525	2,773
Numbers working in science and scientific services (in thousands)	362	714	1,763	3,238	3,864
including scientific workers (in thousands)	98	163	354	928	1,170

National expenditure on research and experimental design is now around 4.7 per cent of the national income and 22 per cent of gross productive investment in industry, agriculture, transport and communications, and the building industry, i.e. investment on expanding fixed production assets and making good wear and tear. It is not possible, of course, to increase indefinitely the proportion of the national income being laid out on research and experimental design, in particular through capital investment in fixed assets. When science undergoes an extensive phase of development, embracing all branches of knowledge and production through a network of specialised research organisations, standard expenditure on science (as a proportion of the national income) becomes unrelated, as it were, to standard expenditure on productive capital investment, which forms part of the norm of accumulation and replacement; but the relationship should be close and quantitatively fairly stable.

The numerical values of some of the components that enter into calculations of the relation between expenditure on science and capital investment (i.e. national income, expenditure on research and experimental design, gross

capital investment) are known. Others (e.g. annual expenditure on science connected with industry; the average period of capital construction) can be determined with acceptable accuracy. But there are important components of the calculation, the numerical values of which it is only possible at the moment to estimate, on the basis of single observations and unsystematised facts. Let us examine the most important of these.

(1) *The proportion of expenditure on research spent without productive application.* A considerable part of the expenditure on research and experimental design, which is probably increasing with the growth of research, does not for one reason or another achieve its objective (work on the theme is discontinued half-way, or is completed with negative results, because of the technical impossibility of putting the scientific idea into practice; lack of the appropriate technology; lack of advantage from applying it in industry; limited resources; and so on). It can be assumed that only 20 to 25 per cent of expenditure of science and research achieves its intended objective (which does not preclude indirectly fruitful results).

(2) *The average length of the research cycle.* There is little information on this, in spite of the fact that every research organisation keeps records of the fulfillment of its research plan.

(3) *The ratio between gross capital investment allocated to the replacement and expansion of fixed assets by traditional and improved equipment and by developed equipment resulting from scientific research.* From the statistics on the withdrawal of fixed assets, standard depreciation charges, and the sectoral allocation of capital investment, this ratio can be taken as 60 : 40.

(4) *The relation between capital investment on implementing the results of research and the expenditure on the research.* Existing estimates of this correlation are extremely varied and contradictory. According to estimates most commonly encountered, capital investment on implementing the results of research is approximately ten times the expenditure on the research.

The creation of a network of research organisations in the Soviet Union embracing all branches of knowledge and

production is nearing completion, and science is emerging from the extensive phase of development. The transition to the intensive phase has already been reflected in a slowering down of the growth rate in the proportion of the national income spent on science, with a marked tendency to stabilisation.

The merging of research and industry, particularly in the planning, design, and experimental stages, it should be noted, is shifting the financing of a significant part of the expenditure on science from the state directly to the costs of production of amalgamated and single enterprises.

The transition to the intensive phase should also be marked by a shortening of the average length of research, an increase in the proportion of expenditure on research that achieves its objective, and, therefore, an increase in expenditure on research on which capital investment can be expected in order to apply it.

Science is thus increasingly becoming an object of macroeconomic planning. It is, above all, imperative to determine the proportion of the national income and accumulation allotted to developing research in all fields of knowledge, particularly science connected with industry. The plan must then make a rational allocation of expenditure between the branches of science, pure research, speculative and applied research. Expenditure is allocated between research institutes with their own budgets, and project-planning and design organisations that are financed by industrial, agricultural, transport, and other enterprises.

Provision must be made in planning input-output tables for the experimental equipment, computers, and other equipment needed for research, and manpower tables and training plans must take account of the demand for the corresponding scientific personnel.

3. TRENDS IN SCIENTIFIC AND TECHNOLOGICAL PROGRESS

Implements of Labour

The trend of development both of single machines and of systems is taking the following directions:

(1) automation;

(2) concentration of capacities with higher speeds, pressures, temperatures, stresses and other parameters of the working process;

(3) the designing of multi-station machine systems.

Each of these three main trends is virtually impossible without the others; concentration of capacities is checked if industry is not automated, while only automation can extend the technical and economic limits of the concentration of capacity, and the making multi-station machines and systems.

Full automation of equipment in which the function of control is also mechanised, with a favourable change toward the optimum working, is linked basically with electrification of production and electronic instrumentation for machines and systems. Between the most advanced, but as yet not numerous, types of machinery and systems and the old types, there are various transitional forms that make it possible to trace the evolution of machinery toward automation in broad outline.

The tendency to concentrate capacities and build multi-station systems of equipment is inherent in the evolution of machinery and the implements of labour in all branches of production without exception. The main of data on the productivity of various groups of equipment from the beginning of their industrial use demonstrates this.

In the 50 years from the middle of the nineteenth century to the early twentieth century, the maximum capacity of a unit of machinery increased by approximately five to seven times, in the last 50 years by 20 to 25 times, and over the last 100 years by 100 to 150 times. Thus the capacity of the first steam engines built in the eighteenth century was five kilowatts, in the middle of the nineteenth 2,000 kilowatts and early in this century 15,000 kilowatts. Steam turbines built in 1884, which replaced steam piston engines, had an initial capacity of 25,000 kilowatts. In 1960, steam turbines were being built with a capacity of 300,000 kilowatts and at the end of the 1960s, one million kilowatt turbines were being designed.

The effective capacity of blast furnaces in the middle of the nineteenth century did not exceed 250 cubic metres; in 1974 a blast furnace with an effective capacity of 5,000

cubic metres and a rated annual capacity of 4,000,000 tons of pig iron, was blown in in the USSR. The productivity of papermaking machinery, which was 13 square metres per minute in the middle of the last century, now reaches 10,000 square metres per minute.

The more powerful the machine, the cheaper is each unit of capacity and of its servicing. Attempts to increase the capacity of machinery or installations by making them larger, while retaining the basic principles of construction and using traditional materials, comparatively quickly come up against economic limitations, even though, technically, such an increase is attainable.

The history of engineering confirms the following law: by the time the size of machinery reaches the critical point, beyond which the cost per unit of capacity increases, design and technological solutions that are new in principle, and new materials are already in existence that will further increase the capacity of single machines and sets. This type of technology includes, for example, production of iron in the iron and steel industry without blast furnaces, fast neutron reactors and the application of superconductivity in power engineering. It would make it possible to surmount the limits imposed by the application of existing technology. In addition, and this is the main point from the economic angle, new generations of machines and equipment would have to ensure higher tempos of reducing all types of input, labour and materials to begin with, and then capital inputs, as well as providing growth of production capacity. The *Guidelines for the Development of the National Economy of the USSR for 1976-1980* therefore put a variety of aims before scientific and technological progress, namely, to introduce advanced technology and production techniques on a broad scale promoting raising of labour productivity and product quality, increasing return on assets, economy ot material resources, improving working conditions, protecting the environment, and rational exploitation of natural resources.

Automation also makes it possible to enlarge machines by linking them in continuous production lines, or in some other combination, for continuous processing. Specialised mass production has created the conditions for organising

the flow of sequential processing with the mechanisation of transfer operations between stations which in turn has favoured the designing of multi-station working and handling machines and control apparatus, and the setting-up of automated production lines. The far-reaching technical division of labour, achieved by machines working on their own, has been superseded by the integration of operations in sets or blocks of machines.

In present-day conditions, it is practically impossible to intensify a process without automating it; the benefit from automation is above all that it removes obstacles to increasing speeds, pressures, temperatures, tolerances, and other technological parameters. Expenditure on automation is therefore of low efficiency or unprofitable if it is not accompanied with or caused by intensification of the production process.

Special importance attaches to the introduction of automated systems of production control using electronic computers, and to the setting-up of system of computer centres.

Fuel, Power, and Raw Material Resources

Technological progress in this sector is seen mainly in an increase of power consumption, the growing share of electricity, the development of new sources of power (atomic and thermonuclear energy) and the greater efficiency of power systems.

In 1974 output of fuel was 1,497,100,000 tons of standard fuel. Generating capacity was 205,442 megawatts. The mean annual growth rate of fuel production between 1955 and 1974 was 6.2 per cent and of generating capacity 9.4 per cent.

The pattern of change in the production of output other than electricity can be expressed by a logistic curve. When saturation point has been reached in a particular type of output, any further growth in its production will depend on population growth, or production may fall as a result of the development goods of the same type but possessing superior consumer properties. Growth of the generation of electricity, on the contrary, can only be slowed down or halted with a slowing down or fall in the growth of total social production.

The generation of electricity outstrips the growth rate of material production as a whole and will continue to outstrip it. This important trend is determined by several factors, as follows.

1. Electricity is finding ever new areas of application both in industry and in everyday life. In industry what is known as technological consumption (smelting of ferrous and non-ferrous metals, welding, electrolysis, etc.) is increasing and in the domestic sector consumption for household and cultural needs (heating, television, refrigerators, etc.).

2. Electrification is the basis for mechanising labour and automating production and is consequently a *sine qua non* of increased labour productivity.

3. The steady increase in the rate of processing as a result of automation and higher speeds increases the relative expenditure of electricity, though this tendency is modified by certain features accompanying set concentration (higher moments of gyration, etc.).

4. The transition from open-cast mining of rich mineral deposits to the working of deep deposits with a lower ore-content calls for large inputs of electricity.

A number of factors, that make it possible to reduce standard expenditure of electricity, modifies the tendency for the power industry to grow faster than average.

The rapid development of the power industry would soon run up against the fact that energy resources are limited unless it were accompanied by a lowering of unit expenditure of fuel, and a turn to new types of high-calory fuel and non-combustible sources of energy, and also to low-grade, low-calory coals that not so long ago were either not mined or were dumped on tips, as is shown by the marked changes in the structure of the fuel balance in which the proportion of oil and natural gas rose from 20.6 per cent in 1940 to 64.6 per cent in 1974.

The efficiency of steam engines in the first decades of their adoption was 2 or 3 per cent. It has now reached 25 to 30 per cent in the large steam-turbine power stations in which most electricity is generated. In the 29 years between 1945 and 1974 expenditure of standard fuel per kilowatt-hour of electricity generated fell from 627 grams to 344 grams; and in 1976-80, according to the *Guidelines for the Development of the National Economy of the USSR for 1976-1980*, it should fall to between 325 and 328 grams.

An important feature of the Tenth Five-Year Plan period will be raising of the role of hydro-electric and atomic power and of cheap coals in the fuel and power balance of the country. Generation of hydro-electric power will rise by 40 per cent instead of the 13 per cent under the Ninth Five-Year Plan. Electricity generation by atomic power stations will nearly quintuple; the increase will make it possible to reduce consumption of fuel resources for generating electricity by 45 million standard tons by 1980. It is proposed to commission atomic capacity totalling 13,000 to 15,000 megawatts through the building of power stations with reactors of a unit capacity of 1,000 to 1,500 megawatts.

The best regional thermal power stations convert only 40 per cent of the chemical energy of fuel into electricity. Going over to building large blocks with magneto-gasdynamic generators (MGD) will make it possible to raise efficiency to 50 per cent, and in the more distant future to 60 per cent. The first experimental installation in the world with an MGD generator was commissioned in the USSR, and later a pilot industrial one. Their distinguishing feature is their great similarity to true industrial MGD power stations.

In the more distant future the control of thermonuclear reactions will provide mankind with a practically inexhaustible source of electricity. The solution of this crucial problem will enable oil and gas to be used primarily as raw materials for the chemical industry.

The main trend in changing the structure of raw materials is a steady decline in the proportion of raw materials of animal and vegetable origin, the higher proportion of minerals and the substitution of synthetic materials for natural ones.

Production and Utilisation of Construction Materials and Natural Raw Materials

Iron and steel occupy the leading position among construction materials. In 1970 Soviet production was 116 million tons of steel; in 1975, 141 million tons; and is expected

to be 160-170 million tons in 1980. The economy, especially engineering and building, do not need simply more metal so much as the most efficient, highly economic types like cold-rolled sheet, rolled shapes, rolled metal with an anti-corrosive cover, metal hardened by heat treatment, transformer and stainless steel sheet, cold-rolled strip. Extension of the grades of rolled metal and improvement of their quality alone would enable us to save five or six million tons of metal in 1976-80.

The main trends of technological progress in the iron and steel industry are the following:

(a) the development of processes eliminating blast furnaces, and extension of electric melting and converter production of metal;

(b) wide use of continuous casting installations and going over to inclined and horizontal casting instead of vertical;

(c) the development of powder metallurgy;

(d) perfection of the finishing processes for metal and rolled grades, i.e. further development of the "fourth conversion".

Synthetic materials are competing most successfully with iron and steel. In 1971-75 the Soviet economy received a total of 11 million tons of plastics. Their individual types rival steel in strength, withstand temperatures of hundreds of degrees without loss of properties, and possess unique technological qualities. A ton of plastics can replace 1.6 tons of iron and steel on average, 0.15 ton of non-ferrous metals, 3.5 cubic metres of lumber, and around five tons of glass and cement. The main direction of technological progress in this field is the creation of synthetic heat-resistant material that would possess the properties of steel and at the same time be easy to work, like thermoplastics, i.e. the group of plastics that acquire a plastic condition when heated.

Soviet industry produced nearly a million tons of chemical fibres in 1975. Each ton of chemical fibre on average replaces 1.5 tons of natural fibre; the proportion of synthetic fibres in the total of textile raw materials rose from 22 per cent in 1970 to 29 per cent in 1975. Raising the proportion of substitutes for natural textile fibres is very profitable

for the economy; it is therefore intended to increase their production to between 1,450,000 and 1,500,000 tons in 1980.

High targets are set for the production of **non-ferrous metals** in 1976-80. Smelting of aluminium, copper, and nickel is to be increased by 20 to 30 per cent; of titanium by 40 per cent. The task has been set of developing output of semiconductors, especially of pure and special materials for the electronics industry and other branches, of developing new high-durability cemented carbides, and of increasing production of high-precision tips for metal-cutting tools. Industry has a great need of economic rolled shapes of non-ferrous metals, copper wire rod, and aluminium strip and tubes. The leading trend in non-ferrous metallurgy is the multiple utilisation of the mineral raw material, and maximum extraction of non-ferrous metals from the ores mined.

The immense scale of industry calls for constant increase in the production of **wood**, improvement of its quality, and extension of the range of materials. It has been estimated that, if the demand for wood were met simply by increasing the felling of timber, the volume required in the next decade would already come to the gigantic figure of 600 to 650 million cubic metres a year. From the angle of nature conservation, and of the economic and technical production possibilities, such a volume would not only be irrational but unreal. The main line of saving of wood is to extend capacities for chemical and chemical-mechanical treatment of wood waste and low-quality woods. A particularly effective technical trend in this field is extension of the production of chipboard and fibreboard.

4. ECONOMIC VALIDATION OF THE PLAN FOR SCIENTIFIC AND TECHNOLOGICAL ADVANCE

Inter-Sectoral and Intra-Sectoral Differentiation of Technical Level

The planning of technological advance has to be based on knowledge of the inter-sectoral and intra-sectoral differences in technical level and of the conditions determining them. Sectoral differentiation is clearly reflected, and can

be easily seen, in the sectoral distribution of assets per worker, calculated as the ratio of fixed production assets to the total number employed.

The clothing industry has the lowest level of assets per worker (700 roubles per employee) and the electricity generating and petroleum production industries the highest (on average around 60,000 roubles).

Progressive shifts in the sectoral structure of industry facilitate the development of automation as this increases the importance of just those sectors in which the opportunities for using developed equipment and technology are greatest. These sectors include: the electricity generating industry, all the many branches of the chemical industry and those with similar technology, such as oil-refining, aluminium smelting and certain other non-ferrous metals, petroleum production, etc. Automation is encouraged to a high degree in these industries by the fact that the orignal raw material or the end product (or both) in all of them is a liquid, gas or free-flowing material suitable for continuous processing.

It is not so simple and effective, however, to introduce automation in all sectors in which the rate of growth is increasing. In engineering, for example, automation, though well advanced, encounters serious obstacles, the chief ones being the assembly process and the large volume of short-run production. Assembly, particularly of large machinery. does not lend itself to mechanisation and even less to automation. A way out of the contradiction between the trend toward enlarging production plant with short production runs, on the one hand, and the need for automation, on the other, is offered by the unification and specialisation of the production of the components and sub-assemblies of machines and separation of their production from their assembly.

It is not only in engineering that the assembly or joining of components makes mechanisation and automation difficult, but also in the furniture, footwear, and clothing industries. In the building industry this obstacle is being successfully overcome by decisively reducing this kind of operation; construction units are being increased in size (large reinforced concrete blocks and panels instead of bricks as the basic building material) and, in addition, the majority of intermediate assembly operations are being

taken over by the building materials industry. In the clothing industry, in which the actual work of sewing, i.e. making up the garment, predominates, the mechanisation of labour is still incomplete. It is significant that the proportion of clothing-industry workers is increasing every year. In the USA, for example, it has reached nearly 9 per cent of all the workers in manufacturing industry.

The differential of technical level within industries is also very marked, and is closely linked with differences in the size and specialisation of enterprises.

The Rate of Replacement of Types of Technology

The tendency for the period in which an established type of equipment predominates to become shorter has been observed over a long historical period of time. The use of steam, and then of electricity, as motive power, and the present scientific and technological revolution, have sharply accelerated the replacement of the types of plant in all the areas in which it is used.

Let us consider several examples illustrating accelerated replacement.

Prime movers	Interval, years
Steam piston engines:	
Savery's (1698), Newcomen's (1712), Watt's (1770, 1796)	85
Cornish (1830, 1846)	50
triple expansion (1890)	40
Steam turbines:	
Parson's (1910)	35
high pressure (1950, 1955)	30
Gas turbines (1970)	15
Magnetohydrodynamic engines, thermo-emissive conversion of atomic energy (experimental installation—1971)	

The replacement of different types of transmission, from the prime mover to the working machine, has parallelled this, and every change in principle in the type of transmission has been reflected in reconstruction of the working machines and of the technology of production. In the steam-engine period, mechanical group transmission definitely predominated. Electric individual and multi-motor drives

opened up the possibility of placing the working machines in the sequence of the technological process, reorganising it on a continuous flow-line basis, and building multiple-tool units and blocks of machinery.

The succession and development of types of communications equipment and computers on the basis of electronics has been very rapid and has caused a revolution in many fields of information.

The interval between discoveries and inventions that cause far-reaching changes in production technology and the product composition of output is thus becoming shorter, and is measurable in something nearer a single decade rather than, as previously, in terms of several decades.

The Pace of Introduction of New Technology in Industry

In planning of scientific and technological advance, the practical possibilities of applying new equipment on a broad scale have to be assessed, for it cannot be assumed that even the most promising major technical innovation will be immediately taken up by industry as soon as it appears.

It took several decades, for example, to complete such a comparatively simple change-over as the mechanisation of production and transport operations in the timber and coal-mining industries.

Complex reorganisation takes considerably longer than simply reorganising the separate operations of a technological process. In mining, for example, mechanisation was begun in the Soviet Union in 1924, with the cutting, hewing, and haulage of coal. It took nine years to mechanise 75 per cent of these operations. The level of mechanisation of haulage, begun in 1927, had reached 75 per cent by 1940, while the mechanisation of loading, which has been going on since 1940, had reached 93 per cent by 1974. The complex mechanisation of coal mining, still unfinished, has therefore already taken more than 40 years.

When the introduction of new equipment requires radical reorganisation of the whole technological process, and the replacement of machinery that is still physically in good

order, the period it takes will be particularly long and complicated. This is borne out by the attempt in the Soviet Union in the early 1930s to replace steam locomotives with an axle pressure of 15 tons by more powerful ones with a pressure of 21 tons. It transpired that, apart from reorganising the locomotive works, it was necessary to replace the light rails by heavy ones, to ballast the railway lines with gravel, rebuild bridges and locomotive depots, and equip wagons with automatic brakes and couplings.

The electrification of railway transport in the Soviet Union was begun in the late 1920s. In 26 years the proportion of freight hauled by electric and diesel-electric traction reached 26.5 per cent, it then increased to 51.8 per cent in three years, and to 78.9 per cent in another three years. The average annual rate of electrification and dieselisation (expressed in freight traffic) was 2.5 per cent.

The dieselisation of the railways in the USA presents certain interest. In 1925, 379 electric locomotives were in operation (0.6 per cent of the total number of locomotives), and the first diesel locomotive had been developed. Subsequently, steam locomotives were mainly replaced by diesels, and 23 years later the number of diesel and electric locomotives had reached 22.1 per cent of the locomotive park. Then, in three years, the proportion of diesel and electric locomotives increased to 46.7 per cent, and to 74 per cent in another three years. In the USA, therefore, despite a powerful engineering industry, rich oil resources and other factors favouring dieselisation, the average yearly rate of expansion was 2.6 per cent.

Thus, in planning partial reorganisation, i.e. the mechanisation of specific operations or the replacement of certain types of equipment by others, the subsequent reorganisation of related production and, consequently, ancillary capital expenditure must be borne in mind.

Equipment Renewal

In view of the often protracted building cycle, and the growing stream of inventions and discoveries making it necessary to accelerate the renewal of equipment and tech-

nological programmes, fixed assets that are formally not old may prove to be obsolescent even before they have been put into operation. Cutting down the length of the building cycle (drawing of plans, construction, and commissioning) must consequently be regarded as both a powerful means of technical renewal of fixed assets and of preventing too early obsolescence, and as an effective means of shortening the time taken to introduce discoveries and inventions. Shortening of the building period is at the same time a matter of shortening the production cycle in engineering, in which time is a most important factor in the quality of output.

The rate of introduction of new equipment also depends on the form in which worn out fixed assets are made good, on the correlation between expenditure on major repairs and on the physical replacement of out-worn and obsolescent equipment.

By increasing outlays on major repairs and overhauls, it is possible to prolong the life of equipment, and consequently to reduce the amount scrapped, but by the same token this slows down renewal of equipment. The cost of major repairs, it should be noted, often exceeds the cost of similar new equipment. Finally, each new overhaul is more complicated, and running repairs become more frequent. The extent of withdrawal is a regulated process, and largely depends on repairs policy. Some reduction in the normal number of major overhauls shortens the life of machinery, while an increase prolongs it.

Reducing the permissible number of overhauls affects perspective equipment input-output tables. The proportion of machinery for replacement must be slightly increased, and of machinery for extending fixed assets must be correspondingly decreased.

Production of New Types of Output

Technological advance is reflected, in particular, in a renewing of the mix of the output being produced (both means of production and consumer goods). New products

are developed mainly in newly created industries. The emergence and development during the years of industrialisation of such previously non-existent branches of engineering as the tractor, automobile, and aircraft industries, and of the chemical industry, and so on, were indicative of striking changes in the range of output. Similarly, the rapid growth in our day of electronics, of the production of electric and diesel locomotives and works transport, refrigerators and washing machines, plastics, and synthetic fibres, isotopes, synthetic diamonds, and herbicides illustrates the incessant renewing of the range of output. The planning of sectoral structure therefore includes to a significant extent planning of changes in the structure of output.

In the traditional branches of industry, also, new items are being made with previously unknown properties, or of significantly better quality.

The mastering of new types of goods, particularly those designed on a new principle and the running in of machines and blocks of machinery (turbines, ships, flow lines) are a long process that sometimes takes several years. It is a mistake, therefore, to consider a product new only in its first year of manufacture. Obviously, the time it takes for a new product to pass into the category of an old one has to be fixed differently for different types of output. For instruments of labour, for example, it can be fixed according to their assumed service-life; in practice, however, this assumption is fraught with a number of difficulties and provides much scope for subjective decisions. It is therefore more reasonable to differentiate the period during which output is considered new, dividing it into three large classes taking two, three, or five years.

The Soviet state plan sets targets not only for the introduction of new items but also for the withdrawal of obsolete products from production. This withdrawal is, of course, a sort of renewing of output that could be called passive renewal. When determining the total extent of renewal, passive renewal must be taken into account.

5. BASIC TASKS OF THE DEVELOPMENT PLAN FOR SCIENCE AND TECHNOLOGY

The plan for scientific and technological advance consists of two sections: (1) a plan of research and utilisation of the achievements of science and technology in the economy; (2) a plan for state standardisation of the most important types of output.

Research and Utilisation of the Achievement of Science and Technology

The state five-year plan for scientific research lays down the tasks relating to basic scientific and technical problems of macro-economic significance, country-wide use of the achievements of science and technology, the buying and selling of licences, the training of scientific personnel, and scientific job organisation.

The Ninth Five-Year Plan contained around 200 scientific and technical problems aimed at over-all solution of questions linked with intensifying and increasing the efficiency of social production. Most of the scientific and technical problems laid down in a five-year plan are of an applied nature. Their solution is ensured by research and technological development when there is a fairly high probability of achieving the intended results. The aim of applied research and technological development is to carry through the selected technological solutions to the stage of making a model of prototype of the new machine, equipment, instrument, material, etc.

The plan lays down the main targets for each scientific and technical problem, defining what is to be made and prepared for practical use within the planned period, and setting the technical and economic indicators and technological processes of the new types of output. The time limits for reaching the targets, the ministries and departments responsible, and the estimated costs of the work are also confirmed.

Most of the problems in the plan have a complex, intersectoral character, which means that their solution requires a whole complex of work to be carried out from the research stage to their application to production. This makes it essential to have one composite, integrated plan of scientific and technological advance.

To dovetail the work of the various agencies engaged in each problem in the plan, co-ordinating plans are drawn up and approved which define the whole systems of research, experimental design, and project-planning work, making of specimens, carrying out of tests, preparation of technical documentation, and so on. Completion dates are fixed for each problem, the organisations responsible for the work and the financing organisation are named, and the cost confirmed.

An indication of the scale of the problems that have to be solved can be obtained from the following example. More than 50 research, project-planning, and design organisations of eight ministries are engaged in the problem of building large power block units, each of great unit capacity, for thermal generating stations.

Tasks relating to the use of scientific and technological achievements in the economy are subdivided into targets relating to the production of new types of output, to the introduction of advanced technology and the mechanisation and automation of production processes, and to the application of computers in the economy.

The plan for starting up new production embraces plant and machinery, instruments, apparatus, articles, and materials being produced for the first time in the Soviet Union, and types of output already in production but which have been so essentially modified that their technical and economic indicators meet the requirements of the present level of development of technology.

Since 1970, the plan has included targets for the sale of Soviet licences abroad and the purchase of foreign licences for plant and machinery, instruments, and technological processes. These targets are drawn up by USSR Gosplan in conjunction with the Committee for Science and Technology and the Committee for Discoveries and Inventions.

The plan for introducting advanced technology and mechanising and automating production processes reflects the main trends of technological advance; they provide for new methods of production, based on the use of high speeds, pressures, and temperatures, efficient technological equipment, and modern methods of automation and production control.

The plan also includes measures for the comprehensive supplying and equipping of industry with equipment for mechanisation and automation, and includes tasks for raising the level of mechanisation of types of work still carried out by manual labour. In addition it includes tasks relating to experimental construction, using new building products and materials, and to the planning and building of towns along progressive lines.

Particular attention is paid to planning the output of plant and machinery for those technological processes in which mechanisation enables the greatest possible number of workers to be released for other work. In both heavy and light industry, and in building, approximately 60 per cent of the workers work by hand, although a considerable part of the work they do could be mechanised with a resulting improvement in economic efficiency. It is estimated that mechanised labour is four times more productive on average than manual labour.

As regards the application of computers, the plan puts forward tasks for automating management and technological and production processes by using automated control systems and computers to carry out various production and economic tasks. The substance of the plan is to set up automated control systems of national importance, and sectoral and departmental automated control systems for managing enterprises and organisations, and controlling technological processes, and to create a network of computer centres for various purposes.

In the years of the Ninth Five-Year Plan (1971-75) more than 2,300 automated and automatic control systems were brought into operation at various levels. For this purpose more than 2,000 computer centres were set up, equipped with third generation electronic computers. The total saving from automatic control in 1971-75 has been calculated at

1,850 million roubles. Its effectiveness for enterprises and amalgamations takes the form of improved production organisation, reduced loss of working time, reduction of idle equipment time, and rational use of materials. In increased output by 3 to 5 per cent, and reduced stocks of materials and made-up components to optimum dimensions. The recoupment period of these systems is two to two-and-a-half years.

The systems of automatic control of technological processes are recouped especially quickly. A broad programme of work in this field is therefore laid down for 1976-80; the volume of automatisation of technological processes on the basis of electronic computers will grow more than three times.

Targets were also set for the training of scientific workers and science teachers, which stipulate the intake of post-graduate students in the different branches of science, and by types of training.

In the main, development of science and technology is financed centrally. The size and structure of the financial resources are determined in the light of the directions taken by scientific and technological advance. Plans envisage a higher growth rate of resources that can be allocated for the development of science and technology than the growth rates in the economy as a whole.

The sources for financing expenditure on science and the introduction into production of the results of completed development work are the state budget, the fund for implementing new technology, the fund for developing production, and bank credits. Allocations from the State budget are assigned for the most important research projects of national significance. Preparatory work on new types of production, including design and development and the making prototypes and specimens is financed from the funds for implementing new technology.

The Planning of Standardisation

A most important part of the development plan for science and technology is the plan of state standardisation and metrological servicing of the economy. This plan is drawn

up by the USSR State Committee for Standardisation (Gosstandart) and the USSR State Committee for the Building Industry (Gosstroy) on the basis of submissions from ministries and departments, the Councils of Ministers of the Union republics, and research and planning and design organisations.

A unified state system for planning the quality of output has been introduced in the Soviet Union, based on the planning of standardisation at all levels from the individual enterprise to the economy as a whole. In accordance with the decision of the Central Committee of the CPSU and the USSR Council of Ministers in 1970 on raising the role of standards in improving the quality of final output, a whole system of work is envisaged on standardising raw materials and industrial supplies, and sets of items and tools the quality of which has a decisive influence on the productivity, reliability, and durability of machinery and instruments, and on the use properties of consumer goods.

The standards are confirmed by USSR Gosstandart; but those for particularly important products are adopted by the government. Products not covered by a state specification standard have their standards fixed, in agreement with Gosstandart, by ministries and departments in the case of standards for industries and by the Councils of Ministers of republics in the case of republican standards. Standards are not laid down for products with a limited or once-only use, their quality being determined by the technological conditions. Technical specifications are fixed either by the management of the enterprise by agreement with the customer, or by a higher economic authority.

In 1975 state standards (GOSTs) numbered more than 20,000, industry standards 16,000, republican standards 7,000, and there were around 100,000 technical specifications. More than half the state and industry standards of the USSR apply the indices and norms adopted by the International Standards Organisation (ISO).

The five-year plan for state standardisation includes tasks for the integrated standardisation of output and standard technological processes, methods of control and testing, regulations for storing, packaging, transporting, and so on. It also includes tasks relating (a) to the creation and introduction of uniform systems of documentation on technical standards, planning and design, technology, planning calculations, etc., (b) to the inter-sectoral standardisation and unification of components, sub-assemblies, and assemblies and sets.

Whereas standards used to apply mainly to industrial output, there is now a system of standards for conservation of the environment, a unified system of documentation, and a single classification and coding system for technico-economic documentation, and work is in hand on a system of labour safety standards. In 1971 the standards of the Unified System of Design Documentation were introduced in all branches of Soviet industry. The experience of the electrical engineering industry, in which this system was introduced experimentally, showed that, as a result, the time taken to develop new lines and substantially improve the quality of designs, was cut by almost a third. A Unified System for the Technological Preparation of Production has also been developed and is in process of introduction.

The standardisation plan contains specific indicators relating to the quality of the most important types of output covered by standards, and the time limits for their introduction.

On 1 March 1976 the State Quality Mark had been awarded to 27,400 types of article produced by around 4,100 industrial enterprises.

Improvement of the quality of output is not an end in itself. There is a direct connection between the quality of a product and the cost of producing it. Improvements in quality necessitate increased costs. The problem consists not merely in the maximum improvement in quality but in selecting the variant that entails the minimum cost relative to unit efficiency. In that connection, it is important to develop reliable and relatively simple methods of measuring the consumer properties of manufactured goods.

In planning qualitative improvements, a system of generalised and differentiated indicators is used. The former relate to the weight of products by quality categories in the total volume of goods sold, and the proportion of goods in total output that carry the State Quality Mark. These indicators are confirmed and used in planning targets for

quality improvements in the plans of enterprises, amalgamations, and ministries. The differentiated indicators relate to reliability, life, degree of standardisation and unification suitability for industrial production, and so on; they are used in planning by product groups.

USSR Gosplan, in conjunction with the State Committee for Science and Technology, Gosstandart, the State Prices Committee, and the Central Statistical Board, has laid down a procedure for certifying the quality of manufactured goods according to three categories of quality—top, first, and second—and the procedure for planning and stimulating the production of top-quality products. With the aim of increasing output of top-quality products, their volume of sales and the scale of supplementary allocations from ministries' reserve funds for economic stimulation to the material incentives funds for fulfilling this task are decided at the same time as the annual plans of enterprises and organisations are confirmed. Coefficients increasing the standard contributions to the incentives funds from profits arising from an increase in sales of top-quality goods (i.e. the most progressive types) are established. While coefficients that lower the standard rate are applied to output of category two (out-of-date) goods. The macro-economic plan for ministries, departments, and Union republics for 1976 stipulates the proportion of output with the State Quality Mark in total sales and also indices of technico-economic production standards.

The effectiveness of research and rates of industrial development depend to a considerable extent on the standard of measuring technique. The standard and calibration base of the USSR includes 67 primary and special standards at the present time. At the beginning of 1975, 287 standards needed to ensure unity of measuration had been confirmed. Metrological services function in 12,000 enterprises. Between 110 and 115 million instruments have already been checked and tested by the state metrological service and up to 200 million by departmental metrological services.

Experience indicates that at least two-thirds of all breaches of technology, departure from standards, and incompatibility of the results of tests and experiments are due to the unsatisfactory state of metrological servicing, lack of means

for measuring, and incorrect calibration of the instruments used. Raising of the standard of measuring technique is therefore a most important reserve for improving product quality, and metrological servicing deserves special attention in state plans.

CHAPTER VII

PLANNING THE USE OF NATURAL RESOURCES

The natural resources of the USSR are vast and varied, which is a favourable condition for growth of its national wealth. The existence of vast deposits of minerals, and of fertile lands, broad forests, and reserves of fresh water encourages high economic growth rates and ensures independence of the mineral raw material base from foreign sources.

The scale of the mining and extraction of natural raw materials and fuels has attained gigantic dimensions; but the development of the economy is causing a rapid growth of consumption of various kinds of minerals and necessitating the mining of deposits in remote, out-of-the-way, and underdeveloped areas. The macro-economic plans envisage faster growth, compared with extraction, of explored reserves of minerals, which will enable their supply to industry to be maintained at an adequate level. "Another important problem...," it was noted at the 25th Congress, "...that we have tackled on a large scale during the Ninth Five-Year Plan period was that of *satisfying the country's fuel, energy, metal and primary materials requirements.* We are confronted with this problem not because there is a physical shortage of natural resources but because their reserves are limited in the settled areas close to industrial centres. To get our oil, gas, coal and ore we are now moving ever farther East and North."[1]

[1] L. I. Brezhnev, *Report of the CPSU Central Committee and the Immediate Tasks of the Party in Home and Foreign Policy, XXVth Congress of the CPSU*, p. 45.

The facts on geological reserves of minerals, timber reserves, and land and water resources indicate that in the long run the Soviet economy will be sure of all the main types of natural resources, but that it is necessary to exploit them carefully and rationally, extracting the maximum output of end product per unit of raw material and fuel by the application of technology, economising on the original raw material, fuel, and materials and ensuring protection of the environment. Under socialism the main role in this is that of complex macro-economic planning of the exploitation and conservation of natural resources.

1. THE EXPLOITATION OF NATURAL RESOURCES AND PROTECTION OF THE ENVIRONMENT

In the Soviet Union, as in other socialist countries, the state regulates man's inter-relations with nature by legislation. The main feature of the legislation is its national character and complex approach to tackling the problems of conserving and improving the state of the environment. The Soviet Union first established maximum permissible concentrations of harmful substances in air and water back in the 1930s. Legislation forbids the commissioning of new industrial facilities before the building of structures for treating effluent has been completed. It was said at the 25th Congress that "...with the development of the national economy and the growth of towns and industrial centres ever larger funds will be required for environmental protection—in the current five-year period alone 11,000 million rubles are being allocated for this purpose. The trend towards increasing these allocations will continue."[1]

In recent years Fundamentals of Land and Water Legislation of the USSR and Union republics have been adopted, and also a Mineral Resources Statute, and a number of special ordinances on nature conservation. In 1972 an ordinance on measures to prevent pollution of the basins of the Volga and Ural rivers by untreated effluent was adopted,

[1] *Ibid.*, p. 52.

which established concrete assignments for ministries and departments as regards the building of sewage disposal facilities and other water conservancy objects. By 1980 it is planned to ensure complete suppression of the discharge of untreated household and industrial effluent in all cities located in the Volga and Ural basins.

Annual and long-term plans confirm targets on nature conservation and the rational exploitation of natural resources. Their main aim is to conserve and improve the country's natural potential through rational exploitation and reduction of the negative effect of industrial enterprises, agriculture, transport, and communal and municipal services on the environment. The *Guidelines for the Development of the National Economy of the USSR for 1976-1980* say, "To work out and put into effect measures for environmental protection and for a rational utilization and reproduction of natural resources."[1]

In annual and long-term macro-economic plans there is a chapter on nature conservation and rational exploitation of natural resources, which includes the following tasks:
conservation and rational exploitation of water supplies;
protection of the atmosphere;
conservation and rational exploitation of land;
conservation and rational exploitation of forest reserves;
conservation and reproduction of fish stocks;
the development of nature reserves and areas where hunting is temporarily prohibited or certain plants are protected; conservation and rational exploitation of mineral resources.

Conservation and Rational Exploitation of Water Supplies

Water supplies are an important factor affecting the territorial location of industry and agriculture, and are no less important for cities and the population.

In a number of areas, like the Donetsk and Krivoi Rog basins, the Urals, and separate parts of the European part of

[1] *Guidelines for the Development of the National Economy of the USSR for 1976-1980*, pp. 25-26.

the USSR, in which there is a high concentration of industry and population, there is already a tight situation with regard to fresh water. In addition, the use of water by some heavy water-consuming industries in fact exceeds the standards laid down. Thus, instead of the standard consumption of 115 cubic metres per ton of steel, 200 to 250 cubic metres are in fact used; up to 350-400 cubic metres of water is expended on producing one ton of nitrogen fertilisers, and 1500 to 2000 cubic metres goes into the production of one ton of synthetic fibre. Improving the technology of production, purification, and recycling of water would yield an immense saving of fresh water, industrial needs for which have reached 250 million cubic metres a day in recent years, and are continuing to grow.

In the USSR, water is mainly used without charge, despite the immense state outlays on controlling river flow (building reservoirs and diverting water from water-rich areas to deficit districts). Approximate estimates are that national expenditure on water at source is 1.5 kopecks per cubic metre. At present, industrial enterprises are charged for water drawn from municipal mains and also for discharging effluent into the sewerage system. The establishing of a scale of water charges for industry so as to recoup state expenditure on reproducing water resources would enable an element of financial accounting to be introduced into water supply and encourage reduction of rates of consumption. Research and design institutes are completing the working out and agreeing of limits for water consumption by industries and enterprises, and are working on developing consolidated indices of water consumption and diversion per unit of output for industries, taking into account the quality of the water consumed. Implementation of a complex of economic planning measures will help economise on the use of water resources.

Pollution of the world ocean has risen steeply in recent years, oil being the main culprit. Active measures have been adopted in the USSR to prevent marine pollution through the introduction of a new system for cleaning tankers and the use of floating cleansing and washing stations, the production of oil traps and installations to hold oil-polluted water, and treatment of the effluent from oil

refineries. Experience indicates that it is quite possible to reduce discharge of oil into the sea and at the same time to recoup the expense involved from the recovered oil.

Protection of the Atmosphere

As industry and transport develop, particularly motor transport, the atmosphere is being more and more polluted. Discharge of cement dust, ash, carbon dioxide, gases, and smoke have a negative effect on the state of the atmosphere and call for the planning of measures to protect it.

The state air pollution observation and control service, in the shape of the USSR Hydrometeorological Service, the State Sanitary Inspectorate, the USSR Ministry of Health, and other bodies, measure the degree of pollution and exercise control over measures to reduce the discharge of wastes, so as to enforce observance of the standards of maximum permissible concentrations of wastes in the air. In order to reinforce control over the purity of the atmosphere, control and regulating point have been set up in cities and major health resorts to check and reduce the toxicity of the exhaust gases of motor vehicles.

Measures to reduce the discharge of substances harmful to man and his environment by industrial enterprises and transport facilities are being taken by installing modern gas-scrubbing and dust-arresting apparatus and equipment and also apparatus to neutralise and render harmless the toxic substances in exhaust gases.

Land Conservation and Utilisation

The USSR has the largest area of farm land in the world. On 1 November 1974 its total extent was 608 million hectares, or 14 per cent of the world total. Arable land constituted 226,200,000 hectares, pasture 330,100,000 hectares, and hay fields 45 million hectares. The central zone of the RSFSR, Moldavia, the Ukraine, the North Caucasus, the Volga area, and the South Urals are famous for their black earths, which possess high natural fertility.

Since 1917 up to 70 million hectares of land have been brought into cultivation, which has made it possible to increase the crop area. In the middle 1950s around ten million hectares of black earth soils were brought under the plough in Siberia and Kazakhstan and around 30 million hectares of dark chestnut, chestnut, and other less fertile soils, which was equivalent to the total crop area of several West European states. It is important to ensure conservation of land wealth, restore the fertility of the soil, and to improve the soil itself and its use.

The main loss of land riches comes from erosion (by wind and water). Approximate estimates are that 17 per cent of farm land (or 100 million hectares) have been affected by various kinds of erosion, including 50 million hectares of arable. Much work is being carried out now in the USSR to protect soils against wind erosion. An example is the complex of agrotechnical measures applied on an area of more than 18 million hectares in North Kazakhstan and the steppe areas of Western Siberia.

Amelioration has been carried out on a broad scale since 1966. In 1976-80 it is intended to bring four million hectares of irrigated land into cultivation through state capital investment, to drain 4,700,000 hectares, and to water 37,600,000 hectares of pasture. In 1961-70 the proportion of produce from irrigated and drained lands was 15 to 18 per cent of the total crop of collective and state farms, and in 1971-75 around 24 per cent; the area of improved land was less than 8 per cent of the total farm area. The main indicators of land conservation and rational utilisation are the increase in irrigated and drained area and the implementation of anti-erosion measures.

Plans for the conservation and rational use of land are drafted by USSR ministries and departments and submitted to the USSR Ministry of Agriculture and the Councils of Ministers of Union republics for state farms and enterprises in the Union republics and various economic regions. The USSR Ministry of Agriculture submits a composite draft plan to USSR Gosplan for the USSR as a whole, USSR ministries and departments, Union republics and economic regions.

Conservation and Rational Utilisation of Forest Resources

The USSR has the largest forest reserves in the world. Their total area is 770 million hectares or 34 per cent of the whole country. The reserves of timber constitute 82,000 million cubic metres, which is more than those of the United States, Canada, Sweden, and Finland combined. Most of the forests of the USSR consist of valuable evergreen varieties, which constitute around half the world reserves of this type.

The function of forests is extremely varied. They have a water-conservancy, soil protection, and sanitary value, and provide 54 per cent of the oxygen balance of the planet. But, as the statistics indicates, world consumption of wood is growing steadily. In the last twenty years annual consumption increased by 500 million cubic metres and is now around 2,000 million cubic metres.

The numerous functions of forests call for an economic, complex, and scientifically validated approach to their conservation, use, and reproduction. In the USSR state inspection is exercised over the condition and rational exploitation of forests. The forestry authorities are responsible for re-afforestation and for improving the productivity of forests, and for protecting them against fire, unauthorised felling, and harmful insects and diseases.

The Soviet Union occupies first place in the world for re-afforestation. Between 1844 and 1917 an area of 900,000 hectares of forest was replanted or seeded in Russia; in 1970 alone in the state forests of the USSR forest plantations and protective forest belts were planted on 1,300,000 hectares. Immense areas of sandy soils are being re-afforested, and forest belts planted to protect valuable farm fields against erosion. The productivity of inferior land is being raised.

A special place in the natural wealth of the USSR is occupied by the unique Lake Baikal. In order to protect it a special method of lumbering has been worked out and introduced in the lumbering enterprises in the forests of its catchment area. Barrier zones have been created and valuable timber species planted, irrigated nurseries have been set up for the basic planting material, and all-round research is being undertaken into Baikal area conservation.

The protection of forests against fire, pests, and diseases is especially important. Forest fires inflict vast losses on the economy. Fire protection measures are being taken by the enterprises of the USSR State Forestry Committee. They are creating anti-fire mineralised zones and fire protection roads. There is also a wide network of chemical fire stations and observation towers and masts.

In drafting conservation plans indicators are used that characterise the measures to be undertaken in regard to re-afforestation, unauthorised felling, and forest fires, and improvement of the standard of exploitation of forests. The main index for planning the volume of replanting and seeding of felling areas is the area of complete felling requiring artificial re-afforestation. This indicator is calculated allowing for the need to close the gap between felling and re-afforestation.

An index is planned for state control over the prompt restoration of forests that will characterise the ratio between the area of replanting and seeding and the area of complete felling on which natural restoration will not take place, and which calls for measures to re-afforest it artificially. The level of exploitation of forests can be gauged by an index that is calculated as the ratio of the volume of fellable reserves in the state forests and the calculated amount felled.

Draft plans for forest conservation and rational utilisation are drawn up by USSR ministries and departments for the forests for which they are responsible, and are submitted to the USSR State Forestry Committee and the Councils of Ministers of Union republics. The State Committee submits a composite draft plan to USSR Gosplan for the USSR as a whole, for USSR ministries and departments, Union republics, and economic regions.

Conservation and Reproduction of Fish Stocks

The USSR's possibilities of developing fisheries are immense. The length of the rivers is over 500,000 kilometres, the area of lakes is 30 million hectares and of reservoirs six

million hectares. The fishing industry trebled its catch of fish and production of various sea products between 1960 and 1975, which has helped improve the national diet. But this has been done mainly by growth of ocean fisheries. The catch of fish from internal waters is growing slowly.

The *Guidelines for the Development of the National Economy of the USSR for 1976-1980* plan increasing stocks of valuable species of fish in internal waters, and envisage a 70 per cent increase in the production of fish from state fish farms. Commercial cultivation of fish will be developed most intensively. The best fish farms already have a yield of five to seven tons of valuable fish per hectare. In addition to carp they farm Amur, silver carp, the *bester* hybrid of sterlet and Danube sturgeon, and other species. It was once calculated that one hectare of ocean could yield up to 50 tons of biological products, but in fact it only yields 0.15 ton. A hectare of internal waters (rivers, lakes, and ponds), and of basins of the warm waters of power stations are much more fertile. The plans therefore envisage measures to extend the scale of work on artificial fish farming, and conservation and restoration of valuable species (sturgeon, salmon, and whitefish).

In order to reduce losses of fry and young fish a survey is being made of water intakes needing the fitting of fish protection devices. In the future these devices will have to be fitted on all existing and newly commissioned intakes.

Plans for protecting and reproducing fish stocks are drafted by USSR ministries and departments and are submitted to the Ministry of Fisheries and the Councils of Ministers of Union republics. The Ministry of Fisheries submits a composite draft to USSR Gosplan for the USSR as a whole, and for ministries, departments, Union republics, and economic regions.

Conservation and Rational Exploitation of Mineral Resources

A powerful mining industry has been created in the USSR that fully supplies the most important sectors of the economy with minerals and provides a sure basis for long-term development. It produces nearly a quarter of the world's output of minerals. But however great the reserves of minerals, they are not unlimited, and therefore have to be treated with extreme care and economy. At the present time, because of imperfect mining technologies a considerable fraction of the raw material is lost and remains unminable. Special legislation has been adopted in the USSR to give backing to the principles of systematic, complex, rational exploitation of mineral resources, beginning with their geological study and the projecting of mining undertakings, and ending with the extraction and processing of the minerals. In order to reduce losses during mining and to raise the degree of extraction of the main and ancillary or by-product components the following indicators are defined in state plans:

(1) indices of the extraction of minerals during mining;

(2) indices of the extraction of components from the mined raw material during dressing and technological processing;

(3) indices of the extraction of by-product components;

(4) measures to improve the coefficient of extraction of oil and gas and the utilisation of accompanying gas.

Plans for the rational exploitation of mineral resources are drafted for the main mining and metallurgical industries by the main types of mineral, as follows: iron and steel and non-ferrous metallurgy; coal mining; the extraction of oil and gas; the chemical industry; the production of building materials.

The State Mining and Geological Inspectorate exercises control over strict observance of the regulations on conservation and on safety in mining operations by undertakings and organisations, and over all-round utilisation of deposits of mineral raw materials and fuels.

2. THE PLANNING OF GEOLOGICAL PROSPECTING AND EXPLORATION

The main job of the Soviet geological prospecting and exploration service is to find and explore new deposits, with favourable technico-economic, mining, and geological indices. These deposits include the following: (a) deposits

with rich or easily enriched ores; (b) predominantly large deposits; (c) deposits with favourable geological and technical mining conditions (primarily suitable for open-cast working); (d) deposits located in areas economically suitable for commercial exploitation.

In drafting plans for geological prospecting work the following standard periods are accepted for the minimum life of the explored reserves of individual mines, pits, open-cast mines, and quarries:

(1) 20 to 25 years for reserves of iron ore and other materials in mines and quarries of the iron and steel industry; and at least 40 years for large ore-dressing plants;

(2) 30 to 40 years for bauxite reserves for large enterprises in the aluminium, copper, lead and zinc, and nickel industries; 20 to 30 years for large enterprises mining and producing tungsten, molybdenum, tin, and mercury; 15 to 20 years for gold mines; 5 to 10 years for small enterprises exploiting rich deposits of certain non-ferrous metals, gold, and valuable non-mineral raw materials, and placer deposits of noble and rare metals (on the whole the periods for non-ferrous metals vary considerably according to the size and character of the enterprise concerned);

(3) 40 to 50 years for coal mines with a rated capacity of 600,000 to 900,000 tons a year, and open-cast pits with a capacity of 3,000,000 tons a year; and 50 to 60 years for pits with a capacity of one to four million tons a year;

(4) 35 to 40 years for oil undertakings in categories $A + B + C_1$ in the USSR as a whole and in separate oil regions;

(5) 25 to 30 years for gas fields;

(6) 40 to 50 years for large undertakings mining materials for the chemical and building materials industries, 20 to 30 years for medium-sized enterprises, and 10 to 15 years for comparatively small mines and quarries.

Plans for prospecting work are compiled in the following chapters:

I. Prospecting and exploration:
   (1) for ferrous metals;
   (2) for non-ferrous and rare metals;
   (3) for noble metals and diamonds;
   (4) for coals, fuel shales, and peat;
   (5) for oil and natural gas;
   (6) for non-metallic minerals
II. Regional geological surveys and geophysical work
III. Hydrogeological and engineering geology work
IV. Research
V. Special work
VI. Unforeseen work and contingencies

In order to improve the efficiency of geological exploration work under five-year and annual economic plans indices by deposit of the quantity of the reserves of minerals prospected are employed, and in five-year plans by large deposits and promising areas prepared for commercial exploitation: the periods for completing the exploration work and for confirmation of the reserves by the State Commission for Mineral Reserves under the USSR Council of Ministers are indicated. Increase of reserves for all minerals is planned as the sum of categories $A + B + C_1$, and for oil and gas by the sum of categories $B + C_1$. For individual minerals (mercury, mica-muscovite, etc.) assignments are set for increase of $C_1 + C_2$ reserves. For planning exploration in deposits being exploited, assignments for the transfer of reserves to a higher category (e.g. from C_1 to $A + B$) are set in addition to increase of $A + B + C_1$ reserves. Increase of reserves of ferrous metals and aluminium raw materials are planned in terms of ore, and reserves of non-ferrous, rare, and noble metals, as a rule, in terms of metal.

The generalised index of the plan is the total volume of geological exploration work, which is set in money terms. The bulk of the outlay on exploration is envisaged in the plan as coming from the state budget, but work on deep exploratory drilling for oil and gas from capital investment funds. The volume of exploratory work in money terms is calculated from the current planned prices, norms, estimates, and the projected volumes of work necessary to carry out the plan for increasing mineral reserves, developing new deposits, and tackling other assignments established by the plan.

Volumes of exploratory work (in money terms) are stipulated in the plans as a whole for ministries and departments, with grouping of the work by the breakdown outlined above

for Union republics, and breaking down the volumes by the most important minerals and objects.

Special attention is paid in the drafting of the exploration work to improving its economic efficiency. The index for appraising this is the cost of exploration per unit of reserves *in situ* or specific expenditure on the exploration of a unit of reserves. The initial data for calculating planning specific expenditure on exploring reserves is the planned total expenditure, including all types of work from prospecting to final detailed exploration, and planned growth of reserves by categories $A + B + C_1$. The size of the specific expenditure on explored reserves is determined as a quotient resulting from the division of the planned expenditure by the planned increase of reserves. Specific expenditure on transferring reserves from category $A + B + + C_1$ to $A + B$ is determined in the same way. In order to estimate specific expenditure for complex deposits, for which exploratory expenditure has not been differentiated (e.g. deposits of lead and zinc), the reserves are recalculated in terms of a conventional mineral at wholesale prices taking into account the index of extraction of the components.

The mineral raw material base of the Soviet Union is being steadily extended through geological study of the earth's interior and exploration of new deposits of raw materials and fuel. In 1971-75 more than 2,000 new deposits were discovered, and over 4,000 brought into commercial exploitation. In the same period another 130 oil and gas fields were plotted on the map.

CHAPTER VIII

THE PLANNING OF CAPITAL INVESTMENT AND CONSTRUCTION

1. SOURCES AND COMPOSITION OF CAPITAL INVESTMENT

Capital construction has played a decisive role in creating the material and technical base of socialism, in implementing the policy of industrialisation, and in strengthening the Soviet Union's defence capability. It is also of prime importance in building the material bases for communist society.

Over the past half-century an enormous investment potential has been created in the Soviet Union, which furnishes a reliable basis for extended socialist reproduction and provides striking confirmation of the immense advantages offered by socialism. A powerful building industry and an advanced engineering industry with many different branches constitute investment sectors ensuring dynamic economic growth and the possibility of opening up important lines of technological advance very quickly and altering the proportions of economic development in the required direction.

The Soviet Union is building on a vast scale. The total of fixed assets brought into operation between 1918 and 1974 was 1,268,000 million roubles and the total volume of capital investment in the same period 1,372,000 million roubles. The volume of capital investment in 1976-80 will be around 630,000 million roubles, or 24 to 26 per cent more than in 1971-75.

The main source for the extended reproduction of fixed assets is accumulation from national income. Another source is the fund for the replacement of outworn fixed assets.

A distinction is accordingly drawn in the economics of investment between gross and net investment. By *gross* investment is meant total expenditure on extending assets and replacing their outworn components. By *net* investment is meant expenditure solely on extending fixed assets.

In planning practice investments financed from both the accumulation and the replacement funds are classed as investments for creating new fixed production and non-production assets and for extending, reconstructing, and technically re-equipping existing fixed assets. Expenditure on the repair of existing fixed assets is not included in capital investment, capital repairs being planned and taken into account separately.

In accordance with the established procedure, investment in the USSR includes:

(a) the cost of all types of construction work, including the erection or reconstruction of buildings and structures, outlays on sanitary engineering installations, water supply, the structures of district heating and gas supply systems, oil and gas pipelines, overhead and underground power transmission grids, etc.;

(b) the cost of erecting and installing equipment, connecting it with mains supply, and erecting and installing service areas, stairways and other technological metal constructions, etc.;

(c) the cost of technological power, lifting and handling, pumping and compressor equipment, and other types of plant included in the building estimates;

(d) the cost of instruments and stocks (inventories) included in the estimates of the building job and counted as fixed assets;

(e) the cost of plant and machinery not included in the job estimates, if they are obtained as part of the capital investments;

(f) other major works and expenditures, including expenditure on design and planning experimental and exploration work and drilling.

The total volume of investment extends beyond what is considered the usual range of outlays and embraces at least three types of expenditure, as follows:

1. expenditure on organising geological prospecting and exploration work, which, in some industries, exceeds the direct outlay on building the appropriate production enterprises (the proportion of such expenditure is especially high in the non-ferrous metal, oil and gas industries; only part of the cost of the prospecting and exploration work is included in the estimates for production capital investment, the larger part being borne as budgetary expenditure by the USSR Ministry of Geology, although it is essentially capital investment);

2. expenditure on research, which has grown phenomenally in recent years;

3. expenditure on capital repairs and overhauls, which are closely tied up in practice with the modernisation and reconstruction of existing assets (at present funds for the development of enterprises include money for the replacement and renewal of equipment, including major repairs).

From the standpoint of the procedure for planning and making investments, they are divided into centralised and non-centralised investments.

Investments for which the main indicators are fixed as part of the state macro-economic plan are classed as *centralised*, and the sources for financing them are fixed in that plan (state budget, depreciation charges, or the profits earned by enterprises and organisations).

Non-centralised investments are those made by state enterprises and organisations out of their production development, social and cultural, and housing funds, or by means of bank loans and certain special-purpose loans.

Planning bodies take non-centralised investments into account when compiling macro-economic plans and provide for them to be matched by material resources, the necessary blueprints and documentation, and production capacity in ancillary organisations.

As a result of the economic reform carried out in the building industry, the weight of non-centralised investments in the total has increased, and their efficient use is acquiring ever greater macro-economic importance.

2. THE PRE-PLANNING STAGE OF INVESTMENT PLANNING

Before any detailed planning of current and long-term investments can be made, the pre-planning stage must be gone through, including the forecasting of fixed assets and capital investments over the long term, the compilation of dynamic inter-sectoral input-output tables, and the drawing up of general schemes for the development and location of sectors and industries, input-output tables for fixed assets and production capacities, and a system of standards for capital construction.

Forecasting

Investment forecasting has to cover the full period required for completing lengthy programmes of capital construction or major projects lasting for ten to twenty years. Such long-term investment programmes are formulated in accordance with the basic social, political, technical, and scientific goals adopted for the long-term period ahead. Such projects and programmes can be broken down by priorities into their stages of implementation. In this connection, it is important when a forecast is being made about the setting-up of entirely new industries, etc., to establish the order of priority to be followed in drawing on natural resources and in what order power transport construction will be carried out. The data can be used later in compiling five-year plans. Next the various investment programmes have to be coordinated and timed correctly and dovetailed in accordance with the actual periods of the perspective plan.

An important methodological task is to determine the extent to which investment decisions are linked; this depends on what construction has already been begun, on the backlog of building work in progress, and on the existing distribution of material production and transport facilities, and the location of towns and centres of population.

On the basis of analysis of the dynamics of fixed production assets, a forecast is made of their withdrawals and the

volume of their replacement, using an analysis of the annual commissioning of assets by type, service life, and age. This forecast in turn forms the basis for fixing the direction of investments for replacement purposes and deciding the order in which investments will be converted into fixed assets, with due regard for the time taken to build them and bring them into production.

Investment forecasting is bound up with defining the directions of scientific and technological progress. The scale of investment in new, science-based industries and sectors, such as enterprises producing electronic computers, aerospace equipment, vacuum equipment, integrated circuits, etc., has to be predicted, as investments in this group of industries are also tied up for the considerable period needed to organise many allied industries and substantially re-orientate capital construction.

In making the forecast, it is extremely important to fix the possible scale of investment in projects designed to solve fundamental problems in modern science. The outlay on many projects of this type can be very large and comparable to the investment in whole sectors of industry. Such, for example, are the investments in space research centres or in building the powerful accelerators needed to resolve problems in high-energy physics.

In forecasting the economic efficiency of scientific and technological advance it must also not be forgotten that there is sometimes a large time lag in the return of investments. To take a well-known example, it has taken nearly two decades for nuclear power-stations to reach and then surpass the indices attained by conventional sources of power.

A Dynamic Inter-Sectoral Input-Output Model

A preliminary estimate of the required volume of investments can be made by using a dynamic inter-sectoral input-output model (see Ch. V). Its results can then be used in compiling full five-year and annual investment plans.

As already noted, the volume of investment resources was a predetermined quantity in the final product of a static input-output model. In a dynamic model, however, produc-

tive investments are not included as a previously given value but are determined by the model itself. Modelling the processes of the reproduction of fixed production assets makes it possible to establish certain ways in which the direction of economic development depends on the state of the economy in the pre-planning period. As a result, the range of possible and economically advisable development variants is sharply reduced in comparison with the static model.

In a dynamic model non-productive investments not directly connected with the scale of production are included in the final product as in a static model. The productive investment in each sector separately distinguished in the input-output table is fixed at the following stage. The total demand of each sector for investment is determined (1) by the increment of assets, which depends on their availability at the beginning of the year and the intended growth of production in the planned year; (2) by the replacement of withdrawn assets; and (3) by the backlog of building work in progress. These problems are solved by developing indicators reflecting the basic aspects of the process of extended reproduction of fixed assets in each particular sector. The aggregate demand obtained by using standard norms gives the volume of productive investments needed to generate the planned consumption fund and carry out non-productive capital construction. In contrast to the static model, the preliminary calculation of productive investment resources can be dropped, since their volume is determined at the same time as demand is calculated in the model itself.

When the demand for productive investments is fixed in a static model, it should be realised, no account is taken of the specific features of the process of capital construction in each particular sector. The specific features that develop with a different technological structure and a different physical composition of investments in the various sectors are only taken into account when the total volume and structure of investments is determined as a component of the final product. A dynamic model reflects the process of reproduction of fixed assets directly in the sectoral breakdown, i.e. describes their dynamics during the planned period.

Unlike a static model the equations of a dynamic model have positive solutions only within a certain range of given values of the net final product, i.e. the final product excluding productive investments. If its value lies outside this range, then the model gives a negative solution. If the range of positive solutions is extended, then negative solutions for indicators of investments primarily arise in asset-creating sectors, i.e. full use of available assets in these sectors is not ensured at this level of the net final product. If the volume of the net final product is less than the lower range of positive solutions, then negative investment develops in those sectors producing consumer goods. Thus a dynamic model enables an objective decision to be made regarding the possible limits of economic development with a set of given initial parameters.

The actual types of dynamic inter-sectoral input-output model may differ, depending on their use of average or incremental indicators of the inter-relation of fixed assets and output, the different methods of calculating investment lags, and various other factors.

3. THE STATE INVESTMENT PLAN

Five-Year and Annual Plans

The main form of state investment planning in the USSR is the five-year plan drawn up and approved, with an annual breakdown, for each USSR ministry and department and Union republic.

Beginning with the 1971-75 plan, targets for the commissioning of capacities and fixed assets are fixed in five-year investment plans for each construction job, and also the volume of investments and building and erection work over the whole period of construction, with an annual distribution according to the standard construction times, including those projects that will be completed after the five-year planned period. These assignments are concretised and made more precise in the annual plans in the light of data on the course of plan fulfillment and changes in resources. In 1976-80 the principles of planning building and erection work will be altered. The drafting of the state development

plan with breakdown by years will go hand in hand with the simultaneous compilation of building programmes based not on the annual planning "horizon" but on the five-year one—with two and three-year plans for building and erection work. Thus it will become possible to go over to compiling complex, long-term plans for major construction projects and large objects, tied in with the existing technical documentation, provision of equipment, and building periods, and also with plans for material and technical supplies and with the capacities of building and erection organisations.

Proposals for the building of new objects not envisaged in the five-year plan can be examined as an exception at the same time as annual plans should the need arise to establish some new line of production, or in connection with the discovery of new mineral deposits, an increase of raw materials for processing, radical changes in technology, or major new advances in science and engineering. The technical and economic substantiation of the proposals and recommendations as to sources of finance and the necessary material and technical supplies for building the objects, and as to organisation of the capacities of the building and erection organisations, have to be made at the same time.

The following planning procedure was adopted in 1971 to ensure the fullest possible coordination of the capital construction plan with other sections of the macro-economic plan and to make certain that projects under construction receive the requisite equipment, building materials, mechanising, manpower, and financial resources.

The total volume of investment is decided at the drafting stage of the macro-economic plan in the light of all the sources of finance (including collective farm funds) balanced against the material, labour, and financial resources, and the capacities of building and erection organisations.

Work is then started on input-output tables for production capacities, for equipment in physical and value terms, and for the materials needed for capital construction; the capacities of state and inter-collective farm building and erection organisations are calculated by Union republics, territories, regions, and areas of concentrated construction, and the use that these tables and calculations can be put to

in compiling and revising capital construction plans is examined.

In addition the following are used to validate the assignments provided for in investment plans: plans and estimates for introducing new technology; plans for implementing organisational and technical measures; calculations for improving the structure of investment and reducing the estimated cost of construction; calculations of financial resources by sector, fixing the scale of internal funds available for financing investment; standards for planning capital construction (standard construction times and backlogs of work in progress; standard unit investments, etc.); schemes for the development and location of economic sectors, industry, and agriculture, etc.

Basic Indicators of the Investment Plan

Some of the basic indicators of the investment plan are: the commissioning of production capacity, separate projects and plant for production purposes, housing, municipal enterprises and utilities, educational, cultural and health institutions; the commissioning of fixed production and non-production assets; and the volume of capital investment and building and erection work. As these plan indicators are being worked out, the calculations are made at the same time regarding the effectiveness and structure of the investment.

The plan for building organisations has long been established on the volume of building and erection work. Clients paid the builders for each cubic metre of brickwork or concrete laid, each cubic metre of soil excavated, each square metre of roofing, and so on. On what objects the work was done, and how far it contributed to completing this structure all that had in practice no effect on the material position of the building organisations. The drive to fulfil the plan by volume of work created the grounds for dispersing forces and funds over many objects and for a rise in uncompleted building work. The *Guidelines for the Development of the National Economy of the USSR for 1976-1980* stress the need to speed up the transfer to the planning and appraisal

of the work of building organisations by the completion and delivery to clients of ready objects and of initial complexes ready for producing output and rendering services. Thus the next stage in improving planning of the construction industry has been defined. The confirmed indicators of the plan for building and erection organisations establish the volume of work by the objects or stages that are to be completed in the plan year and to be delivered to the client at their estimated or budgeted cost. Profits and funds for economic incentives will correspondingly be calculated by the extent to which finished work and stages of work are handed over to clients.

The volume of investments is decided on the basis of synthetic input-output calculations at the preliminary planning stage, when total availability of national income and accumulation is being established. The directions of investments stem from the principal assignments of the five-year plans. The assignments for commissioning capacity, structures, and projects were the main indicators of the capital investment plan but plan estimates of the volume of commissioned fixed assets and capacities determine the quantities of capital investment and work needed to provide them.

The report of the Central Committee to the 25th Congress of the CPSU said that it was necessary to alter the very approach to the planning and utilisation of capital investments and to ensure the planning of existing production and new construction as a single whole. Capital investments should not be apportioned to ministries and departments either in general or by new objects, but for the planned increment of production. Material and financial resources need to be directed in the first place to the technical re-equipping, modernisation, and reconstruction of existing enterprises, i.e. to where production capacity can be extended without new construction or with the least unit capital investment. The commissioning of production capacities is therefore planned separately as a result of:

(a) increasing capacity at existing enterprises through their complete utilisation and the carrying out of the necessary organisational and technical measures;

(b) reconstructing and expanding existing enterprises, preference being given to the variant for reconstructing existing enterprises that is most economical in terms of construction costs, commissioning periods, and recoupment indices compared with the construction of new enterprises, account has also to be taken of current restrictions on the building and reconstructing enterprises in major cities and certain parts of the country;

(c) building new enterprises; in selecting the variant, the effectiveness of the projects presented for approval has to be carefully analysed from the aspect of recoupment periods, unit capital outlay, the location of enterprises, and the development of the construction industry's production base.

The commissioning of production capacity must be viewed, first, in the light of completing the construction of jobs and projects already started, and then of including new projects in the plan. The 25th Congress gave USSR Gosstroy, USSR Gosplan, ministries and departments the job of drafting a plan of capital investment for 1976-80 in such a way that the commissioning of fixed production assets would govern the growth of capital outlays. That would facilitate concentration of funds on the initial objects, reduction of uncompleted construction, and an additional commissioning of nearly 13,000 million roubles of fixed assets. The commissioning period is determined from the standard times for building enterprises, and for new complexes and objects to begin operating.

The indicators of the commissioning of fixed assets are established for the economy as a whole, for the main sectors, ministries and departments, Union republics, and individual building projects and enterprises, with production and non-production assets shown separately.

The commissioning of fixed assets is planned in value terms for objects of both productive and non-productive significance. The commissioning of production capacity and non-production projects is also planned in physical terms.

The scale of the assignments for the commissioning of both production and non-production fixed assets is decided from the estimated cost of the enterprises (their phases, shops, works, and initial complexes), structures, and buildings to be commissioned in the plan period.

The commissioning of plant and equipment not requiring erection, acquired for enterprises and other objects being built, and also equipment requiring erection but earmarked for storage as a permanent reserve, is planned at the same time as the commissioning of the enterprises or objects concerned.

The plan does not include expenditure that does not increase the value of fixed assets (outlay on temporary buildings, structures, and installations, expenditure on training operatives, the cost of objects with a service life of less than one year, and so on).

Account has to be taken of the fact that major projects often take several years to build. It is therefore inevitable that there is always uncompleted construction on building sites, which is a necessary stage, within certain limits, in the investment process. The commissioning of new projects due to start operation within the year and the amount of work in progress needed for commissioning projects in subsequent years is therefore reviewed annually in the course of implementing the investment plan.

The need for investment to complete work on previously commissioned enterprises and structures is determined by the estimated value of the work that still remains to be done.

The preliminary need for investment on work to be in progress at the end of the planned period is fixed on the basis of sectoral standard norms for building work in progress according to capacity and the volume of investment.

Thus, in order to speed up the commissioning of projects, reduce the scale of uncompleted construction, and at the same time ensure the necessary volume of work in progress, it is necessary to use established norms for construction times and standard amounts of work in progress in planning practice.

The following standards have been established for the different sectors of the economy and for various types of construction:

(1) a general standard time of construction in months, including the length of the preparation period, dates for delivering equipment for erection and installation, and the duration of installation work;

(2) the spread of investment and building and erection work by years as a percentage of the estimated cost; for a number of sectors the time taken to equip individual initial or starting complexes is also indicated.

The setting of standards for work in progress helps to plan investments and construction work correctly, to concentrate resources, and achieve more rhythmic operation of building and installation organisations. The standard is calculated as a percentage of the estimated cost of a particular enterprise or non-production project, its phases or initial complex (excluding the estimated cost of commissioned objects). In fixing it, account is taken of the length of the building time, the estimated cost, the structure of the investments, the intermediate commissioning of individual objects and phases, and the date for completing construction.

The Compilation of Itemised Lists

Itemised lists form an integral part of the capital construction plan, providing an enumeration of all work carried over and new projects due for completion in the planned period. They include assignments for commissioning fixed assets and production capacity and regarding the volume of investments and building and erection work. Contract building and erection work, material and technical supplies, and the financing of construction are all planned on the basis of itemised lists.

Completion dates and the annual distribution of investments and work are laid down in the itemised lists in accordance with current standards regarding construction times.

New projects can only be included in these lists if the carry-over in the sector is provided with investments in the amounts needed to complete them within the allotted time; an essentional condition for their inclusion in the lists is the existence of the necessary back-up technical and economic documents for each project. The documentation must contain data confirming the necessity and desirability of beginning construction in the planned period and the correctness of choice of area and site.

Technical and economic indicators of the future operation of the enterprise must be worked out, and also indicators of the effectiveness of the investment, including the profitability of the enterprise, the prime cost per unit of output, productivity of labour, recoupment period for the investment, output per rouble of fixed assets, etc.

In accordance with government instructions, only those projects can be entered in the itemised lists which are provided with the following:

(a) technical documentation approved in the established way, working drawings, and estimates of the volume of work to be carried out in the planned year, by 1st September of the year preceding the planned year;

(b) indents for technological, power, lifting and handling, pumping and compressor, and any special equipment requiring time to manufacture, and data on the aggregate need for general-purpose equipment, instruments, fittings and cables, by 15 April of the year preceding the planned year;

(c) indents for specific types of general-purpose equipment, instruments, fittings, and cables, no later than 15 September of the year preceding the planned year.

The years in which construction is started and completed, and the capacities of the objects are coordinated with the development of allied industries. On sites located outside towns or in areas with a shortage of labour, itemised lists are drawn up in an integrated, composite manner for production projects, housing, and public utilities, cultural and social amenities, and other municipal undertakings.

Itemised lists relating to newly begun production projects with an estimated cost above 2,500,000 roubles and those projected on a complete set of imported equipment have to be approved by the USSR Council of Ministers and are included in the macro-economic plan as specific items. The itemised lists of similar projects valued between one million and 2,500,000 roubles are approved by USSR ministries and departments, and the Councils of Ministers of Union republics in agreement with USSR Gosplan.

Itemised lists of production projects carried over with an estimated cost above 2,500,000 roubles are approved by USSR Gosplan, while those valued up to 2,500,000 roubles in accordance with the procedure laid down by USSR ministries and departments and the Councils of Ministers of Union republics.

Once the itemised lists of projects have been confirmed, intra-project lists are compiled each year by the builders in agreement with the general contractor, allocating the investment for each project to various objects.

4. PLANNING THE STRUCTURE OF INVESTMENT

Investments are allocated in the state plan as follows: (a) in the productive and non-productive spheres by the different sectors of the economy and the major branches of industry, agriculture, and transport; (b) in the total investment figure by outlays on extending and reconstructing existing assets and on new construction, on maintaining and technically re-equipping existing enterprises, etc., taken separately. It is also usual in investment economics to distinguish the reproductive, sectoral, technological (purpose), and regional structure of investments. The *technological structure* occupies an especially important place in the investment plan, i.e. the volume of building and erection work and the volume of plant, instruments, and minor equipment. Plan assignments are fixed for the main investment sectors—engineering, the building industry, and the building materials industry—in accordance with this structure.

Provision has to be made in investment plans for an increase in the ratio of machinery and equipment in total investment. Increasing the active part of fixed production assets enables output per rouble of fixed assets to be increased and the return on assets and unit investment to be improved. In addition note has to be taken of the fact that an increase in the proportion of machinery in total investments only ensures an increase in the active part of assets when it exceeds the out-of-date machinery withdrawn from fixed assets to wear and tear and obsolescence. Any increase in the proportion of machinery must go hand in hand with a probing into bottlenecks at enterprises and the setting of priority tasks for improving the economic efficiency of investment.

The volume of building and erection work fixed in the course of planning the technological structure of investment is the basis for drawing up the plan for contract building work and the manpower plan for the building industry. The differentiation of investment by equipment and other active components of investment makes it possible to coordinate capital construction plans with the production plans of the engineering industries and with plans for deliveries of equipment.

To estimate the efficiency of the technological structure outlined in the plan, indicators of the ratio of building and erection work and of expenditure on plant, instruments and minor equipment in total investment are used, compared with the indicators for the preceding period.

The technical structure of investment is directly affected by the ratio between production and non-production projects, i.e. its object or *purpose structure*. A high proportion of non-productive construction is usually associated with a high proportion of building and erection work and a relatively low proportion of plant and equipment. Yet non-productive construction is an important trend of investment ensuring a rise of national prosperity. During the Tenth Five-Year Plan the quality of housing will be improved and construction periods reduced, and a change-over made to new standard designs providing better lay-outs, better finish, and better fittings inside flats; and work on improving the hygiene of populated centres and protecting the environment will be increased. The industrial base for non-productive building, especially of housing, will be vastly extended.

When the correct proportions are not observed between productive and non-productive investment, it leads to investment not being sufficiently integrated, to unsatisfactory progress in productive construction, and to serious difficulties in ensuring labour and engineering and technical personnel for newly commissioned enterprises; and the rapid running in of new enterprises is hampered.

The ratio of expenditure on simple and extended reproduction, and within the latter on new construction and on extension, reconstruction, and modernisation, is planned

within the framework of the *reproductive* structure. Planning of the proportion of investment in simple and extended reproduction is particularly important in the extractive industries in view of the special features of the production processes (the working out of deposits, and exhaustion of oil and gas wells).

Whereas around 70 per cent of capital investment was directed to new construction in the pre-war period, the weight of outlays on the reconstruction, extension, and technical re-equipment and modernisation of existing enterprises had already reached 50 per cent by the 1950s, and in 1971-74 was 66 per cent (capital investment in industry on objects for production use). The *Guidelines for the Development of the National Economy of the USSR for 1976-1980* approved by the 25th Congress point out the need to direct capital investment primarily to the building of objects that will help speed up scientific and technological progress, and to the technical re-equipment and reconstruction of existing enterprises. In 1976-80 industrial growth in the European part of the USSR and the Urals will come about mainly in this way, with limitation both of new construction and of the extension of existing power- and water-intensive production units.

The *sectoral structure* of investment reflects its distribution by major (composite) sectors of the economy, and by branch and sub-branch of material production and the non-productive sphere. Thus, in industry, the following key sectors are distinguished: electricity generation, iron and steel, engineering, oil production and refining, coal-mining, chemicals and the light, food, and other industries. In the non-productive sphere, investments are planned for housing, education, culture, health, science, etc. At present special attention is being paid to investment in developing science and its major centres supplied with modern equipment, and on establishing computer centres and creating automated control systems. Substantial investments are being directed to measures to protect the environment.

The actual distribution of the investments of state and cooperative organisations, collective farms, and the general public in the main sectors of the economy is shown in the following table.

Table 9

Distribution of the Investments of State and Cooperative Organisations, Collective Farms and the General Public by Principal Sector (in percentages of the total)

	1966	1970	1974
Industry	35.8	35.7	35.6
Agriculture	16.6	17.5	20.6
Transport and communications	9.4	9.5	10.6
Construction industry	3.0	3.7	3.7
Housing construction (including individual)	17.4	16.4	14.7
Construction of trading, and municipal enterprises, and scientific, cultural, educational, and health institutions	17.8	17.2	14.8
Total	100.0	100.0	100.0

In the plan for 1976-80 the line of a fundamental redistribution of capital investment in agriculture will be continued. Whereas capital investment on productive construction in agriculture was 110,000 million roubles in 1961-70, in 1971-80 it will come to 260,000 million roubles, and will rise from 18 per cent of total capital investment to 23 per cent.

In planning the *regional structure* investments are allocated by Union republics, and by major regional production complexes of Union and republican importance, and measures are decided for the mutually coordinated building in a particular area of objects falling under the control of various departments and bodies. The planning of investment on a regional breakdown is done on the basis of the technical and economic drafts of the area organisations of the economy, for example, area planning projects, schemes for regional production complexes, town planning and building projects, and so on.

The building of industrial enterprises, with group ancillary production and administrative facilities, engineering

structures and services, and communications, is being widely practised. As a result of the combining of enterprises into industrial complexes the estimated cost of building is substantially reduced and operating costs lowered. At the time of writing 360 schemes for the general plans of industrial centres have been drafted and confirmed, embracing 4,500 enterprises in various industries. Their estimated cost as a whole will exceed 51,000 million roubles. The projecting and construction of a number of common facilities will enable the cost of these to be reduced by 2.2 per cent, i.e. by more than 1,000 million roubles, compared with the building of separate undertakings.

5. DEFINING THE ECONOMIC EFFICIENCY OF INVESTMENT

The efficiency of investment is estimated at all levels of planning (from enterprise and collective farm, building trust, and transport organisation to amalgamation, ministry, and department up to USSR Gosplan) and at all stages of the drafting of a perspective plan. In the early stages, when the main directions of the macro-economic plan are being established, investment efficiency is estimated only for major sectors and economic areas and for the economy as a whole. At later stages all the basic and supplementary indices are determined at all levels of planning.

Indicators of the General Efficiency of Capital Investment

The following indicators are used to calculate the overall economic efficiency of investment (E_y):

(a) for the economy as a whole, the economies of Union republics and economic sectors (industry, agriculture, transport, construction), the ratio of the annual increment to the national income (net output) in its given objects structure in comparable prices (Δy) to the investment in the sphere of material production (J) giving rise to this increment:

$$E_y = \frac{\Delta y}{J};$$

(b) for indvidual branches and sub-branches of industry, agriculture, transport, construction, and for ministries, departments, and amalgamations (provided net output is not calculated for them), the ratio of the increase in profits to the investment giving rise to this increase:

$$E_R = \frac{\Delta R}{J},$$

where ΔR—annual increase in profits over the planned period;

J—investment in building production facilities;

(c) for individual enterprises, construction jobs, and projects, individual measures, and technical and economic problems, the ratio of profit to investment:

$$E_R = \frac{X - M}{J},$$

where X—value of the annual output (for the project) in works wholesale prices (without turnover tax);

M—prime cost of the annual output;

J—estimated cost of building the project (or capital outlay on measures and technical and economic problems);

(d) for industries and enterprises where transfer prices are used, and for enterprises making planned losses, the ratio of the saving from reducing the prime cost of output to the investment giving rise to these savings.

In determining overall economic efficiency in accordance with points (b), (c), and (d), the recoupment periods of the total investment are also fixed on the basis of the inverse relationship between investment and either profits or the saving effected by reducing prime costs.

These calculations should be accompanied with an analysis of the factors affecting a raising or lowering of efficiency, factors that include the following:

(1) changes in the labour intensity of output and the possibility of releasing manpower or the necessity of attracting it in the wake of investment;

(2) changes in the materials intensity of output releasing additional reserves of means of production in the economy or increasing their expenditure;

(3) changes in the assets (capital) intensity of output securing savings in investment or giving rise to additional expenditure;

(4) a reduction of construction times and a lowering of estimated building costs.

Additional indices are used to estimate the effect of key factors on the economic efficiency of investment and its tie-up with other sections of the plan: labour productivity, return on assets (in terms of gross commodity output or of physical output), unit capital investment, etc.

The overall efficiency of investment in enterprises and establishments in the non-productive sphere operating on the basis of cost accounting (e.g. municipal transport, tourist facilities, etc.) is calculated on the same principles as for enterprises in the sphere of material production.

Indicators of Comparative Economic Efficiency of Investment

Estimates of the comparative economic efficiency of investment are used in compiling variants of economic or technical decisions, choosing alternative locations of enterprises and complexes, deciding problems of the choice of interchangeable products, the introduction of new types of equipment, the building of new enterprises or reconstruction of existing ones, and so on.

The indicator of comparative efficiency of investment is the minimum reduced or normalised outlay. For each variant the reduced outlay comprises total current outlays (prime costs) and capital investment reduced to a similar unit of measurement in accordance with the standard coefficient of efficiency:

$$M_i + E_n J_i = \text{minimum},$$

where J_i—the capital investment for each of the variants;
M_i—the current input (cost) for the same variants;
E_n—the standard coefficient of the efficiency of capital investment.

Indicators M_i and J_i can be used either as the aggregate investment and prime costs of annual output or in the form of unit values, i.e. investment per unit of output and prime cost per unit of output.

The standard coefficient of efficiency for the economy as a whole is taken at not less than 0.12 (i.e. not less than 12 kopecks per rouble of investment). Where necessary, in the interests of stimulating technological advance, for considerations of accounting for dissimilar wage levels (zonal and sectoral), different price levels, varying lengths of building programmes, and regional differences, sectoral instructions permit deviations from the established standard coefficient in agreement with USSR Gosplan.

The standard coefficient is subject to revision when the five-year plans are being compiled.

When determining the economic efficiency of the introduction of measures in concrete circumstances, indices of the best available solutions of a particular economic task are used as the basis for comparison, while indicators of the best applied (or projected) national and foreign plant are taken when introducing new equipment. The indicators of the investment variants under consideration are compared with standard coefficients and the indices of economic efficiency achieved in previous periods.

When determining the magnitude of the economic effect to be obtained from adopting a measure in particular circumstances, indicators of the commonest methods of solving the particular problem are taken as the basis for comparison; indicators of substitutes are used when introducing new equipment.

The outlay and effect of comparable variants need to be compared: e.g. for a whole range of enterprises and branches of production, the time between incurring the outlay and obtaining the benefits; the prices adopted to reflect costs and benefits; the nature of costs and benefits from the angle of simple and extended reproduction; the range of outlays comprised by the volume of investment; the methods of

calculating cost indicators used in calculating efficiency, and other factors.

When investment variants that differ in length of construction times, allocation of investment over the separate construction periods, or the feasibility of building in stages without adverse effect on the fulfilment of production targets are being compared, the effect that the different lengths of the investment period have on the variants is calculated.

When the investment in the different variants is made at different periods of time, and current costs alter over time, the variants are compared by reducing (normalising) the costs incurred in the later years to the current moment by using a reduction coefficient, as follows:

$$B = \frac{1}{(1+E_{n.p.})^t},$$

where B—reduction coefficient;
t—reduction period in years;
$E_{n.p.}$—standard coefficient for reducing differently-timed costs (fixed at 0.08).

The reduction of differently-timed costs can only be used when calculating the economic efficiency of variants and cannot serve as grounds for altering estimated costs of construction.

When variants with different durations of construction are being compared, the real, once-and-for-all benefit is calculated in the form of the additional profit to be obtained during that period when projects are commissioned ahead of schedule determined.

The comparative economic efficiency of investment on the reconstruction of existing enterprises is determined by comparing the indices for the different variants of reconstruction with those of enterprises before reconstruction and with variants of new construction. In doing so account must be taken of the losses of production and profit, and increase of current outlays during the period of reconstruction.

When new technology altering the quality and operational nature of output is being introduced, the changes in

costs and benefits both in the sphere of production and the sphere of using the output need to be taken into account.

When new types of raw materials and other industrial supplies are being created, and the properties and quality of materials improved, investment efficiency is determined with due regard for the investments and current outlays involved in the production, transport, and use of these materials. The calculation must be based on the annual consumption of the material provided for in the project.

CHAPTER IX

PLANNING THE LOCATION OF INDUSTRY

The rational location of a country's productive forces is a major factor raising the efficiency of social production. Planning of the location of industry is therefore an integral part of macro-economic planning.

1. METHODOLOGICAL PRINCIPLES OF PLANNING THE LOCATION OF INDUSTRY

When planning the location of production, it is essential to take into account: (1) the specific character of each sector, its technological and technical features, the nature of its raw material base, the consumption of materials and transportability of its product, etc.; and (2) the natural and climatic features and economic resources of each economic area. The basic directions in the location of the country's productive forces over the long term are accordingly worked out in a specific order. The first stage consists in drawing up sectoral schemes for the development and location of industry, and the second stage in drawing up schemes for its development and location in economic areas and republics. The third stage comprises the compilation of a General Scheme for the location of productive forces in the Soviet Union, which coordinates the sectoral and regional schemes. These schemes provide the basis for formulating the requirements as to the location of industry in sectoral, regional, and macro-economic plans. This order of operations makes

it possible to integrate sectoral planning with regional planning, taking into consideration the development interests both of sectors and economic regions.

Sectoral Principles for the Location of Industry

The principles for siting enterprises according to their sphere of activity have to be subdivided into general principles, i.e. those applicable to all sectors of production, and specific, sectoral ones, applicable to separate sectors, or groups of industries.

The general principles include the ensuring of maximum economic efficiency of production in a sector. The sectoral plan must ensure the necessary volume of output with the least possible expenditure of labour and resources.

At various stages in the work of drawing up the sectoral location plan, a wide range of factors determining the choice of areas and sites for construction and the types and capacities of enterprises designated for construction, is studied and taken into consideration: namely, the present state and future prospective development of the industry's raw material base; the available market; the condition of existing enterprises and the possibilities of extending them; the facilities for transporting raw materials and completed output (finished and semi-finished); water supply and energy resources; the possibilities that exist for cooperation with existing and planned enterprises in a given sector and other sectors; the order of construction of the starting complexes (phases); the available work force, and natural, climatic and other factors. The effect of the separate factors, however, varies in degree from sector to sector, which makes it possible to pick out the decisive factors from all the rest, and to formulate specific, sectoral principles of location.

Sectors can be divided into five groups according to the various factors influencing the siting of enterprises.

Group I includes industries in which the siting of enterprises is determined primarily by the availability of raw materials: viz. metal-intensive branches of engineering,

thermal power stations[1], and a number of industries in which the weight of the finished product constitutes only a small proportion of the weight of the basic raw material (in other words, industries with a high rate of consumption of raw materials per unit of finished product).

Thus, in the sugar industry, the weight of granulated sugar is 12 to 16 per cent that of the sugar beet; in the dairy industry, the weight of butter is 4 or 5 per cent that of the raw material. It is wasteful to transport such types of raw material for long distances, apart from their limited storage period. Group I also includes industries processing perishable raw materials (canning, wine-making, fish processing, etc.).

Saw-mills, wood-working enterprises and pulp and paper mills are also materials-intensive. It takes 2.3 cubic metres of wood to produce 1.0 cubic metre of plywood, and 5 cubic metres for one ton of pulp. The proportionate cost of raw materials in the cost of these products varies between 50 and 75 per cent of the cost. Such enterprises are best located in forested areas; but some wood-processing mills will be built on main inland waterways, down which the timber can be rafted. In locating enterprises in the extractive industries (iron ore, oil, coal, etc.) rational exploitation of the mineral deposits is of the utmost importance.

More deposits are usually prospected that can be exploited within a planned period. When the plan is being drawn up, it is essential to determine which of them are to be opened up and in what order. The first deposits to be brought into exploitation are those capable of ensuring efficient operation of the extractive enterprises over a long period.

Group II includes industries in which the enterprises are sited at the point of consumption, and includes enterprises producing not easily transportable products of great weight, e.g. building materials, bricks, reinforced concrete components, and furniture.

Thus, 1,000 bricks weigh three or four tons, one cubic metre of reinforced concrete two or three tons, so that the

[1] Thermal power stations, using high-quality fuels (fuel oil, natural gas, high-calorie coal) and requiring minimum expenditure on transport, can also be sited in power-consuming areas.

cost of transport is high. The cost of carrying bricks for 100 kilometres equals their cost of production; in the case of non-metallic minerals the distance (by road transport) is 30 to 60 kilometres. Many types of building material cannot easily be transported not only because of their bulk and weight, but also because of losses, and specialised transport is needed for many types of building materials. Enterprises in this sector are established in all consumption areas, and 85 to 90 per cent of their output is consumed on the spot or in neighbouring areas. Once valid decisions relative to the location of enterprises producing building materials have been made, it is possible to avoid the situation in which enterprises of other industries are sited in a particular place solely because the construction industry is based there.

With the rapid development of high-economy pipelines, oil refineries are chiefly located in areas with the highest consumption of oil products. Smelters for tin and certain rare-earth metals are also located at the point of consumption, as the deposits are not usually large, and it is therefore uneconomic to build factories near individual deposits.

Group II also includes industries in which the weight of the finished product is much greater than that of the main raw materials: e.g. baking, confectionary, distilling, brewing, and the soft drinks industry.

Group III consists of branches of industry in which the location of enterprises is affected by such factors as the availability of suitable labour. The availability of labour is also important, of course, for enterprises in other industry groups, but in this group it is the main, deciding factor.

This group is not homogeneous, but includes: (1) such labour-intensive industries as precision and instrument engineering, the manufacture of polymers, and electronics, which are attracted to areas with a skilled work force and to places where there is a concentration of scientific establishments; (2) enterprises of a number of industries that are sited with a view to the best use of available manpower (enterprises in the textile, knitting, and clothing industries, the footwear, haberdashery, and allied industries, and certain branches of the food industry). The locating of such enterprises in the Donbass, Kuzbass, or similar centres, where

men are predominantly employed in the steel works, coke by-product plants, and underground in the coal mines, makes it possible to solve the problem of jobs for women.

It is most important to improve the utilisation of labour in medium-sized and small towns, where the labour force is not sufficient to permit the location of complicated, highly-skilled industries. Manufacturing enterprises and highly specialised industries with a limited demand for labour, and which are coordinated with enterprises in big industrial centres, are best located in towns of this size.

Group IV consists of industries that are attracted to sources of fuel or electricity.

Energy-intensive industries are usually taken to include those using between 200,000 and 1,400,000 kilowatt-hours of electricity per worker. The energy factor strongly affects the location of aluminium plants (approximately 20,000 kilowatt-hours of current being used on average to produce one ton of aluminium). This also applies to magnesium, zinc and fuel. Areas with cheap power supplies also attract the electrolytic production of ferro-alloys of non-ferrous metals. The creation of united power systems or grids in the different parts of the country, and the subsequent completion of work on creating a single, country-wide, high-voltage grid, is modifying the effect of this factor and considerably extending the range of areas suitable for the location of energy-intensive enterprises.

Thermal power stations, and certain branches of the chemical industry, are attracted to sources of fuel. For example, in enterprises producing synthetic fibre, 95 tons of theoretical standard fuel per worker are used. Over comparable distances, the cost of delivering fuel is six times greater than the transport costs of the raw materials, and 5.5 times those of the finished product.

Group V embraces sectors in which the siting of enterprises is affected by two or more factors.

In the iron and steel industry, three or four tons of raw materials and fuel are used to produce one ton of pig iron. The most favourable sites for such enterprises are those where there are both raw materials and fuel. If such a combination does not exist, the enterprise is situated between the sources of raw material and fuel or, alternatively, at

both, in order to use the transport facilities in both directions.

Large chemical complexes consume vast amounts of raw materials, electricity, and water. To produce one ton of synthetic fibre, six or seven tons of raw materials and 18 or 19 kilowatt-hours of electricity are used. The modern chemical industry has become a major consumer of water. More than a thousand cubic metres of water are used to produce one ton of such items as ammonia, acetylene, polyethylene, and caprolactam. In order to reduce the consumption of fresh water, it is essential to extend the practice of recycling the water two or more times.

Chemical complexes are best located in areas providing a combination of all these factors—raw materials, power, and water (e.g. in West and East Siberia); but it should be noted that the building of gas and oil pipelines, which sharply reduce the transport costs of these raw materials, modifies the effect of the raw material factor, so extending the range of possible sites for chemical works.

Group V also includes enterprises in those industries in which the weight of the finished product roughly equals the weight of the raw materials (e.g. flour-milling, cotton-spinning, sugar-refining, and the whole-milk dairy industry). When the siting of such enterprises is being decided, not only is the cost of producing the output taken into consideration, but also the transport costs both of delivering raw materials to the point of production and of delivering the goods to the consumer. Enterprises in these industries may be situated in consumption areas and at the source of the raw materials, or at points between the two. There can be cases when location at several sites offers equal economic advantage.

In industries involved in the international socialist division of labour, or significant export producers, these features are also taken into consideration when planning the location of enterprises.

In industries producing a wide range of products, it is generally necessary to subdivide the enterprises into several homogeneous groups.

In engineering, for example, it is best to identify the following groups:

(1) enterprises whose product has a low consumption of metal but requires large inputs of skilled labour per unit of output;

(2) engineering with an average consumption of metal but requiring significant inputs of skilled labour per unit of output (electrical engineering equipment, machinery for the light and food industries, equipment for the chemical industry, lighting apparatus, and domestic electrical appliances);

(3) engineering with an above-average consumption of metal requiring a limited amount of skilled labour but much semi-skilled and unskilled labour (mining equipment, lifting and handling equipment, road-building machinery, etc.);

(4) engineering with a high consumption of metal and low labour intensity (when considering the metal and labour intensity of these engineering groups, it should be noted that it is not enough just to take specific indicators into account; the total consumption of materials, labour, and power by the enterprises as a whole must be considered—take a factory producing wheeled tractors and one producing metallurgical equipment: unit consumption of metal per million roubles of output in the first is only half that in the second, but at the same time, total consumption of metal in the first is 2.5 times that in the second);

(5) specialised fields (e.g. shipbuilding) the location of which is conditioned by special factors;

(6) enterprises supplying or providing services to other industries.

A different approach to the question of location is necessary in each of these six sub-divisions of engineering.

After industry, the next most important sector of material production is agriculture. The rational location of agriculture in geographic and economic areas, as noted in the Programme of the CPSU, is an essential condition for a rapid increase of farming.

Environmental and climatic factors strongly affect the distribution of farming. The cultivation of different types of crop is limited to certain zones. As a result of scientific progress, the range of zones where many crops (industrial crops, vegetables, and fruit) are cultivated has been extended by the reclamation of arid areas and deserts and by the

opening up of northern regions; but science is still only able to modify or lessen the effect of environmental factors and not eliminate it. This also applies, although to a lesser degree, to stock raising. The rearing features of particular breeds have a significant effect on their zonal spread.

In agriculture, it is only possible to achieve maximum output at minimum cost by rational use of the land. This is the most important precondition, although not the only one, for raising the efficiency of farming. Rational land use involves combining crops in certain proportions, alternating them in time and introducing a scientific rotation suiting the conditions of a particular zone. The need to make full use of the output obtained, and the seasonal character of farming also make it essential to combine the various branches of agriculture. There is a close link between arable and livestock farming, although the form it takes varies from area to area.

Sectoral specialisation in agriculture has a different character from that in industry. In agriculture, the single-crop branches (cereals, vegetables and potatoes, sugar beet, cotton, etc.) are combined with the production of other non-basic specialised crops, which are accommodated to and complement the main one. The particular character of specialisation in agriculture, and the organic link between the main and ancillary branches, must be taken fully into consideration when planning the distribution of farm production. The transport factor has a not inconsiderable effect.

A characteristic of farming is its extension over wide areas. This is especially true of arable farming and, to a lesser extent, of stock raising. The primary products of both, as a rule, are very material-intensive, so that the delivery of farm produce to points of consumption or processing entails significant transport costs. Consequently, the location of urban and industrial centres, with their demand for farm produce, has a decisive influence on the distribution of a number of crops.

It is becoming increasingly pressing for substantiated projects to be drawn up for the location of branches of agriculture by area and zone, since such a rational distribution would ensure obtaining output with the minimum total costs of production, transport, and capital investment.

Principles for the Regional Location of Industry

The economic areas of the USSR vary as regards natural and climatic conditions, scale of mineral reserves (and their degree of exploitation), availability of labour, type of specialisation, level of development and concentration of industry and farming, and provision of transport facilities. Despite these differences, the economy of each area constitutes a single complex. When regional plans for the location of production are being drawn up, the following principles must be followed:

(1) increasing the economic efficiency of industry in the areas;

(2) provision of integrated development through the rational use of the area's natural, labour, and economic resources;

(3) inter-sectoral specialisation (i.e. the setting up of specialised enterprises to supply various sectors) and inter-sectoral combining of production;

(4) provision of rational development of industrial centres within a republic or economic area;

(5) the establishing of optimum economic links within and between regions.

Projects and plans for the location of industry drawn up on these principles enable each economic area to take its place in the social division of labour, and to make efficient use of the raw materials, supplies, labour, and other resources at its disposal.

2. THE METHODOLOGY OF PLANNING THE LOCATION OF INDUSTRY IN A SECTOR

A basic prerequisite for planning the location of industry in a sector is to have sectoral schemes for the development and distribution of the economy as a whole and of industry. At the time of writing location schemes for 86 key industries are being drawn up using economic-mathematical methods and computers.

The complexity and labour-consuming character of the planning calculations involved in drawing up sectoral loca-

tion schemes vary; for single-product sectors (cement, sugar, etc.) it is comparatively straightforward and simple.

In sectors producing several types of output, and especially in those with a wide range, the complexity and labouriousness of the calculations are greater. The amount of planning work also depends on the nature of the interdependence of a given sector and other sectors. The more extensive and close the links with other sectors, the greater is the volume of the calculations. Such factors as the interchangeability of different types of raw materials, supplies, and output available for consumption, operate in the same direction.

The number of possible sites for the location of enterprises to be built also has a big effect on the volume of planning work. The larger the number of sites, the greater is the number of possible location variants, which means that finding the optimum variant will entail much work. In a number of industries (sugar, alcohol, butter, cheese, etc.) the selection of possible sites is complicated by the fact that the total number of operating enterprises is decreasing, owing to the closing-down of old enterprises that are inefficient or even run at a loss. In these industries rational decisions have to be made as to which enterprises it is advisable to shut down.

Finally, additional problems can arise when sectoral location plans are being drawn up, such as reducing the loss caused by errors in siting industry made in an earlier period, and off-setting their adverse effects in subsequent location plans. The use of computers for multi-variant calculations creates favourable conditions for carrying out this work.

In theory it is possible to formulate problems for the location for any industry; but given modern mathematics, computers, and the needs of economic development, three groups of such problems can be formulated and solved.

I. When the number of possible sites is limited, and the number of raw material sources (or consumption points) is small, the problem is best formulated for the whole sector or industry, i.e. on a country-wide scale.

II. When the number of possible sites is numbered in hundreds (occasionally even in thousands), and the number of raw material sources (or consumption points) is numbered

in thousands, or even tens of thousands, direct solution of such a problem on a country-wide scale is not practicable because of the vast amount of initial data and the complexity of the quantitative relationships. But the problem can be solved if it is broken down into several stages by aggregating. The formulation and solution of such two- or three-stage problems is more complex and labourious than Group I problems.

III. When output is produced or consumed within a town or administrative area (e.g. the bakery industry), there is no need to formulate the problem on a country-wide scale; and for them it is best to formulate local, sectoral problems.

Let us take an example from Group II, and examine the formulation of the problem taking an industry in which enterprises process raw materials from several thousand sources.

The industry produces three types of output, all consumer goods in general demand. The weight of each type varies from 5 to 40 per cent of the weight of the raw material. Enterprises like these, as already mentioned, are located near the sources of raw material, and may be produced by specialised enterprises.

The following method of solving the problem in stages may be adopted.

Stage One. The country is divided into a certain number of regions, depending on the features of the industry. In this example, the country is divided into 26 areas (ten major economic areas in the RSFSR, three in the Ukraine, and the thirteen other Union republics). Such a division suits the technical capabilities of the computers, and enables maximum use to be made of existing statistics and data from planning calculations compiled by economic areas and republics, reducing the work entailed in collecting initial information to the minimum.

For each of these regions, the sources of raw material, present and future, and consumption of each of the three types of output, actual and future, are quantified. As relative capital investment varies considerably from region to region, the regional coefficients for capital expenditure, present and future, must also be quantified. Current running costs do not vary greatly from one region to another and are therefore

not taken into account in our example; if, however, they were significant, this type of cost would have to be taken into account and would, of course, be represented as a separate element in the criteria.

By solving this problem, the scale of production of each of the three types of output over some forward period or other is known, i.e. the optimum intra-industry structure of the three products for each region is determined.

Formulation of the problem: to determine the optimum structure of production in the given sector in each region, provided that the costs of transporting the products, given the existing (known) sources of raw materials, will be minimal.

Notation Used in the Model

Known quantities

n—the number of regions, each of which we will denote by i, where $i = 1, \ldots, n$;

l—the number of types of available output, each of which we will denote by j, where $j = 1, \ldots, l$;

P_i—the quantity of raw materials in the ith region;

λ_j—standard consumption of raw materials on the jth product;

Q_{ij}—annual demand for the jth product in the ith region;

a_{jrd}—cost of transporting a unit of the jth product from the surplus region (r) to the deficit region (d) at current freight rates;

C_{ij}—unit operating costs of the production of a unit of the jth product in the ith region;

U_j—sectoral average of unit capital costs for the production of the jth product;

h_{ij}—regional coefficient for adjusting unit capital investments in the jth product in the ith region;

E—standard coefficient for the efficiency of capital investment.

Sought-for quantities

x_{ji}—volume of production of the jth product in the ith region;

x_{jrd}—quantity of the jth product transported from the rth region to the dth region.

Constraints

$x_{ji} \geqslant 0$—volume of output cannot be a negative quantity; this also applies to the volume of freight $x_{jrd} \geqslant 0$;

$\sum_i x_{ji}\lambda_j \leqslant P_i$— consumption of raw materials in the production of all types of output in the ith region must not be greater than the raw material resources in that region;

$\sum_r x_{jrd} = Q_{dj}$—total volume of the jth product brought into region d from other regions equals the demand in region d for that product;

$\sum_d x_{jrd} = x_{jr}$—total volume of the jth product transported from the rth region equals the volume of production of the jth product in that region.

It is required to determine the minimum of the functional:

$$\min \Big\{ \sum_{j,\,r,\,d} a_{jrd}x_{jrd} + \sum_{j,\,i} c_{ji}x_{ji} + E \sum_{j,\,i} h_{ij}U_j x_{ij} \Big\}.$$

When Stage One of the problem has been completed, the optimum structure for the production of the sector's goods in each region is known.

Stage Two. Now that it is known which products each economic area (or region) must produce, and in what quantities, we turn to the question of determining the actual sites for enterprises, and their capacities. Thus, for example, if, as a result of solving Stage One, it is found that it is necessary to increase production of one of the products in an economic area, the best possible variant must be found for the location of the enterprises to be built, i.e. it is a question of formulating the problem of the location of enterprises producing homogeneous output in relation to the sources of raw materials.

In solving this problem, the main factors to be taken into consideration are manufacturing costs and transport outlays, and these vary inversely. Manufacturing costs depend to a great extent on the volume of production. When the volume

of production within an enterprise increases, unit costs decrease. At the same time, however, other things being equal, the radius within which raw materials are transported is extended, with a consequent rise in transport costs. The effect of both these factors, therefore, must be taken into account, and a combination of the two should be found that offers minimum total costs.

In determining the optimum scale of enterprises, and deciding of their location, it is important to increase the efficiency of capital expenditure, i.e. to reduce the amount of capital expenditure per unit of fixed capacity, and cut down the recoupment period. Unit capital investment and recoupment periods consequently must also be taken into account as well as the costs mentioned above.

The range of initial data depends on the nature of the problem and its formulation. When it concerns the location of enterprises in relation to sources of raw materials, the basic initial data are as follows:

(i) the annual resources of raw materials within the area selected for this particular problem;

(ii) the location of sources of marketable raw materials and the amount of raw material available from them;

(iii) total costs of delivering raw material from source to processing enterprises;

(iv) the productive capacities of existing enterprises, and the additional capacity that must be obtained by building new enterprises and extending existing ones so that all available marketable supplies of raw materials will be fully processed;

(v) the cost of processing a unit of raw material, in accordance with the volume of production; when the capacities of the new plants are greater than any one of those already operational, processing costs are determined approximately, taking the indicators of standard designs in two variants: (a) when the plant is operating at full capacity, and (b) when it is operating under capacity;

(vi) the unit capital investment riquired for building new enterprises and reconstructing others that are already operational, in accordance with plant capacity and local conditions.

The initial data must satisfy several general requirements.

Above all, the statistics must be sufficiently large and, as far as possible, evenly distributed over a period of time within which the effects of various features on an economic indicator can be examined, which makes it possible to determine the correlation between them with the necessary degree of accuracy.

Unknowns are the scale on which raw material must be processed at each possible site, and the scale on which raw material will be transported from source to processing enterprises.

In solving the problem, one has to try and find the location variant and the volume of production at each enterprise that will minimise the total outlay on processing all supplies of the raw material, transporting raw material to the processing point, and on capital investment, taking account of the recoupment period. This is, in fact, the optimality criterion in this instance.

Thus, we have:

p—number of points of raw-material production, each of which we will denote by r, where $r = 1, \ldots, p$;

n—number of possible points for producing the finished product, each of which we will denote by i (i.e. $i = 1, \ldots, n$).

Sought-for quantities

x_i—volume of production of output at the ith point; volume of production will be measured by the quantity of raw material processed at a given point;

Z_{ri}—quantity of raw material transported from the rth source of raw material to the ith point of production of completed output.

Known quantities

Q_r—quantity of raw material produced at the rth point;

$g_i(x_i)$—cost of production per unit of finished product at the ith point of production, depending upon the scale of production at that point;

$U_i(x_i - x_i^0)$—unit capital expenditure at the ith point of production, depending upon an increase in capacity above that of already operational

enterprises (if $x_i \geqslant x$), or depending upon the scale of production at the new installation (if $x_i^0 = 0$);

a_{ri}—cost of transporting one unit of raw material from the rth point of raw material production to the ith processing point.

Constraints

1. The quantity of processed raw material must equal the amount of raw material received from all sources;

$$x_i = \sum_r Z_{ri}.$$

2. All raw material supplies from every source must be transported to the processing enterprises:

$$Q_r = \sum Z_{ri}.$$

3. Raw material supplies from all sources must equal the quantity of raw material processed at all points of production of the finished product:

$$\sum_r Q_r = \sum_i x_i.$$

The aim of the problem is to find the minimum total costs of transporting raw material to processing points, of processing it, and the amount of capital invested. Hence, the values of the unknown quantities must ensure the minimum of the functional:

$$\min \left\{ \sum_i g_i (x_i)\, x_i + \sum_{r,\,i} a_{ri} Z_{ri} + E \sum_i U_i (x_i - x_i^0)(x_i - x_i^0) \right\}.$$

When Stage Two has been completed, we will know the optimum variant, i.e. the variant that ensures:

(i) rational location of processing enterprises, with the best links (from the point of view of costs) with sources of raw material;

(ii) determination of the most appropriate capacities at each site, which enable all the available raw material supplies in each zone to be fully processed;

(iii) the minimum total costs of producing output and transporting raw materials.

Thus, solving the given sectoral problem in two stages covers the sphere of producing the finished product, transport of the raw materials to the processing enterprises, and transport of the product from one economic area or region to another. As a result of solving the problem, the optimum variant for the location of enterprises in the industry is known, i.e. the variant that ensures (a) minimum total expenditure on production of the finished product and on transporting raw material to the processing enterprises and delivering output to other regions, and (b) minimum expenditure on capital investment.

The use of economic-mathematical methods and computers when drawing up sectoral location plans greatly reduces the labour involved and the time taken by the design and planning calculations, lowers their costs, and increases their accuracy.

3. THE COMPILATION OF REGIONAL PLANS FOR THE DEVELOPMENT AND LOCATION OF INDUSTRY

Among the problems to be solved in the course of regional planning, it is important to note the following: increasing the specialisation of republics and economic areas; substantiating the combination of specialisation of economic areas with their all-round development; the development of new industrial complexes and agricultural centres; protection of the environment, and rational use of natural resources.

The methodology of drawing up regional plans has its own specific features. An important place in their compilation at all stages is occupied by: input-output calculations relating to production and consumption (as regards a number of types of industrial output, local materials, meat, milk, potatoes, vegetables, etc.); regional input-output tables of the capacities of construction organisations; schemes for the development of industrial complexes and agricultural centres; and plans for area planning.

The economy of the Soviet Union is being developing as a single economic complex, formed on the basis of the community of economic aims and interests of all the republics. Unity of macro-economic sectoral, and regional planning ensures a correct combination of the interests of the different nations and nationalities with the interests of the state as a whole, which enables the economies of all the Union republics to flourish.

In the 50 years (1922-72) the volume of industrial output of the Kazakh SSR increased 600 times; of the Tajik SSR more than 500 times; of the Kirghiz SSR more than 400 times; of the Uzbek SSR almost 240 times; of the Turkmen SSR more than 130 times; and of the Moldavian SSR 31 times. Great advances were also made in developing the economies of the other Union republics.[1]

Regional planning is an integral part of macro-economic planning, and its improvement and consolidation are an important prerequisite for the integrated development of the economies of republics, economic areas, territories, and regions.

Ensuring Integrated Development of Union Republics and Economic Areas

When regional plans for the development and location of industry are being drawn up, the most appropriate and progressive structure for the industry of each economic area must be found so as to ensure full use of available resources and production assets, and to increase the effectiveness of social production. Because of the great diversity of the areas, their industrial structure cannot be identical.

A constituent part of the work on compiling regional plans for the location of industry is determining the tasks regarding specialisation of the area and ensuring its integrated development. Industries being developed in an area can be divided into two groups: (a) those in which it is specialising, and (b) service industries. Thus West Siberia is

[1] L. I. Brezhnev, *The Fiftieth Anniversary of the Union of Soviet Socialist Republics*, Moscow, 1973, p. 22.

specialising in the coal, iron and steel, and engineering industries, while the main industries in the Volga area are petroleum production, oil refining, chemicals, and engineering. In the Central area the specialisation is different; there the existence of immense labour reserves, including a skilled work force, and the limited character of power resources make it advisable to develop such industries as precision and instrument engineering, light industry, the production of radioelectronic apparatus, and so on.

Industries serving the regional economy—electricity supply, the food industry, stock-piling and preparatory industries, instrument-making, the building industry, housing and municipal services, are regarded as ancillary, but it should be noted that this classification is somewhat relative. Whether the industries of a region are put in the one group or the other depends on the role they play in the regional and national economy. Thus, the food industry in the Northern Caucasus is one of its specialisations, while in many other areas it is an ancillary industry serving the area.

Selecting the industries of specialisation that determine the industrial profile of an area, and planning their future development, are only one of the problems to be solved in the course of drawing up regional plans. Another important task is to ensure complex integrated development of the area. This ensures, in the first instance, that full use is made of available natural resources and that priority is given, in areas of new development, to exploitation of the most economic natural resources. The creation of the Urals-Kuznetsk complex in the prewar period, for example, led to highly effective use of the iron-ore deposits of the Urals and of the coals of the Kuzbass.

Side-by-side with the industries in which republics and economic areas are specialising, industries that are technologically and economically allied with them are being developed. Cotton growing is the most important specialisation in the agriculture of the Uzbek SSR. In addition Uzbekistan has become a main important producer of machines for cotton-growing. Enterprises producing textile machinery, and a cotton-processing industry have also been established here. Complex development also enables rational use to be made of available manpower.

All-round development of the economy of each economic area leads to levelling up of their development. This is reflected in the levelling up of the indices of per capita industrial output, personal incomes, etc. In the areas people's needs for particular types of consumer goods (building materials, fuel, foodstuffs, footwear, etc.) are being increasingly supplied by their own industry. Matters are different as regards the output in which the area specialises, which may also be for general consumption; regional differences in the per capita levels of production of such output may increase rather than decrease.

The Creation of Industrial Complexes

Work on the creation of industrial complexes and the determination of their optimum size is begun in the preliminary stages of drawing up regional plans.

The modern conception of an industrial complex is of a whole number of industrial enterprises, situated on one site or in neighbouring geographical locations and having a common infrastructure. Centres, in which most of the enterprises have production links with each other, can be called industrial-production complexes.

Depending on the nature of the enterprises they contain, industrial complexes may be divided into three groups, as follows: (1) those comprising heterogeneous, unlinked enterprises; (2) those comprising enterprises that are allied technologically; and (3) those comprising both the preceding groups.

Heterogeneous enterprises situated in one geographical location may have a common power system, a single system of water supply, sewerage, water purification, and other engineering services and communications. The setting-up of an integrated system of transport and warehousing facilities also produces great benefits.

Thus, the length of railway lines within the area of an industrial complex can be reduced by 18 to 47 per cent and of roads by 9 to 30 per cent. The establishment of an integrated system of servicing and ancillary enterprises results in substantial savings in capital investment and operating costs, and enables rational use to be made of electricity,

fuel, and water. A reduction of 20 to 40 per cent in the ground space occupied by industrial enterprises is also of no little significance.

The creation of industrial complexes of the second and third groups provides incomparably greater benefits.

When technologically allied enterprises are grouped together in one location, the savings obtained through cooperation of ancillary and preparatory industries and stockpiles, are added to the advantages mentioned above.

Savings can be made in capital investments by reducing the production area occupied by ancillary and preparatory shops by 25 to 40 per cent, and by reducing the amount of equipment by 35 to 50 per cent. Operating costs are also reduced.

Finally, savings are made by coordinating the use of raw materials and supplies by several enterprises or by combining their consecutive technological processing at various stages.

The problem of optimising the scale of industrial complexes is closely linked with a number of other problems, such as the specialisation or combination of enterprises, and optimation of their size, location, etc. The enterprises needed to supply and service others are determined for each variant, and also the enterprises or sub-units of enterprises producing unified blanks, assemblies, and parts usable in various industries, or carrying out ancillary work.

Several criteria can be used to establish the optimum size of an industrial complex. One of these is ensuring a maximum increase in the efficiency of production, given the volume of production planned for the economic region.

Natural and geographical factors apart, the scale of complexes depends on the sectoral structure of the enterprises in it, and on how extensive and close are their technological and economic links with other enterprises and industries. The degree of concentration on the enterprises giving the complex its character strongly influences its size. The greater the degree of concentration, the more allied industries are concentrated around the determining specialist enterprises.

The size of a complex is essentially affected by the availability of labour. A surplus of labour enables its size to be

increased while a shortage has the opposite effect. When a complex consists primarily of industries employing male labour, industries predominantly employing female labour have to be included in order to ensure full utilisation of available labour.

The creation of industrial complexes must be closely tied up with the development of a rational system of towns and a uniform settlement policy for the country. It encourages the establishment of common, joint construction facilities, saving 20 to 40 per cent on capital investment, and united residential areas meeting the requirements of science and the technological possibilities of the building industry. Solution of all these problems necessitates close cooperation between the regional planning agencies and sectoral and town planning and building institutes.

The General Scheme for Distribution of the Country's Productive Forces

A General Scheme for the distribution of the Soviet Union's productive forces for the years 1971-80 (basic principles) was created by our scientific, design and economic planning organisations as a whole. Compiled in accordance with a single programme and method, it is a scientifically substantiated conception of the distribution of the Soviet Union's productive forces. It includes the formulation of general (synthetic) problems, schemes for location by sectors of the national economy, schemes for development of the productive forces of Union republics and economic areas, and also schemes for the creation of large macro-economic complexes.

In addition, the General Scheme includes forecasting estimates (basic trends) of the comprehensive, integrated use of mineral, timber, water, and land resources up to the year 2000.

It defines the prospects for economic growth in the republics and economic areas, provides a scientific basis for the location of production in the different regions, taking into account physical conditions, distribution of natural

and labour resources, and the existing levels of production. This will ensure their further specialisation and all-round development of their economies.

The data for the General Scheme were collected in the course of compiling the long-term, perspective plan for the development of the Soviet economy for the years 1976-90. In accordance with the joint resolution of the Central Committee of the CPSU and the USSR Council of Ministers, decisions regarding the planning and building of enterprises and installations have been taken since 1971 on the basis of the sectoral and regional schemes for the location of industry. Use of the Scheme will make it possible to draw on major reserves to increase the effectiveness of social production.

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The authors work for USSR State Planning Committee.

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A detailed analysis is given of the problems of growth rates and economic proportions; ways to accelerate technological progress and raise the efficiency of social production, improve management and organisation, and the quality of work throughout the economy.

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development of agriculture, consumer goods industries and the services sphere is also described. Considerable attention is devoted to the extension of international economic ties and the spotlight is focussed on the tasks involved in developing the national economy of the USSR in the long term.


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