JPRS L/9561

20 February 1981

Translation

RAILWAY TRANSPORT ECONOMICS AND PLANNING

Part I

Railway Transport Economics

Ed. by

I.V. Belov and M.F. Trikhunkov

FBIS FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000300080044-2

JPRS L/9561

20 February 1981

RAILWAY TRANSPORT ECONOMICS AND PLANNING

PART I

RAILWAY TRANSPORT ECONOMICS

Moscow EKONOMIKA I PLANIROVANIYE ZHELEZNODOROZHNOGO TRANSPORTA. YAST'I. EKONOMIKA ZHELEZNODOROZHNOGO TRANSPORTA in Russian 1978 signed to press 20 Sep 80 pp 7-20, 25-32, 53-61, 76-78, 79-84, 97-99, 135-154, 180-189, 197-203, 212-217, 217-225, 241-245, 246-254, 259-265, 292-294, 300-304, 309-323

[Book edited by Doctor of Economic Sciences, Professor I.V. Belov and Candidate of Technical Sciences, Associate Professor M.F. Trikhunkov, confirmed by The Main Administration of Academic Institutions of the Ministry of Railways as a textbook for railway transport technical schools, Izdatel'stvo "Transport," 15,000 copies, 352 pages, UDC 385+658.062.2:656.2]

CONTENTS

[II - USSR - FOUO]
[III - USSR - 38d FOUO]

ANNOTATION

The economic problems of development and operation of railway transport are outlined in the textbook, the characteristics of its material and technical base are given and the principles and methods of management and planning, the economics of operational work, the cost of shipments, the wage system, tariffs, financing and cost-accounting and the material and technical supply on the railroads are considered. The textbook is intended for students of technical schools and may also be used independently by those studying the fundamentals of railway transport economics.

THE ECONOMIC CHARACTERISTICS OF THE COUNTRY'S UNIFIED TRANSPORT SYSTEM

Moscow EKONOMIKA I PLANIROVANIYE ZHELEZNODOROZHNOGO TRANSPORTA: EKONOMIKA ZHELEZNODOROZHNOGO TRANSPORTA in Russian Part 1, 1978 signed to press 20 Sep 78 pp 7-20

[Chapter 1 from the book "Ekonomika i planirovaniye zheleznodorozhnogo transporta: ekonomika zheleznodorozhnogo transporta," Izdatel'stvo Transport, 15,000 copies, 352 pages]

[Text] 1.1. The General Characteristics of the Unified Transport System

The aggregate of the various types of the freight and passenger transport which services production and handling processes in the national economy is called the transport system.

All types of mainline transport of the handling sphere forms the country's unified transport system (YeTS). It includes universal and special types of transport. Universal transport includes mainline railroads, spur tracks, highways, inland navigable waterways, air lines and maritime lines. These types of transport can haul both freight and passengers.

Special transport includes pipelines and high-voltage electric power transmission lines (LEP).

Special types of transport have an important effect on the development of all types of universal transport and especially of railway transport. For example, partial, economically justified transfer of fuels to pipelines may considerably ease the work of railroads. Local combustion of fuel and transmission of electric power over electric power transmission lines may be more feasible than shipping it by universal types of transport.

The concept of a complete complex of YeTS hardware, besides the railway network, includes the rolling stock, all permanent developments including transport warehouses and also loading-unloading machines and mechanisms. Millions of trucks, many hundreds of thousands of rail cars, thousands of locomotives, ocean-going and river ships and aircraft are used to haul goods and passengers in the YeTS of the USSR.

More than nine million workers were employed in the YeTS in 1975.

The unity of the transport system is provided by various forms of coordination--technical, production, economic, organizational and legal.

One of the important tasks of increasing the efficiency of the YeTs is to develop the scientific fundamentals of its economic unity. This means primarily development of a unified system for optimum planning of shipments and operation of rolling stock to create conditions for more efficient distribution of shipments between the types of transport. Development of a unified planning and accounting system for transport expenditures in the national economy and improvement of tariffs based on their unification are also of important significance. The economic unity of the transport system can be accomplished successfully on the basis of developing a unified automated transport control system.

Transport-economic ties in the national economy are becoming ever more complicated at the current stage of development of economics. Intraproduction freight traffic volumes are tied directly to those of the handling sphere of transport. This requires clearer tying-in of the overall production technology at enterprises to organization of shipments. Dissemination of the experience of the Odessa and Leningrad transport workers, Elektrostal' workers and enterprises of Chelyabinskaya Oblast and the Southern Urals Railroad is of important significance in this regard.

The transport system of the USSR is unified by its socioeconomic nature. All the main means of transport are state and public property. They are used in the interests of the workers. This is one of the decisive advantages of the social transport system over the capitalist system.

The means of transport in capitalist countries are either privately owned or owned by the government. For example, all railroads are private in the United States. State railroads predominate in other countries. But even here they are not public property, but are used in the interests of the ruling capitalist monopolies.

Another decisive advantage of the socialist transport system is planned development and utilization of all types of transport. Planning permits proportionality in development of the national economy and of the transport system servicing it. It makes it possible to establish economic agreement among the needs of the national economy and the populace in shipments and the traffic (carrying) capacity of the transport system. Moreover, planning ensures proportionality in development of individual aspects of transport within the transport system and also between individual services and sections within each type of transport. All this contributes to the best use of the main means of transport with regard to creation of the required reserves.

Thus, Soviet railway transport has no equal in the world in the level of utilization of hardware, freight intensity, volume and economy of operation. With the length (together with spur tracks) of approximately 15 percent of the worldwide railway network, it performs almost 55 percent of the freight traffic turnover of all the world's railraods. The freight intensity on USSR railroads is six times higher than on United States railroads and locomotives are utilized 2-3 times better and rail cars are utilized 3-4 times better.

The unified transport system of our country is being developed without crises and depressions, reflecting the continuous growth of the entire national economy. Its planned development provides constant, higher effectiveness of capital investments to transport compared to capitalist countries.

Under the conditions of the scientific and technical revolution the advantages of socialist economics create unlimited opportunities for development of new equipment and improvement of transport production. The USSR occupies first place in the world on the scales of using electric traction on railroads. The success of the Soviet Union in development of the maritime fleet and in development of modern turboprop and jet airliners is undisputed. A strong thrust in development of high-speed passenger transport by water is development of hydrofoil ships.

An important source of the rapid growth and increase of production efficiency in the national economy, including that in transport, is the highly conscientious, creative attitude of members of society who labor. This is yet another of the fundamental advantages of socialism over capitalism.

The socialist social order determines all the advantages of the unified transport system of the USSR and provides the opportunity to organize its operation more efficiently and to provide high quality of shipments--safe, intact and timely delivery of passengers and material goods to their points of destination.

1.2. The Place of the Unified Transport System in the National Economy

The place and significance of the unified transport system in the national economy can be characterized by a number of economic indicators and primarily by the gross public product and the national income.

The fraction of transport and communications comprises four percent in gross public output and approximately six percent in the national income (according to existing accounting).

The specific weight of the unified transport system exceeds eight percent in the total contingent of workers involved in the national economy. One should bear in mind in this case that loading-unloading operations are not taken into account in the main transloading activity of all types of transport, except air transport. With regard to them, the contingent of workers of the transport system comprises approximately 10 percent of all workers and salaried employees. Thus, the transport system is a large consumer of the country's labor resources.

Transport is one of the most fund-consuming sectors. The cost of all basic funds of the unified transport system comprises approximately 12 percent of the total cost of the basic funds of the national economy. The fraction of transport increases to 20 percent in the basic production funds. If the cost of the sidings of industrial enterprises is added to this, the specific weight of the transport system reaches 25 percent in basic production funds.

The annual capital investments to the transport sphere are significant. They comprise approximately 10 percent of the total capital investments in the country's national economy.

The transport system consumes an enormous amount of material resources of the national economy. Almost 19 percent of the diesel fuel, more than 90 percent of the heating oil, approximately 10 percent of lumber, 6 percent of all electric power and 4 percent of ferrous metals are directed to it. Almost the entire output of transport machine-building enterprises and the greater part of motor vehicle gasoline go to transport.

The structure of the material resources consumed by transport does not remain stable, but varies. Thus, the consumption of pit coal was reduced sharply with regard to conversion of the railroads to electric and diesel locomotive traction. The specific weight of transport in consumption of lumber is being reduced. The mass installation of railroad ties on the railroads and also extension of the service life of wooden ties contribute to this.

The national economy transfers enormous material valuables to transport for shipment. Approximately 60 million tons of various types of freight with a total cost of approximately 12 billion rubles are in the process of movement at one time in transport. The freight en route comprises approximately 35 million tons alone in railway transport and its costs is more than 9 billion rubles.

The expenditures of the national economy on transport are high. The total expenses of the transport system of the USSR (including spur tracks) on freight and passenger shipments comprise more than 75 billion rubles annually with regard to expenditures for loading and unloading. Approximately 80 percent of these expenditures go to freight shipment.

Transport expenditures occupy a significant specific weight in the price of individual types of products at the point of consumption. For example, they comprise an average of 15 percent in the price of oil, 20 percent in the price of pit coal, 35 percent in the price of iron ore, 60 percent in the price of salt and so on. The fraction of the transport component in the price of a product has a tendency to increase. This is explained by the fact that an ever greater volume of ton-kilometer of shipping work goes to each ton of product produced in the national economy. This trend is typical for most of the world's developed countries.

The total mass of products produced in our country has almost doubled during the period from 1961 to 1975. The total transport expenditures increased threefold during this period. As a result the specific value of transport expenditures per ton of produced product increased from approximately 7 to 10 rubles.

The index of specific freight traffic turnover pl_{ud}, which characterizes the amount of ton-kilometer shipping work per ton of product produced, is determined by the ratio of the total freight traffic turnover of all types of transport ΣP to the total volume of product output in tons ΣQ

$$pl_{уд}=\frac{\Sigma Pl}{\Sigma Q}. \qquad (1.1)$$

In 1960 the value of the index of specific freight traffic turnover per ton of product comprised 496 ton-kilometers and in 1975 it comprised 703 ton-kilometers, i.e., it increased by 207 ton-kilometers. This increase was the result of a significant increase of the average length of freight shipments in almost all types of transport.

The distribution of the total expenditures by types of transport is characterized by the data in Table 1.1.

Table 1.1. Expenditures of National Economy By Types of Transport

(1) Вид транспорта	(2) Суммарные транспортные затраты		(5) В том числе затраты в сфере обращения	
	млрд. руб. (3)	(4) % к итогу	млрд. руб.	% к итогу
Железнодорожный (6)	19,8	26,7	16,8	33,2
Автомобильный (7)	48,1	64,9	27,7	54,7
Речной (8)	1,6	2,2	1,5	3,0
Морской (9)	4,0	5,4	4,0	8,0
Нефтепроводный (10)	0,6	0,8	0,6	1,1
Итого (11)	74,1	100,0	50,6	100,0

Key:

1. Types of transport
2. Total transport expenditures
3. Billion rubles
4. Percent of total
5. Including expenditures in handling sphere
6. Railway
7. Motor
8. River
9. Maritime
10. Oil pipeline
11. Total

It is obvious from the table that approximately 92 percent of the total expenditures of the transport system (without regard to air and gas pipeline transport) in almost 88 percent of the expenditures for transport in the handling sphere go to motor and railway transport.

The distribution of expenditures between various types of transport does not agree with the distribution of the volume of transshipping work between them. Thus, railway transport of the handling sphere (without spur tracks) carries out more than 62 percent of the freight traffic turnover and approximately 42 percent of the passenger traffic turnover. However, its expenditures comprise only 33 percent of the total expenditures of the transport system in the handling sphere, whereas the fraction of expenditures of motor transport, which carries out 6.5 percent of the freight traffic turnover in more than 40 percent of passenger traffic turnover, reaches almost 55 percent. This situation is explained by the high cost of shipments in motor transport. Four-fifths of the total volume of freight shipment and the overwhelming majority of the volume of passenger shipment are included in this fraction. The average length of freight and passenger shipments in motor transport is tens of times less than that on railroads. Moreover, motor transport carries out a large volume of intraproduction shipments whose cost is even higher compared to the average.

Improvement of the operation of the unified transport system is of important significance for increasing the efficiency of all social production. Reducing transport expenditures by only 1 percent yields a saving of approximately 750 million rubles annually on the scale of the national economy.

1.3. Indicators of the Density of the Transport Network

The Soviet Union with its enormous territory (22.4 million km^2) has a long transport network. The length of the tracks is increasing every year. The network of new types of transport--motor, pipeline, air and electronic (electric power transmission lines)--is increasing at especially high rates.

The dynamics of growth of the length of the transport network is shown in Table 1.2.

Table 1.2. Length of Railway Network, thousand kilometers

Type of Railways	Years			
	1950	1960	1970	1975
General-purpose railroads	116.9	125.8	135.2	138.3
Spur tracks (including narrow-gauge)	--	102.5	120.8	1305.
Inland navigable waterways	130.2	137.9	144.5	145.4
Paved highways	177.3	270.8	511.6	660.5
Oil pipelines and mainline petroleum product pipeline	5.4	17.3	37.4	56.6
Mainline gas pipelines	2.3	21.0	67.5	99.2
Air lines (within the USSR)	300.5	375.2	596.0	645.0
High-voltage electric power transmission lines (with voltage more than 35 kV)	31.4	124.4	445.5	604.8

It is also important to note the relative indicators for the characteristics for the degree of saturation of the country with the transport network, besides the absolute dimensions of the length of tracks. A number of these indicators is used. Let us consider the following of them:

the indicator which characterizes the density of the network d_t as the ratio of its length L to the area of the country's territory S,

$$d_т = \frac{L}{S}. \quad (1.2)$$

This indicator is usually measured in kilometers of length of the network on 100 or 1,000 km^2 of territory;

the indicator which characterizes the density of the network d_n as the ratio of its length to population N,

$$d_н = \frac{L}{N}. \quad (1.3)$$

This indicator is usually calculated in kilometers of the length of the network per thousand residents;

the indicator which characterizes the relative density of the network, determined from the dimensions of the country's territory and its population,

$$d_{\text{тн}} = \frac{L}{\sqrt{SN}}. \tag{1.4}$$

The most generalized relative indicator of the country's saturation with a transport network, along with territory and population, takes into account the total volume of products produced in the country Q expressed in weight. It is determined by the formula

$$d_{\text{тнп}} = \frac{L}{\sqrt[3]{SNQ}}. \tag{1.5}$$

Different types of corrections are used to find the most comparable indicators of the density of the transport network by countries or regions of a given country.

First, the entire territory is divided into inhabited (with per capita population of more than one person/km^2) and uninhabited and the indicators are determined for all the territory and only for inhabited territory. Some indicators of the density of the transport network of the USSR in 1975 are presented in Table 1.3.

Table 1.3. Density of Transport Network of USSR

Type of Railways	Length of Railways, km		
	Per 10,000 Residents	Per 100 km^2 of Territory	
		All	Only Inhabited
Railroads (including spur tracks)	10.7	1.15	1.82
Inland navigable waterways	5.8	0.65	0.98
Paved highways	26.4	2.90	4.26
Oil and petroleum product pipelines	2.3	0.25	0.33
Gas pipelines	3.9	0.44	0.63
Total	41.9	5.39	8.02

As can be seen from the table, the best indicators of providing the territory and populace with a railway network are motor and railway transport.

Second, railways themselves which, as is known, are distinguished by their technical equipping and traffic and carrying capacity, are also reduced to comparable form. To do this, the following correcting ratios are used, for example: 1 km of ordinary paved highway is equivalent to 0.15 km of one-track railroad, while 1 km of improved paved highway is equivalent to 0.45 km of one-track railroad. The density of pipelines as corrected with regard to pipe diameter since their carrying capacity depends to a great extent on this.

The corrected indicators more accurately reflect the level of development of the country's transport system and its saturation with all types of railways.

1.4. Main Results and Prospects for Development of the Unified Transport System

The development of all sectors of the national economy, the growth of the population, an increase of the cultural level and standard of living of the workers and also expansion of international ties of our country are accompanied by continuous and rapid growth of freight and passenger traffic turnover of the transport system. As can be seen from the data of Table 1.4, the absolute dimensions of freight and passenger traffic turnover increased in all types of transport during the period from 1951 to 1975. The freight traffic turnover of oil pipeline, marine, motor and air transport increased at the highest rates. Passenger traffic turnover increased more rapidly in air and motor transport.

The growth of freight traffic turnover of the transport system occurs both due to an increase of the volume of freight shipments in tons and due to the increase of the average length of their shipment in all types of transport with the exception of river and maritime transport. Higher rates of development of new types of transport have a significant effect on variation of the specific weight of each type of transport in the total freight and passenger traffic turnover (Table 1.5). In this case the specific weight of railway and river transport is decreasing continuously, while that of motor and oil pipeline transport is increasing. The specific weight of maritime transport in cargo shipments decreased appreciably during 1971-1975.

Under modern conditions, each percentage of increase of freight traffic turnover of the transport system yields a total of more than 50 billion t-km, including more than 30 billion t-km in railway transport.

The relationship of the freight traffic turnover of individual types of transport varies significantly if the foreign trade export-import shipments are excluded from the total freight traffic turnover. In this case the specific weight of railway transport in internal freight traffic turnover of the USSR increases to 75 percent. Thus, as before, the railroads remain the main type of transport in servicing the freight shipments inside the country.

Motor transport occupies first place in the transport system by the volume of freight shipped in tons. Approximately 80 percent of the total volume of freight shipments goes to it, or five times more than to railway transport and almost two times more than to all remaining types of transport taken together. The insignificant specific weight of motor transport in the country's freight traffic turnover is explained by the small average distance of freight shipment by trucks, which comprised approximately 16 km in 1975 compared to 466 km in river transport, 1,338 km in oil pipeline transport, 3,681 km in maritime transport and 894 km in railway transport.

The relationship of individual types of general-purpose transport in passenger traffic turnover varies appreciably (compared to the data presented in Table 1.5) if intracity passenger bus shipments are excluded from it. Thus, the specific weight of mainline railroads increases significantly in intercity passenger traffic turnover. It comprised approximately 55 percent in 1975 with average distance of a trip by passengers of 657 km in intercity traffic. The average distance of a passenger trip by rail comprises 90 km in all traffic.

Table 1.4. Increase of Total Freight and Passenger Traffic Turnover of Transport System of USSR

Type of Transport	Freight Traffic Turnover, billion t-km, by years				Passenger Traffic Turnover, passenger-km, by years			
	1950	1960	1970	1975	1950	1960	1970	1975
Railway	602.3	1,504.3	2,494.7	3,236.5	88.0	170.8	265.4	312.5
Maritime	39.7	131.5	656.1	736.2	1.2	1.3	1.6	2.1
River	46.2	99.6	174.0	221.7	2.7	4.3	5.4	6.3
Motor	20.1	98.5	220.8	338.0	5.2	61.0	202.5	303.6
Oil Pipeline	4.9	51.2	281.7	665.8	--	--	--	--
Air	0.14	0.56	1.9	2.6	1.2	12.1	78.2	122.6
Entire Transport System	713.3	1,885.7	3,829.2	5,200.8	98.3	249.5	553.1	747.1

Table 15. Specific Weight of Various Types of Transport in Total Freight and Passenger Traffic Turnover, percent of total

Type of Transport	Freight Traffic Turnover By Years				Passenger Traffic Turnover By Years			
	1950	1960	1970	1975	1950	1960	1970	1975
Railway	84.4	79.8	65.2	62.2	89.5	68.5	48.4	41.8
Maritime	5.6	7.0	17.1	14.2	1.2	0.5	0.3	0.3
River	6.5	5.3	4.5	4.3	2.8	1.7	1.0	0.9
Motor	2.8	5.2	5.8	6.5	5.3	24.4	36.1	40.6
Oil Pipeline	0.7	2.7	7.4	12.8	--	--	--	--
Air	--	--	--	--	1.2	4.9	14.2	16.4
Entire Transport System	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: The fraction of air transport comprises less than 0.1 percent in the freight traffic turnover.

Air transport, which has the highest average distance of passenger shipments of 1,331 km, occupies second place in intercity passenger traffic turnover (more than 20 percent). The average distance of intercity passenger shipments by general-purpose buses is low--approximately 35 km, while the average distance of all passenger automobile shipments is even less--8 km. Therefore, motor transport occupies third place (approximately 15 percent) in intercity traffic of passenger traffic turnover, although it is inferior only to railway transport in the total volume of passenger shipment. Water transport does not yet play a significant role in the country's total and intercity passenger traffic turnover.

Thus, railway transport as before retains its decisive significance in the field of passenger shipments.

The continuous growth of freight and passenger shipments requires corresponding technical equipping of the transport system. An enormous volume of work was carried out during the period 1951-1975 in the USSR to strengthen its material and technical base.

The length of the railroad network was increased by more than 18 percent during this period. Construction of the world's largest Baikal-Amur Mainline Railroad was begun in 1974. Conversion of railroads to progressive types of traction--electric and diesel--was essentially completed. The total length of the railroad lines serviced by these types of traction exceeded 130,000 km, which comprises 94 percent of the operational length of the railroad network. In 1975 electric and diesel traction performed 99.6 percent of all freight traffic turnover of railway transport. The specific weight of diesel and electric locomotives in shunting work reaches 89 percent.

Extensive measures have been carried out to strengthen the output of the upper structure of the track--laying heavy type rails, installation of crushed stone ballast, concrete reinforced ties and jointless track. The locomotive and rail car fleets were supplemented with more improved rolling stock--powerful electric and diesel locomotives, eight-axle gondolas and high-capacity tank cars. The length of the lines equipped with automatic block systems and centralized traffic control was increased.

The length of paved highways increased 3.7-fold. The fleet of trucks was supplemented with vehicles of various types and capacity (from 0.4 to 65 tons or more). State trials of BelAZ-549 dump trucks with capacity of 75 tons have been completed. Multiwheel truck trains-coal carriers with capacity of 120 tons have been developed and investigations are being carried out to develop even more powerful dump trucks (with capacity of 180 tons). The specific weight of specialized dump trucks designed to transport bulk freight, tank trucks, refrigerator trucks and truck-tractors for shipment of perishable products, milk, flammable goods and containers was increased in the truck fleet.

Comfortable and large-capacity ZIL, LAZ and other buses were developed to haul passengers in intercity and intracity communications. The fleet of compact automobiles was supplemented with modern types of machines such as Chaika, Volga, Zhiguli, Moskvich and Zaporozhets.

The Soviet Union is a great maritime power. The total tonnage of the commercial maritime fleet of the USSR exceeds 17 million tons. The fleet contains ships of different capacity, including large tankers for shipment of petroleum products.

During the past few years the fleet was considerably supplemented with highly economical universal and specialized ships with high degree of mechanization of loading-unloading operations. A Soviet supertanker of the new series "Mir" with capacity of 150,000 tons has been constructed. Construction of container-carrier ships has been expanded for shipment of large-capacity containers. Construction of container-carrier ships with roll-on-roll-off handling, which can carry approximately 230 20-ton containers, is planned. Ships of even greater capacity--no less than 1,100 large-capacity containers--will be constructed in the future.

The passenger fleet was supplemented with new large-capacity ocean liners. Powerful icebreakers, including the atomic icebreaker "Arktika," which was the first in the world to reach the north pole, have been developed to increase the navigation season through the Northern Sea Route.

Extensive qualitative changes have also occurred in river transport. Development of a unified deepwater river system in the European USSR has been essentially completed. Ships with diesel power plants comprise the main fraction of self-propelled river cargo ships. The nonself-propelled river fleet has been completely renovated; barges are now constructed mainly with metal hulls. Ships of an essentially new class--mixed river-sea navigation and twin-hull catamarans--have been developed. Capacity has been increased and the speed and safety of ship traffic on the rivers has been increased.

Passenger hydrofoil ships of the "Raketa" and "Meteor" class, having speed of 60-70 km/hr, appeared for the first time in the Soviet Union. Construction of air-cushion ships, which provide speed up to 120 km/hr, has begun. Comfortable two- and three-deck motor ships with capacity up to 350 persons and with speed of 25-26 km/hr are being used to ship passengers over long distances.

Air transport has achieved extensive development. A new qualitative jump in development of civil aviation occurred in the mid-1950s when jet and later turbojet aircraft appeared on the country's air routes. The first of them was the TU-104 with capacity of 100 passengers, designed for flight altitude of 8-9 km at a speed of 800-850 km/hr.

Further technical progress was related to the rapid increase of aircraft capacity, their speed, altitude and nonstop flight range. TU-134, TU-154 and IL-62 aircraft are now operating on the air routes of the USSR in long-range flights and YaK-40 and AN-24 aircraft are operating on local lines.

The world's first supersonic passenger aircraft, the TU-144, with capacity of 120 passengers was developed in our country. The speed of this aircraft is 2,500 km/hr, the calculated flight range is 6,500 km and the flight altitude is 20 km. The world's largest cargo aircraft, the "Antey" (AN-22) with capacity of 80 tons, was constructed in the USSR.

Helicopters have achieved extensive distribution. Soviet designers have developed many different types of helicopters including super-powerful types.

Pipeline transport was developed at the highest rates. The total length of mainline oil pipelines and petroleum product pipelines increased more than tenfold during 1971-1975 and the length of gas pipelines increased 43-fold. The total length of both comprised 156,000 km in 1975. Primarily large-diameter pipelines of 1,020 and 1,220 mm are now being constructed in the USSR. Pipes with diameter of 1,420 mm are being developed for petroleum products. The task of further increasing pipe diameter fo 2.5 meters, primarily for gas, is being posed.

Soviet industry has also developed a system of powerful pumping installations and other equipment. Special pipeline systems are being developed for moving mass bulk goods (coal, ore, construction materials, grain and so on) in containers and capsules.

Extensive measures for further increasing the efficiency and work quality of railroad and other types of transport were provided by the decisions of the 25th CPSU Congress and by the decree of the CPSU Central Committee and USSR Council of Ministers: "On measures to develop railway transport in 1976-1980."

The freight traffic turnover of the transport system will increase by approximately 30 percent during the 10th Five-Year Plan and passenger traffic turnover of general-purpose transport will increase by 23 percent.

Freight traffic turnover in railway transport will increase by approximately 22 percent and passenger traffic turnover will increase by 14-15 percent. It is planned to put into operation approximately 3,400 km of new railroad lines and 4,000 km of second tracks and two-track inserts, to electrify 4,500 km of railroads and to equip 16,000-17,000 km of railroads with block systems and centralized traffic control. A total of 2,200 electric locomotives, 6,400 sections of mainline diesel locomotives and 2,500 diesel shunting locomotives, more than 400,000 freight cars and 16,600 passenger cars and 270,000 containers will be delivered to railway transport during the five-year period. The level of complex mechanization of loading-unloading operations will increase to 93 percent and labor productivity will be increased by 18-20 percent.

The cargo traffic turnover of maritime transport will increase approximately 1.3-fold. The capacity of maritime ports will be strengthened primarily by construction of specialized transloading complexes with docks having total length of 5.3 km. The fleet will be supplemented with highly productive dry-cargo, tanker and combination ships with total tonnage of approximately five million tons of deadweight.* The fraction of the specialized dry-cargo fleet--timber carriers, container carriers, lighter carriers, trailer carriers, ships designed to transport bulk goods and other ships--will be increased.

Cargo traffic volume will be increased by approximately 22 percent in river transport. Mechanized docks with total length of approximately 6 km will become operational. The river transport fleet will be supplemented with large-capacity barges, pusher-tugboats, cargo motor ships with increased capacity, including ships of river-sea mixed navigation, small-capacity ships for shipment of cargo on small rivers and also more improved types of passenger ships.

---

*Deadweight is the total capacity of a ship, including all supplies (fuel, water and so on) required for navigation.

Pipeline transport will achieve further development. Approximately 18,500 km of oil pipelines and petroleum product pipelines will become operational during the five-year period and automated production control systems will be developed and introduced on the main pipelines.

Freight traffic turnover will be increased by 45 percent in general-purpose motor transport, while passenger traffic turnover will be increased by 28 percent in bus transport. It is planned to construct and reconstruct no fewer than 65,000 paved highways during the five-year period.

Shipments in air transport, especially over long distances and in difficultly accessible regions, will achieve further development. The passenger traffic turnover of air transport will increase 1.3-fold. Operation of new passenger aircraft such as the IL-86 (air buses), YaK-42 and cargo aircraft of type IL-76 will begin and research will continue to develop new aircraft corresponding to the future needs of development of civil aviation. Introduction of equipment systems which provide automation of air traffic control and takeoff and landing of aircraft is provided on wider scales.

The main task of the unified transport system during the 10th Five-Year Plan remains more complete and timely satisfaction of the needs of the national economy and of the populace for shipments. To do this, it is planned to further strengthen the traffic and carrying capacity of all types of means of communication included in the transport system. An increase of the rating and capacity of transport facilities, specialization of them and an increase of speeds are the main trends in development of the transport system for the future. Increasing the rating of the entire transport system and improving the quality of its operation will be accomplished simultaneously with further improvement of transport ties between the economic regions of the country.

6521
CSO: 8144/0359

TECHNICAL-ECONOMIC CHARACTERISTICS AND SPHERES OF EFFICIENT USE OF TYPES OF TRANSPORT

Moscow EKONOMIKA I PLANIROVANIYE ZHELEZNODOROZHNOGO TRANSPORTA: EKONOMIKA ZHELEZNODOROZHNOGO TRANSPORTA in Russian Part 1, 1978 signed to press 20 Sep 78 pp 25-32

[Excerpt from Chapter 2 of the book " Ekonomika i planirovaniye zheleznodorozhnogo transporta: ekonomika zheleznodorozhnogo transporta," Izdatel'stvo Transport, 15,000 copies, 352 pages]

[Excerpt] 2.2. Technical and Economic Characteristics of Types of Transport

Railway transport. The main advantages of railway transport are its universality, regularity of shipments during the entire year and its enormous carrying capacity. Thus, the carrying capacity of a single-track electrified line reaches 20-27 million tons annually in one direction, while that of a two-track line completely outfitted with modern technical equipment reaches 90 million tons or more annually.

However, construction of railroads requires extensive expenditures of labor and energy resources, metal and other material goods. The cost of constructing 1 km of single-track railroad under average conditions comprises approximately 300,000-500,000 rubles, and under the difficult conditions of the Arctic, in swamp and mountainous terrain, it is 2-3-fold higher. Expenditures of metal (without rolling stock) comprise 130-200 tons per kilometer. Construction of a two-track line costs 60-70 percent more than a single-track line.

Specific capital investments and operating expenses on railroads depend to a significant degree on the volume of shipments. Capital investments in permanent facilities and expenses to maintain them have an important effect on the value of these indicators. These expenditures do not depend mainly on the volume of shipments and go to an even less extent to unit product with an increase of it. Thus, a decrease of the total specific capital investments and operating expenses is provided. For example, independent expenses comprise 2-3 kopecks per 10 t-km with freight intensity of 5 million t-km/km annually, while these expenses are reduced to 1-1.3 kopecks with freight intensity of 20 million t-km/km. Therefore, railroads can be constructed to assimilate a significant volume of mass freight turnover and also freight traffic volume having high rates of growth during an extended time period.

Specific capital investments comprise approximately 15 kopecks/10 t-km with average freight intensity of railroads equal to 22.6 million t-km/km. Of this, 12 kopecks goes to permanent facilities and 3 kopecks go to rolling stock. The cost of railway freight shipments is equal to 2.478 kopecks/10 t-km. The cost of shipments is 2.5-3-fold higher in passenger traffic, while specific capital investments are 3-4 times higher than in freight traffic.

The rate of delivery by rail transport comprises an average of 260-270 km/day for all freight. It increases to 350-370 km/day when freight is shipped by block trains.

The labor productivity of a single worker engaged in shipments exceeds 1.7 million reduced ton-kilometers.

Indicators of the cost of shipments and labor productivity are presented in Table 2.1 for types of transport.

Table 2.1. Cost of Shipments and Labor Productivity in Transport

Type of Transport	Cost of Shipments				Labor productivity of one worker, thous. reduced t-km	
	of freight, kop/10 t-km		of passengers, kop/10 pass.-km			
	1970	1975	1970	1975	1970	1975
Rail	2,341	2,478	5,455	6,063	1,382	1,715
River	2,450	2,590	15,510	17,530	1,651	2,014
Maritime	1,460	1,980	47,180	64,030	7,635	8,008
Motor (general-purpose)	57,130	50,510	9,850	10,040	114	160.6

River transport. The seasonality of work, extensive winding of the route, dependence on weather conditions (drying up of unregulated rivers in summer and storm conditions on reservoirs and large rivers) and the low speed of cargo delivery are typical for river transport.

The length of the navigation season on the rivers of our country fluctuates from 100 days annually in the Kolymo-Indigirka Shipping Line to 27 days in the lower branch of the Volga, Don and Dnepr Rivers. Many rivers cannot be used for navigation due to their shallow depths. These rivers are used only for floating timber during the spring season.

Due to their winding nature, the route along rivers is longer in most cases than along railroads. An increase of the river route comprises an average of 20-25 percent in regions with a developed railroad network. However, the ratio of the length of river and railroad routes significantly deviates from the average on some lines. For example, the distance by water between Moscow and Astrakhan' is two times greater than by rail. The water route between Zaporozhe and Kiev, Kotlos and Arkhangelsk is considerably shorter than the rail route.

The average speed of cargo delivery on rivers is lower than on railway transport and comprises 100-150 km/day. This is related to the significant increase of water drag to ship traffic when they increase speed. Thus, the specific drag on rivers is 6-10 times less at low speeds (3-6 km/hr) than in railway transport. But drag increases with an increase of speed in proportion to the square of speed, while the consumed power of the ship engines increases in proportion to the cube of speed.

The speed of cargo delivery in river transport differs by types of shipments. Raft timber is delivered at the lowest speed (60-80 km/day) and cargo transported in self-propelled ships is delivered at the greatest speed (280-350 km/day).

The average cost of river cargo shipments is close in value to the cost of railway shipments. However, the length of the navigation season, the type of shipments, type of fleet, type of cargo and capacity of ships have an important effect on the cost of river shipments. Therefore, differences in cost are sharper by shipping lines than by individual railroads. Whereas the highest cost indicators in railway transport (on dead-end railroads) exceed the lowest by a factor of 3-4 (on railroads with predominance of transit shipments), this ratio reaches 1:20 in river transport. Thus, the cost of cargo shipments in the Volga Combined Shipping Line comprises approximately 1.3 kopecks/10 t-km, while that in the Kolymo-Inigirka Shipping Line (the shortest navigation season) comprises more than 20 kopecks/10 t-km. Extending the length of the navigation season by using powerful icebreakers is of important significance to reduce the cost of river shipments. A reduction of the cost is provided for all elements of expenditures in this case.

Cost differs significantly by the types of shipments and the type of fleet. Raft timber and petroleum goods are delivered at the least cost (2-3 times less than that on railroads). Shipments by barge are somewhat less expensive than by self-propelled ships due to the lower specific expenses to maintain barges and the higher productivity of pusher tugs.

Passenger shipments by river motor ships are 2-3 times less expensive than shipments by train. The average cost of passenger shipments on river transport comprises more than 17 kopecks/10 passenger-km. However, the level of comfort offered the passengers is considerably higher on river vessels. Therefore, trips on motor ships attract a large number of passenger-tourists. The influx of passengers to river transport increased significantly, especially in suburban zones, during the past few years with construction of hydrofoil ships, which have a speed of 60-80 km/hr.

Specific capital investments in barges on river transport is 2-3 times higher for dry cargo than in railway transport and is somewhat lower in permanent facilities. Canals and dams which require high monetary expenditures usually solve a number of other national economic problems. Therefore, the fraction of expenditures to permanent facilities related to cargo shipments is lower in most cases in river transport than in railway transport.

One of the factors which delays intensive development of river shipments in our country is some nonconformity between the direction of flow of rivers and the direction of mass freight traffic volume. This disadvantage is eliminated by organizing mixed rail-river shipments which now comprise more than one-third of the freight traffic turnover of river transport. However, mixed rail-water shipments are not always economical in regions with a dense railroad network. Therefore, technical and economic calculations must be made when organizing shipments with participation of river and railway transport. Mixed rail-water shipments between points not connected by rail are usually advantageous economically with low density of the railroad network. The greatest economic effect is achieved upon deviation from direct rail communications to mixed communications of tanker, loose and bulk cargo.

The level of labor productivity in river transport is somewhat higher than in railway transport and comprises more than two million reduced t-km per worker.

Maritime transport. The most important advantage of maritime transport is the unlimited carrying and traffic capacity, long navigation season, directness and horizontal nature of the route and the high capacity of ships.

There are no expenditures in maritime transport for maintenance of maritime routes, with the exception of canals, the length of which is comparatively short.

The average length of the navigation season in maritime transport of the USSR comprises 330 days. But some ports (Murmansk, Liyepaya, Novorossiysk, Batumy and Vladivostok) operate year-round.

The rate of cargo delivery by sea is higher over long distances than by rail and fluctuates from 350 km/day for dry-cargo carriers to 550 km/day for petroleum products. The average cost of maritime shipments comprises 1.98 kopecks/10 t-km. The cost of shipment depends to a significant degree on the type of navigation (foreign, major coastal shipping and minor coastal shipping) and the type of cargo. The cost is the lowest (approximately 1.2 kopecks/10 t-km) in foreign shipping over long distances. The highest cost of maritime shipments is minor coastal shipping (approximately 4 kopecks/10 t-km). There are significant differences in the cost of shipments by the types of vessels as well. Thus, the cost of shipment of petroleum goods in tankers is 2-2.5 times less than that of dry-cargo carriers.

Capital investments in ports and port facilities are significant in maritime transport. However, the specific expenditures are low with high productivity of loading-unloading machinery and with long shipping distances.

With regard to the comparatively high rates of delivery, large capacity of ships and significant shipping distances, labor productivity in maritime transport is very high and comprises more than 8 million reduced t-km per worker.

Passenger shipments by maritime transport are more expensive than railway and air transport. Therefore, maritime passenger transport is mainly utilized as tourist transport. The influx of passengers to maritime transport in the country's resort zones is increasing significantly with supplementation of coastal passenger lines with hydrofoil vessels of the "Raketa" and "Meteor" class.

Motor transport. This type of transport is characterizes by high maneuverability and mobility, the possibility of delivering goods direct from the warehouse of the shipper to that of the consumer and relatively high rate of delivery.

The average cost of freight shipments in motor transport comprises 50.51 kopecks/ 10 t-km. This is approximately 20-25 times higher than the average cost of rail shipments. But if one determines the cost under comparable conditions, then freight shipments over short distance are more expensive by rail than by motor transport.

The degree of utilization of the truck fleet in time and mileage, the technical state of the fleet and the condition of the roads have a significant effect on the cost of motor shipments. Trucks are still inadequately utilized at present. Thus, the operating time of trucks comprises a little more than 9 hours per day. Approximately half of all trucks travel the return trip empty and approximately one-third are idle for repair or awaiting repair. The highest cost is achieved in freight shipments in truck-trains on paved roads. They are one-half to one-third lower on the average.

Capital investments in highways fluctuate from 30,000 rubles (improved dirt roads) to 1-2 million rubles (motor expressways) per kilometer of route. Operation of motor vehicles is also possible on dirt roads, which is very important in some cases to develop small volumes of freight and passenger shipments.

The average rate of freight delivery by truck comprises approximately 350-400 km/day. It is somewhat higher on intercity lines and lower on intracity lines.

Labor productivity in motor transport is the lowest and comprises 160,600 reduced t-km per worker. This is explained by the low capacity of the vehicles, the relatively low qualitative indicators of their utilization, the large number of maintenance staff and the insignificant average distance of shipments.

Due to its high maneuverability and mobility, motor transport is a convenient and inexpensive type of intracity and suburban communications. The specific weight of vehicles in city transport shipments comprises more than 60 percent.

Air transport. The advantages of air transport include high speed, the straightest line of the route, all-terrain capacity and long range of nonstop flights.

The cost of freight shipments in air transport is 60-70 times higher than in railway transport and now comprises an average of 160 kopecks/10 t-km. The high cost is related to the high specific rating of the engines required to move one tone of cargo through the air and by the high cost of fuel. It depends on the type of aircraft. The lowest cost is on turboprop and turbojet aircraft compared to the average and the highest cost is on piston aircraft.

The cost of passenger shipments is much lower than freight shipments, which is explained by the differences in the weight of passengers and freight. Passengers and freight are transported in air transport mainly by the same types of aircraft. The average weight of a passenger with regard to the weight of hand luggage is equal to 90 kg. Consequently, the cost of transporting passengers will be on the average as low as the cost of freight shipment as is the weight of a single passenger is less than the weight of one ton of cargo, i.e., 10-11 times.

The weight of the shipped tare of rail cars rather than the weight of passengers has the main effect on formation of operating expenses in passenger shipments in rail transport. There is an average of 1.8 ton of rail car tare per passenger and 0.8 ton of weight of rail car tare per ton of freight.

The ratio is different in air transport. Only 0.24 ton of the service weight of the aircraft goes to each passenger and 2-3 tons of the service weight goes to each ton of cargo.

Organization of air communications requires no expenditures on construction and maintenance of route. Significant capital investments are required only in construction of airfields. However, the expenditures per kilometer of route are lower in air transport than in railway transport over long distances with a large number of scheduled flights between air fields.

The average rate of shipments in air transport comprises approximately 400 km/hr and the rate of piston aircraft is less than 300 km/hr, the rate of turboprop aircraft is 600-650 km/hr, that of turbojet aircraft is 800-900 km/hr and that of the supersonic TU-144 is 2,500 km/hr.

The range of nonstop flight on different types of aircraft fluctuates from 500 km (the YaK-40) to 10,000 km (TU-144). Air routes are an average of 20-25 percent shorter than railway routes and 35-50 percent shorter than river routes.

The high speed of air communications permits modern powerful aircraft to achieve enormous carrying capacity. Thus, an express train with 720 seats having average route speed of 50 km/hr has carrying capacity of 36,000 passenger-km/hr. The IL-18 aircraft with 100 seats and speed of 650 km/hr provides carrying capacity of 65,000 passenger-km/hr, while the TU-114 with 170 seats at a speed of 800 km/hr provides a capacity of 136,000 passenger-km/hr.

The disadvantages of air transport, besides the high cost of shipments, should include some dependence on weather conditions. But improvement of the equipment and technology of "blind" flight and automation of aircraft landing significantly reduce the effect of this factor on the regularity of flights.

Pipeline transport. This type of transport includes oil pipelines, petroleum product pipelines and gas pipelines. The important advantages of pipeline transport are the absence of rolling stock and as a result of empty runs, a significant reduction of loss of goods and stable operating conditions regardless of the season of the year and climatic conditions.

The cost of pumping oil and petroleum products over pipelines is one-half to one-third that of shipping them by railroads and comprises an average of 0.96 kopeck/10 t-km. It depends to a significant degree on the pumping distance due to the absence of loading and unloading operations.

Expenditure for maintenance of permanent facilities, hardly dependent on the volume of pumping through pipelines, occupy a large specific weight in the total volume of operating expenses. Therefore, flow capacity can be increased to reduced cost by laying large-diameter pipes (1,020-1,220 mm or more).

The viscosity of petroleum products and the degree of loading the pipelines have an important effect on the cost of pumping. The cost is reduced significantly if several different petroleum products are pumped sequentially over the same pipeline, thus providing a high degree of loading at low capacity of individual flows.

Specific capital investments in pipeline transport are considerably lower than in railway transport. Thus, construction of 1 km of pipeline requires approximately one-half the expenditures than construction of 1 km of railroad of the corresponding carrying capacity.

The pumping rate of petroleum goods comprises 70-80 km/day. It is somewhat higher over large-diameter pipes due to the lower specific drag.

Labor productivity is highest in pipeline transport, which is provided by a high degree of automation of pumping processes and high annual capacity of pipelines. The level of labor productivity exceeds 12 million t-km per worker.

Electronic transport. The length of electric power transmission lines (LEP) comprises more than 600,000 km in the USSR and the generation of electric power comprises more than 1,000 billion kW·hr annually. The main part of electric power (approximately 80 percent) is generated at thermoelectric power plants.

The advantages of electric power transmission lines over other types of transport are very great. Thus, if electric energy were generated at the point of its consumption, the shipments on railway transport would increase by 14 percent. This would require enormous capital investments in rolling stock, development of the carrying capacities of railroads and also the capacities of the corresponding sectors of ferrous metallurgy, machine building and so on. The required capital investments exceed many times those related to development of LEP.

An undoubted advantage of electronic transport consists in the possibility of fast maneuvering of energy within the energy system and also between individual energy systems. The disadvantages should include the high losses of electric power during transmission, especially over long distances.

One should bear in mind that some incompatibility of these indicators should be taken into account when comparing types of transport by the average indicators of labor productivity and cost of shipments. Thus, the average indicators of the cost of shipments are calculated with different average distance, which varies from 16.1 km in motor transport to 3,681 km in maritime transport. Moreover, the cost of shipments on various types of transport also includes different groups of expenditures. For example, expenses for maintenance of track facilities, which comprise approximately 15 percent of their total value, are included in the cost of railway shipments. This group of expenditures is not included in the cost in river and motor transport.

The differences in freight intensity, which have an important effect on the average cost of shipments, are also very significant.

Section indicators of the cost of shipments calculated under comparable conditions deviate significantly from average indicators.

Consequently, it is impossible to use average indicators of cost when determining the effectiveness of transfer of freight traffic volume from one type of transport to another.

The incompatibility of the indicators of labor productivity occurs due to differences in the rates of delivery, in the composition of the operating contingent and also due to differences in shipping conditions. Thus, the staff engaged in track maintenance is not included in the operating contingent in river and motor transport, whereas workers engaged in track repair are taken into account in the operating contingent on railroads.

6521
CSO: 8144/0359

PLANNING OF RAILROAD TRANSPORT

Moscow EKONOMIKA I PLANIROVANIYE ZHELEZNODOROZHNOGO TRANSPORTA: EKONOMIKA ZHELEZNODOROZHNOGO TRANSPORTA in Russian Part 1, 1978 signed to press 20 Sep 78 pp 53-61

[Excerpt from Chapter 4 of the book "Ekonomika i planirovaniye zheleznodorozhnogo transporta: ekonomika zheleznodorozhnogo transporta," Izdatel'stvo Transport, 15,000 copies, 352 pages]

[Excerpt] 4.2. Types of Transport Plans

Future, annual (fiscal) and operational (quarterly and monthly) plans are developed in railway transport, as in the entire national economy.

Future plans include the five-year plan and long term plans calculated for 10 years or more. The main directions and most important indicators for development of the national economy and its sectors are established in the future plans. The need to develop future plans is caused by the fact that implementation of important reconstructive measures in railway transport, for example, such as construction of mainline railroads, double tracking, development of new powerful types of locomotives and so on requires a long time and should be tied in in a complex manner to plans for development of other sectors of the national economy. Future plans should provide introduction of the latest advances of science and technology.

The tasks in the total volume of shipments in tons, freight traffic turnover and passenger traffic turnover, the dimensions of capital investments with allocation of the most important titles or objects of construction, the growth of labor productivity and reduction of the cost of shipments, the use of rolling stock and the task for profits are established in the future plans of railway transport. The indicators confirmed in the five-year plans are distributed by years.

The annual plans of railway transport should provide fulfillment of future plans. At the same time they are worked out with regard to a specifically developing situation for operation of transport during the planning year. Annual plans include more developed nomenclature of indicators than future plans and encompass all aspects of the activity of railway transport. The indicators of the annual plan are established for the year with distribution by quarters.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000300080044-2

Not all indicators of the annual plan are confirmed by the superior organization. Part of them are calculated and serve to determine the main operating indicators of the railroads. Thus, the most important qualitative indicator of operating activity--the productivity of a freight rail car--is confirmed in the plans of the railroads by the Ministry of Railways. But the trip of a loaded rail car, the percentage of empty runs, the dynamic load of the rail car and a number of other indicators must be calculated to determine this indicator.

Operational plans include quarterly plans of shipments with distribution of them by months and the monthly technical plans (norms of operating work) of railroads. The need to develop operating plans is determined by the fact that some changes occur during fulfillment of the annual plan. For example, the need for shipments may change with regard to overfulfillment of production plans by industrial enterprises, a high yield of agricultural products and so on.

Qualitative indicators of utilization of rolling stock, operating fleets of rail cars and locomotives, regulating tasks in transfer of loaded and empty rail cars by junction stations and other tasks are established by the network as a whole and by railroads in technical plans.

Operating tasks calculated for the 10-day and 5-day period, 24 hours or shift are established for some types of work.

4.3. Main Sections of the Annual Plan

The annual plan of railway transport for the network as a whole and by railroads is worked out for the following main sections: the plan of freight and passenger shipments, the operating plan of the railroads, the plan of major overhaul of main facilities, the plan of capital investments, the plan of planning-research work, the plan of scientific research work and introduction of the advances of science and technology, the plan of industrial output, the labor plan, the plan of material and technical supply and the financial plan (including the balance sheet of income and expenses).

The plan of freight and passenger shipments is the main, initial section of the plan. The volumes and directions of shipments are established in it. The necessary measures to increase the carrying and traffic capacity of the railroads, the required dimensions and structure of rail car and locomotive fleets and consequently the volume of the required capital investments are determined as a function of the volume of shipments and also as a function of the capacity of freight traffic volume and passenger traffic volume by direction.

The number of transport workers, the fuel, electric power and material requirements, the dimensions of income and expenses of railroads, i.e., indicators of almost all the remaining sections of the plan, are calculated on the basis of the shipment plan.

The operating plan of railroads includes the operating plan of rolling stock and the plan of operating expenses. The mileage and required fleets of rail cars and locomotives are calculated in the first plan on the basis of the given dimensions of shipments and indicators of rolling stock utilization. The qualitative indicators of rolling stock utilization are worked out with regard to the use of leading methods of labor and introduction of new technology and progressive production processes. The second plan includes wage expenses, social insurance deductions, fuel expenditures, electric power and material expenditures, depreciation and miscellaneous expenses and also indicators of the cost of shipments.

The plan for major overhaul of main facilities provides fulfillment of work to maintain locomotives, rail cars, containers and other permanent facilities of railway transport in a working condition.

The volume of work expressed in physical and monetary terms on reconstruction of objects of railway transport and on new construction and also expenditures to acquire rolling stock, modernization of it and acquisition of spare parts is determined in the capital investments plan.

The volume of planning-research work on railway transport for the construction of future years and current construction, carried out both through one's own planning organizations and through the planning organizations of other ministries and agencies, is established in the plan of planning-research work.

The plan of scientific research work and introduction of the advances of science and technology provides fulfillment of scientific research and experimental work to develop and test industrial models of new machines, mechanisms, equipment, devices and materials.

The plan of industrial output by enterprises of railway transport determines the volume of gross, commercial and sold products and the variety of them, the task on repair of rolling stock and production of spare parts, output of individual types of machines, mechanisms and so on.

The required contingent of workers, the wage level and fund and also the task on the increase of labor productivity are established in the labor plan.

The plan of material and technical supply determines the need of transport for fuel, electric power, materials, spare parts, equipment and sources of meeting this need.

The financial plan of transport establishes the necessary expenses for providing a given volume of work and the dimensions of income and profits.

Besides the enumerated sections, the summary annual plan of the railroads includes the plan on state budget organizations (health, education and training of personnel).

All the main sections of the railroad plan contain indicators both for the railroad as a whole and for divisions.

The annual plan of railroad divisions consists of approximately the same sections as the railroad plan. The indicators for major overhaul of rolling stock are not established for a division since the railroad management is responsible for this work. State capital investments are also not planned by divisions since they are beyond the framework of the division in nature and significance.

4.4. Indicators of Plans Confirmed for the Railroad Network and Its Subdivisions

The following indicators are confirmed in the annual national economic plan for railway transport:

freight traffic turnover by the railroad network as a whole (in billions of ton-kilometers);

passenger traffic turnover for the railroad network as a whole (in billions of passenger-kilometers);

the wage fund of workers and the task for an increase of labor productivity;

the total volume of capital investments with separation of especially important construction projects;

the volume of products sold by the industrial enterprises of transport with separation of individual types of products;

the profit plan for main activity.

Moreover, delivery of the most important types of equipment, materials and fuel to transport is provided in the plan of material and technical supply of the national economy.

The Ministry of Railways confirms the plans for the railroads. The tasks of the railroads are confirmed by the following indicators of the plans:

by shipments--freight traffic turnover in tariff ton-kilometers and passenger traffic turnover; the total shipment of goods with separation of the most important ones and the cost of 10 reduced t-km;

by use of rolling stock--the productivity of the locomotive and freight car and turnover of the freight car;

by labor--the total wage fund for the main activity and the task for an increase of labor productivity;

by finances--the total sum of profits for the main activity and the total and calculated profitability; payments to MPS [Ministry of Railways] and appropriations from MPS;

by capital investments--the total volume of state capital investments, including the volume of construction and installation work; introduction of basic funds and production capacities into operation;

by major overhaul of basic funds--the volume of capital (planned) and average repair of locomotives, passenger and freight cars, containers and railroad track;

by planning-research work--title lists with indication of the capacity and cost of construction, deadlines for working out the contract design and detail plans and the technical-economic justification of construction of new and expansion of existing facilities;

by material and technical supply--the volume of fuel, electric power, material, spare parts, equipment and other deliveries.

The railroads work out the remaining indicators of the plans themselves and utilize them as calculating indicators.

The railroad management confirms the plans for the most important indicators for the divisions of railroads. The divisions in turn confirm the plans for line enterprises by the number of general indicators and indicators differentiated with regard to the specifics of operation of these enterprises.* Moreover, monthly technical norms of operating work are established by MPS for the railroads and by the management of railroads for divisions.

The plan of freight traffic turnover is established by railroads in tariff ton-kilometers and by divisions of railroads in operating ton-kilometers. This is explained by the fact that it is impossible to establish the work in tariff ton-kilometers within a railroad division according to the existing system of accounting.**

Operational ton-kilometers somewhat exceed tariff ton-kilometers (by 2-2.5 percent) as a result of using intrarailroad procedures, differences in accounting for operational and tariff distances in terminals, the different accounting time and for other reasons. The percentage of the interruption between tariff and operational ton-kilometers is taken into account in the shipments plan mainly for those railroads where the use of intrarailroad procedures is inevitable.

Indicators of the railroad plan are determined on the basis of tariff or operational ton-kilometers. Thus, measurements of utilization of rolling stock, fuel consumption, freight traffic turnover by types of traction and rail car and locomotive fleets are calculated on the basis of operational ton-kilometers, while labor productivity, the cost of freight shipments, operating expenses, the dimensions of income and income rates are calculated by tariff ton-kilometers.

In this regard, the dimensions of operational ton-kilometers are also established in calculating indicators, besides tariff ton-kilometers.

The activity of railroads and divisions is evaluated by the results of fulfillment of the planned tasks for those indicators which are confirmed by a superior organization. At the same time, all calculated indicators should be carefully reviewed when analyzing fulfillment of the plan.

The decisions of the 25th CPSU Congress provide for further improvement of the system of criteria for evaluating the work of production associations, enterprises and organizations, based on the need to improve the final results of production, to increase its efficiency and to improve product quality.

---

*This problem is outlined in detail in the second part of the textbook.

**Engineer routes are the primary source to calculate operating ton-kilometers and the railroad agency is the primary source for calculating tariff ton-kilometers.

4.5. The Structure of Planning Bodies

The USSR Council of Ministers fulfills the planning management of the national economy of the USSR and the councils of ministers of the union republics fulfill this role for republics. The central palnning-economic body of the national economy is the State Planning Committee of the USSR Council of Ministers (Gosplan of the USSR). It relies in its work on the Gosplans of the union republics and the planning bodies of the union ministries and agencies.

The following organizations manage planning work in railway transport: the planning-economic administration and the planning departments of administrations in the Ministry of Railways, the planning-economic departments, planning groups or engineers-economists for planning in services in the railroad administrations, the planning-technical-economic departments in railroad divisions, engineer-economists for planning in line enterprises and chief bookkeepers of enterprises or rate setters in separate line enterprises (Figure 4.1).

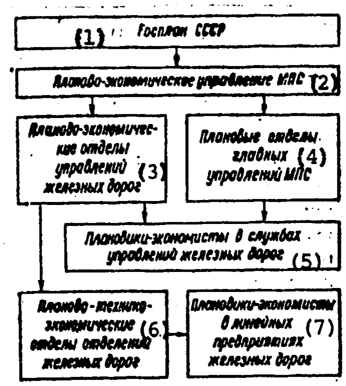

Figure 4.1. Structure of Planning Bodies of Railway Transport

Key:
1. Gosplan of the USSR
2. Planning-economic administration of MPS
3. Planning-economic departments of railway administrations
4. Planning departments of main administrations of MPS
5. Planners-economists in management services of railroads
6. Planning-technical-economic departments of railroad divisions
7. Planners-economists in line enterprises of railroads

The Main Freight Administration, which includes the Administration of Shipment Planning, is involved in problems of operational planning of freight shipments in MPS. Operational planning of shipments is entrusted to the freight services with shipment planning departments on the railroads. The monthly operating plans of the railroads or the monthly technical norms are worked out at the Ministry of Railways by the main administrations of traffic and locomotive facilities and they are worked out in the railroad administrations by the services of traffic and locomotive facilities.

There are planning departments in the railroad-construction trusts, planning sectors in railroad-construction offices and engineer-economists for planning in construction sections. There are planning-production or planning-technical departments at large plants of MPS (locomotive-rail car repair and machine building plants) and there are planning groups or engineer-economists for planning at small plants.

The planning-economic administration of MPS and the planning departments of administrations of MPS manage subordinate planning bodies in the railroad network and coordinate their work.

The conversion of the railroads to new conditions of planning and economic incentives and also rapid technical re-equipping of transport made it necessary to expand the rights of the railroad divisions and line enterprises. A number of measures was implemented for this purpose on organization-technical strengthening of the railroad divisions and line enterprises of transport; their rights in the field of planning were also expanded significantly. The railroad division now carries out complex planning of the production-economic activity of all enterprises within its boundaries, with the exception of enterprises of general railroad significance. It considers and confirms plans and monitors the course of fulfillment of these plans.

4.6. Procedure for Development of Plans

The planning of the national economy, including that of transport, is based on future plans with distribution of tasks by years. National economic plans are worked out on the basis of plans compiled by the enterprises themselves, construction projects, ministries and agencies and also by the union republics on the basis of the main trends of the future plan confirmed by the CPSU Central Committee and the USSR Council of Ministers.

The plan for development of railway transport is compiled in the following procedure.

Step 1. The planning-economic administration, with the participation of the planning departments of the railroads and administrations of MPS, works out the preliminary tasks for the railroads and organizations of MPS on the basis of control figures confirmed by the CPSU Central Committee and the USSR Council of Ministers for railway transport as a whole. The preliminary tasks include the scope of shipments (freight and passenger traffic turnover), the volume of capital investments, putting production capacities into operation, the growth of labor productivity and reduction of the cost of shipments and also the limits on consumption of basic maqerials.

The preliminary tasks confirmed by the Ministry of Railways are reported to the railroads and organizations, which work out the tasks by railroad divisions and plants. The divisions in turn establish similar tasks for the line enterprises subordinate to them.

Step 2. The line enterprises, based on the limits received by them, compile their own draft of the plan. The drafts of the plan are discussed by the collectives of the enterprises, are refined and are then presented to the railroad division. The division considers the drafts of the plans of enterprises, confirms them and presents the summary draft of the plan for the division as a whole to the railroad administration. The railroad administration considers the drafts of the plans of the railroad divisions, confirms them and submits a summary draft of the plan for the railroad as a whole to the Ministry of Railways. The planning-economic administration of MPS, with the participation of the main administrations, considers the drafts of the railroad plans and compiles a summary draft of the plan for railway transport as a whole, which is submitted to the USSR Council of Ministers and Gosplan of the USSR after confirmation by the management of the ministry.

Step 3. Based on confirmation of the plan for railway transport by the government, the planning-economic administration jointly with representatives of the railroads and division administrations of MPS works out the plan for the railroads. After confirmation by the Minister of Railways, the plan is reported to the railroad administrations. The planning-economic departments of the railroads, jointly with the services and representatives of divisions, work out the plan for the divisions and after it has been confirmed by the chief of the railroad, report it to the corresponding divisions of the railroad. The divisions work out the plan for subordinate enterprises.

After the plan has been confirmed, superior bodies should check whether the plan has been delivered to its executors on time and whether the indicators of the plan correspond to those tasks which were confirmed.

An integral part of the planning work is control and analysis of fulfillment of the plan. Well-organized analytical work makes it possible to prevent the appearance of disproportions in the economy of transport or to rapidly eliminate existing disproportions and to determine and mobilize internal reserves to fulfill the plan and for economical consumption of allocated funds.

In light of the decisions of the 25th CPSU Congress, problems of increasing the operating efficiency of each enterprise, of providing continuous growth of labor porductivity, of reducing cost, increasing profits and profitability and improving the use of production funds acquire especially important significance. Therefore, requirements on control-analytical work increase sharply in all sections of railway transport.

The developed analyses should be complex and should encompass all the confirmed and most important calculating indices.

The analyses, along with an outline of the factual material on fulfillment of the plan, should contain proposals directed toward mobilization of available reserves, increasing the effectiveness of utilization of basic production funds and improving planning-economic work.

6521
CSO: 8144/0359

CHARACTERISTICS OF THE VOLUME OF SHIPMENTS AND FREIGHT TRAFFIC TURNOVER OF RAILWAY TRANSPORT OF THE USSR

Moscow EKONOMIKA I PLANIROVANIYE ZHELEZNODOROZHNOGO TRANSPORTA: EKONOMIKA ZHELEZNODOROZHNOGO TRANSPORTA in Russian Part 1, 1978 signed to press 20 Sep 78 pp 76-78

[Excerpt from Chapter 6 from the book "Ekonomika i planirovaniye zheleznodorozhnogo transporta: ekonomika zheleznodorozhnogo transporta," Izdatel'stvo Transport, 15,000 copies, 352 pages]

[Excerpt] 6.4. Nonuniformity of Freight Shipments.

Freight shipments as a whole are distributed nonuniformly by seasons of the year throughout the railroad network and by individual railroads. The main reasons for this are the seasonality of production of certain types of products and also the seasonality of operation of river and maritime transport. For example, grain shipments are concentrated in July-November, the maximum sugarbeet shipments are in the fourth quarter of the year, shipments of construction materials are during the second and third quarters and so on. Many port railway stations increase loading several times after the beginning of the navigation season by hauling freight to water transport.

The nonuniform loading of individual freight as a whole throughout the railroad network is shown in Figure 6.3. The nonuniform loading is even greater in many cases for individual stations and railroads.

Nonuniform shipments by seasons of the year complicate the work of railroads and require creation of the necessary reserves of carrying capacity which are utilized only during months of maximum shipments. To assimilate the required shipments, all calculations on checking the carrying capacity of individual sections are constructed on the basis of the volume of work during the maximum month.

The planned system of management and socialist distribution of the productive forces in the USSR permit a significant easing of nonuniformity of freight shipments. Therefore, creation of reserves of construction materials at points of their consumption before the beginning of construction work and erection of the required number of warehouses and elevators at the point of state grain purchases for prolonged storage of it specifically contribute to this. Shipment of fuel, metallurgical raw material, construction and lumber goods must be intensified

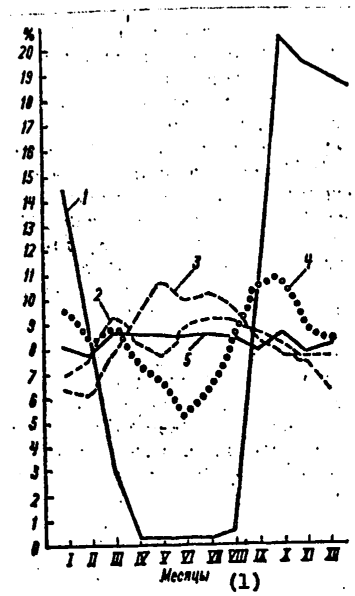

Figure 6.3. Nonuniform Shipments of Freight By Months in Percent of Annual Shipment: 1--sugarbeets; 2--timber; 3--mineral-construction materials; 4--grain products; 5--coal

Key:
1. Months

prior to June-July for easing the nonuniformity within the year, i.e., before the beginning of mass shipments of agricultural products.

The ratio of the dimensions of freight shipments during the maximum month to the mean monthly figure for the year is called the coefficient of nonuniformity. Let us assume that 7,860,000 tons is shipped annually for a section or an average of 7,860,000 ÷ 12 = 655,000 tons per month, while the scope of shipments during the maximum month (September) comprises 850,000 tons. Under these conditions the coefficient of nonuniformity for the given section will be

$$\kappa_н = 850 : 655 = 1{,}3.$$

The coefficient of nonuniformity of shipments is always greater than 1.

Besides the nonuniformity of shipments during the year, there is nonuniformity of shipments by days of the month and periods of the day on the railroads.

Intramonthly nonuniformity is characterized by a lesser scope of freight operations during the first days of the month and also during weekends compared to the remaining days of the week. It is explained primarily by the deficiencies in the work of the supply-service bodies (untimely issue of details for shipment of goods), the nonrhythmic work of enterprises, stopping of work of individual enterprises on

Saturdays, Sundays and holidays. The railroads together with the freight shippers should work out and implement measures to eliminate the decrease of work during some days of the month.

A reduction of freight work (loading and unloading) at nighttime is typical for nonuniformity during 24 hours. The transport shops should work round the clock at large enterprises to reduce the nonuniform work during the 24 hour period.

Shipments are nonuniform not only in time but in directions as well. The amount of freight shipped in one direction (during the year, quarter or month) is greater on most sections of the railroad network than in the other direction (opposite). There are usually more trains in this direction.

A line with greater scope of freight traffic volume is called a loaded line and one with lesser volume is called an empty line. The ratio of the amount of freight shipped in an empty line (ΣP_{por}, to the amount of freight shipped in a loaded line, ΣP_{gr}, is called the coefficient of reversibility. This value is usually less than one and is determined by the formula

$$\kappa = \Sigma P_{\text{пор}} : \Sigma P_{\text{гр}}.$$

The more nonuniform freight traffic volume by direction, the higher the mileage of empty rail cars and single runs of locomotives, the higher is the need of sections for carrying capacity since it is determined due to the dimensions of shipments in the loaded direction. All this makes the cost of shipments more expensive.

An increase of loading of persistently empty lines with additional freight yields a high economic effect. These lines specifically are: from the center to the Donbass, to Arkhangel'sk and the Urals, from the Urals to the Kuzbass and Karaganda, from Leningrad to Vorkuta and the Urals, from Central Asia to Siberia and so on. It has been established that the cost of shipments of additional freight in empty lines is one-third to one-fourth as much than when shipping in the loaded line.

The coefficient of nonuniformity of freight shipments comprises approximately 1.15 in time and that of the coefficient of reversibility comprises approximately 0.6 on the average throughout the railroad network of the USSR.

6521
CSO: 8144/0359

MAKING FREIGHT SHIPMENTS MORE EFFICIENT AND THE ECONOMIC EFFECTIVENESS OF SHIPMENTS

Moscow EKONOMIKA I PLANIROVANIYE ZHELEZNODOROZHNOGO TRANSPORTA: EKONOMIKA ZHELEZNODOROZHNOGO TRANSPORTA in Russian Part 1, 1978 signed to press 20 Sep 78 pp 79-84

[Excerpt from Chapter 7 from the book "Ekonomika i planirovaniye zheleznodorozhnogo transporta: ekonomika zheleznodorozhnogo transporta," Izdatel'stvo Transport, 15,000 copies, 352 pages]

[Excerpt] 7.1. Characteristics of the Main Types of Inefficient Shipments

Making freight shipments more efficient is a combination of measures directed toward improving the shipping process and transport-economic relationships. It is provided by improving planning and organization of shipments and also by feasible distribution of production and development of national and technical progress. Making shipments more efficient is an important reserve for reducing transport expenditures and for increasing the efficiency of social production.

The characteristic feature of making freight shipments more efficient is that it is accomplished not only within the framework of transport activity but in the field of material production as well. Making shipments more efficient may be regarded as necessary and significant only if it leads to a reduction of expenditures in the national economy as a whole.

A socialist planned economy has at its disposal extensive opportunities to reduce expenditures, specifically, by eliminating inefficient shipments. A shipment which causes expenditures for transport, excessive for the national economy, is regarded as inefficient. These shipments include counter shipments, cross shipments, excessively long shipments, excessively repeated shipments, split shipments, circular shipments and those which can be accomplished more feasibly by other types of transport. Transport of products poorly prepared for shipment is also inefficient.

Shipments of goods in a direction counter to the main flow of homogeneous (mutually interchangeable) goods are called counter shipments. Explicit counter shipments when homogeneous freight is transported in a counter direction by the same section of railroad and hidden shipments when these shipments are accomplished on parallel sections of the railroad or by other types of transport (for example, shipment of timber by rail counter to the flow of this freight by water) are distinguished.

Counter shipments of homogeneous goods is one of the most widespread types of inefficient shipments.

Excessive freight traffic turnover, caused by inefficient counter shipments ΣPl_{vstr}, is equal to the product of double the amount of freight shipped in a counter direction, ΣP_{vstr}, by the distance of the segment of counter direction l_{uch}

$$\Sigma Pl_{встр} = 2\Sigma P_{встр} l_{уч}. \quad (7.1)$$

Of the two counter flows, a lesser flow is inefficient ΣP_{vstr}. An efficient flow should be directed from a region with a surplus of given freight to a region with a shortage of given freight.

Let us assume that 50,000 tons of silicate brick is being shipped on section AB with length of 300 km (Figure 7.1, a) in direction BA and that 20,000 tons of the same brick is being shipped in direction AB. It is obvious that the flow of brick in direction BA is the main flow. This means that shipment of 20,000 tons of brick in direction AB should be regarded as inefficient.

(1)

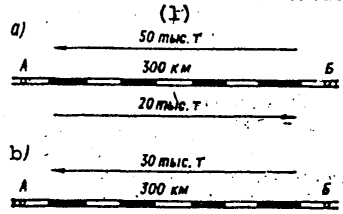

Figure 7.1. Diagrams of Inefficient (a) and Efficient (b) Shipments

A scheme of shipment over the same section shown in Figure 7.1, b is efficient. As one can see, the counter nature of the shipment was eliminated by moving the shipment of 20,000 tons of silicate brick from direction AB. As a result only 30,000 tons will follow in direction BA. Thus, it is obvious from comparison of the shipment diagrams shown in Figure 7.1 that 20,000 tons of freight contains twice as much mileage in scheme "a": a total of 50,000 tons of flow BA is in flow AB. The surplus counter freight traffic volume comprises 2·20,000 tons times 300 km = 12 million t-km.

Crossed shipments are related to inefficient shipments in cases when crossing of flows of identical freight is permitted, which causes excessive mileage of it. For example, inefficient shipments are crossed shipments of homogeneous mineral fertilizers from the Northern Urals to Altayskiy Kray and from Western Siberia to the western regions of Kazakhstan and shipments of lumber from the Urals (through the Sverdlovsk Railroad) to Central Asia and from Siberia to the Donbass. However, not all crossed shipments are inefficient. The configuration of the railroad network is taken into account when determining the inefficiency of these shipments, comparing specific shipping distances according to crossed directions.

Excessively long shipments are those carried out beyond the distribution zones of the product and which cause excessive freight traffic turnover. These zones are established by the schemes of normal directions of freight traffic volumes. Excessively long shipments can usually be replaced by shipments for shorter distances. Different goods have different maximum shipping distances. For most goods, shipments with a distance of more than 2,000-3,000 km are regarded as excessively long.

Repeated shipments occur in cases when goods which were hauled to it prior to shipment are sent from a station. Thus, some freight may initially come from an enterprise to a base and then from a base to the customers. If it is established that this shipment is unfeasible from national economic aspects, then it should be related to excessively repeated shipments. Shipments of a product intended for long storage at points where elevators and refrigerating units are located, from which it is transported within a certain time to customers or to processing points, are not excessively repeated shipments.

Shipments which do not provide conditions for routing them are called split shipments. They usually occur in cases when one customer receives freight from several shippers with the possibility and rationality of attaching it only to one of them.

Circular shipments are regarded as those in more extended directions instead of the shortest directions. But not all circular shipments are related to inefficient shipments. Thus, in some cases a circular path is less expensive. Moreover, some circular shipments are caused by the insufficient carrying capacity of the lines.

The efficiency of rail shipments, which it is more feasible to carry out by other types of transport (motor, water and pipeline), is determined by technical and economic calculations or previously established spheres of efficient use of various types of transport. The most typical inefficient shipments of this type are short-run shipments. Shipments in rail cars for distances up to 30-50 km or more are regarded as short-run shipments for most freight. These shipments can be more efficiently accomplished by motor transport.

Inefficient shipments are also those by rail during the navigation season parallel to water routes. It is economically more advantageous to use mixed rail-water shipments in some directions. Pumping of petroleum products through pipelines is very efficient compared to shipping them in railroad tank cars.

Inefficient shipments also includes transport of products poorly prepared for shipment (unenriched ores and pit coal, unprocessed raw timber, unpressed scrap metal and raw cotton, machines with uncompact loading of them and so on). A reduction of the mass of goods shipped by reducing the content of moisture and empty spaces in them, the use of consolidated loading and so on leads to an increase of the load-carrying capacity and volume of rail cars.

7.2. Measures to Eliminate Inefficient Shipments

An objective prerequisite for making shipments more efficient in the USSR is social responsibility for the means of production and transport. The main economic criterion in this case is achieving minimum combined national economic expenditures for production and shipment.

Elimination of inefficient shipments is achieved by workingout and implementing measures to make them more efficient. They can all be divided into two groups:

measures which do not require capital expenditures and which are usually accomplished during the current period. These are primarily measures to improve planning of supply, service and shipments;

measures which require significant capital expenditures and which are accomplished over a long time period (frequently several years). This group includes measures to improve the distribution of production and changing of production processes of existing enterprises.

The same shipment during the current period may be regarded as efficient (for example, shipment of unprocessed wood from Siberia to the Ukraine), but when considered for the long term it may be regarded as inefficient (construction of woodworking enterprises in the region where timber is procured and lumber is shipped are feasible).

Elimination of the main mass of inefficient shipments is possible only as a result of working out and implementation of measures of the second group.

Analysis of freight shipment by rail and other types of transport shows that a significant part of inefficient shipments occurs due to the dispersion of product distribution by enterprises subordinate to different ministries and agencies. For this reason counter, split, repeated and excessively long shipments of construction materials are permitted (especially reinforced concrete products, brick, crushed stone, and so on), fuel (pit coal and oil), machines, equipment, forest products and other goods. Counter shipments of homogeneous or interchangeable types of products are also permitted (for example, Donetsk and Moscow and Pechora and Kuznetsk coal, gasoline of different brands, cement and so on). A number of oblasts and economic regions export and at the same time import a large amount of the same product and frequently over excessively long distances. All these types of inefficient shipments can be eliminated without loss to the economic activity of enterprises by coordinating the delivery plans of different ministries and agencies and by organization of interchangeable operations of a homogeneous product.

Further development of routing of shipments, specifically, using the experience of the Belorussian Railroad, is of important significance for elimination of split shipments.

An important measure to reduce inefficient shipments is to use scheme of normal directions of freight traffic volumes worked out by using computers. The use of computers for these purposes permits one to process the schemes of normal freight traffic volumes for all the main types of goods and to arrange annual correction of them with regard to current changes in the country's economics.

Regionalization of production and shipments of national economic products and establishing optimum zones for distribution of the products of individual enterprises and production associations contributes largely to elimination of inefficient shipments. Correct specialization and cooperation of production and establishment of efficient long ties between suppliers and customers are of important significance in this case.

An effective means of making shipments more efficient includes further improvement of the distribution of the country's productive forces by economic regions. It primarily envisions the need for optimum distribution of the sources of raw material and production and also proper consideration of the transport factor when designing new and reconstructing existing enterprises. Especially large number of excessively long shipments is caused by deficiencies in the geographic distribution of production. Approximately five percent of goods shipped over a distance of more than 3,000 km determine 25-30 percent of the freight traffic turnover and more than half of all the long-range shipments goes to basic goods (pit coal, ferrous metal and petroleum, forest and grain products). Counter shipments of reinforced concrete products, ferrous metals and other goods are explained by deficiencies in specialization of a number of products.

Energy- and heat-consuming products have been significantly developed in a number of regions of the country with a limited local fuel base. This causes a large number of excessively long shipments of fuel from remote regions, specifically, of pit coal from Western Siberia to the European USSR. Intensive development of the sectors of the national economy in the Urals, in Western and Eastern Siberia, in the Far East and in Kazakhstan will smooth somewhat the irregularity of production distribution in our country. Construction of the Baikal-Amur Mainline Railroad, introduction into operation of which will permit the existing and newly constructed enterprises of Siberia and the Far East to be provided with local raw material, is of special significance. At the same time, there may also be some increase of long-range shipments of such goods as timber, petroleum, coal, construction materials and so on with regard to construction of BAM [Baikal-Amur Mainline Railroad].

The 25th CPSU Congress posed the task of further improving the distribution of the country's productive forces and putting into operation a number of large enterprises and industrial complexes, especially in the eastern regions, during the 10th Five-Year Plan. The main trends of development of the national economy of the USSR for 1976-1980 envision "to ensure the increase of oil and gas production, aluminum production, more than 90 percent of the increase of coal mining, approximately 80 percent of the increase of copper production, 45 percent of the increase of cellulose production and approximately 60 percent of the increase of cardboard production planned for the five-year plan in these regions."* Development of large petroleum refining plants in some regions and extensive construction of oil pipelines will significantly reduce the excessively long shipments of petroleum products by rail.

Measures to improve the equipment and technology of production and transport--introduction of new equipment, construction of concentration combines, processing of timber in timber procurement regions, output of new materials and so on--are of important significance for making shipments more efficient. At the same time, scientific and technical progress have a different planning effect on making shipments more efficient. Thus, coal concentration, which contributes to an increase of the utilization factor of the carrying capacity of rail cars, leads to an increase of repeat shipments.

An enormous reserve for making shipments more efficient is hidden in the proper development of all types of transport, economically justified distribution of

---

*"Materialy XXV s"yezda KPSS" [Proceedings of the 25th CPSU Congress], Moscow, Politizdat, 1976, 223 pages.

shipments among them, construction of straightening lines and an increase of the carrying capacity of operated railways.

When working out measures to make shipments more efficient, one should take into account that significant changes will occur in the near future in the structure of the country's fuel balance, specifically the specific weight of oil and gas will increase significantly (up to 70 percent). In this regard the possibilities of using fuel for generation of electric energy at production points at subsequent transmission of it by LEP to remote regions are being expanded. This will make it possible to do away with delivery of fuel to that point for local thermoelectric power plants. Specific changes will also occur in the use of forest products (an increase of processing wood in the eastern regions, extensive utilization of wastes and spoilage, expansion of the output of plywood, packing cardboard and so on are envisioned), in production of mineral fertilizers (increasing the specific weight of concentrated and complex fertilizers), construction materials (development of new enterprises) and so on. Raising the quality of produced products will also have a definite effect on making transport-economic ties more efficient.

The feasibility of one or another measure to make shipments more efficient is established on the basis of technical and economic calculations. Proper consideration of the transport factor is of important significance in this case, i.e., consideration of expenditures on shipment of goods which are contained in the total cost of a product at the point of consumption. Thus, the cost of a product at the point of its consumption due to high transport delays may be so significant with a long shipping distance that it becomes more feasible to organize production of this product locally, although its cost will be higher here than that of production in other regions. Proper consideration of the transport factor also contributes to optimum distribution of productive forces, efficient concentration of production and specialization and cooperation of it.

6521
CSO: 8144/0359

MAIN INDICATORS OF THE ANNUAL PLAN OF SHIPMENTS BY RAIL AND METHODS OF CALCULATING THEM

Moscow EKONOMIKA I PLANIROVANIYE ZHELEZNODOROZHNOGO TRANSPORTA: EKONOMIKA ZHELEZNODOROZHNOGO TRANSPORTA in Russian Part 1, 1978 signed to press 20 Sep 78 pp 97-99

[Excerpt from Chapter 9 of the book "Ekonomika i planirovaniye zheleznodorozhnogo transporta: ekonomika zheleznodorozhnogo transporta," Izdatel'stvo Transport, 15,000 copies, 352 pages]

[Excerpt] 9.3. Determining the Scope of Dispatch and Arrival of Individual Goods

Comparison of the road plan of shipments begins with determination of the scope of dispatch (shipment) of goods. The scope of dispatch is established from production plans, supply and turnover of merchandise. Feasible and possible shipment by other types of transport is taken into account in this case. Detailed calculations of the future scope of shipment by rail are made only for main mass goods.

Coal resources for the planned period are determined on the basis of the production plan and the coal export plan from the pits (unshipped residues for the beginning of the planned period). Consumption for the mine's own needs, losses during concentration and briquetting, and shipments by other types of transport and industrial sidings are excluded from this total amount of coal. Consequently, that part of coal which will not be shipped by general-purpose railroads is excluded. At the same time transshipping of coal from river and maritime transport to rail transport and shipments of coal from concentration plants are additionally included in the volume of shipments if these shipments are available on the given railroad.

Example. There is a deposit of pit coal in the region of the railroad. Mining of the coal according to plan comprises 5.6 million tons and export of unshipped coal residues from the pits comprises 500,000 tons. The coal consumption norm for the mine's own needs is established at the rate of 1.5 percent of its production, which comprises (5,600·1.5):100 = 84,000 tons.

The coal concentration plant and thermoelectric power plant, connected to the coal mines by spur tracks of noncommon use, are located in the coal production region.

The plan for concentrating the coal is 2.1 million tons, losses of coal during concentration and losses of coal during briquetting are five percent, or (2,100·5): :100 = 105,000 tons. This means that the yield of concentrated coal will be equal to 2,100 - 105 = 1,995,000 tons. The concentrated coal is exported to other regions. The need of the local electric power plant for coal is 650,000 tons.

Under the given conditions, part of the pit coal not transported over general-purpose tracks comprises:

Mine's own needs	84,000 tons
Transport over spur tracks to concentration plant	2.1 million tons
Transport over spur tracks to electric power plant	650,000 tons
Total	2,834,000 tons

Consequently, 5.6 million + 500,000 + 1,995,000 - 2,834,000 = 5,261,000 tons of coal for shipment over general-purpose tracks.

The volume of shipments is determined separately for petroleum products by crude petroleum and petroleum products. The resources of petroleum and petroleum products are established on the basis of the oil production and refining plan. The unexported residues are determined in this case. The consumption of petroleum products for the own needs for the fields and petroleum plants, pumping over local and mainline pipelines and direct water shipments accomplished without the participation of railroads are excluded from the total resources. Transfer of petroleum products to the customers at the point of production and arrival of this freight to the railroads from water and pipeline transport are also taken into account.

The scope of shipment of coke, pig iron, commercial steel ingots, the products of rolling mills (rolled steel) and iron and manganese ore is determined by goods of the metallurgical industry. The volume of shipment of forest products is taken into account separately by round timber, lumber, ties, prefabricated houses, plywood and similar woodworking products.

The scope of shipment of cement, brick, stone, crushed stone, gravel, construction sand, roofing materials, refractory brick, ballast, industrial raw material of mineral origin and casting sand is determined with respect to mineral construction materials.

The volume of shipments of most construction products is calculated on the basis of the production plan and for some types of construction materials on the basis of the norms of consumption of the material per million rubles of construction and installation work. During the past few years, an average of 13,000 tons of shipments of mineral construction materials by rail in the USSR have gone to each million rubles of construction and installation work.

The volume of grain shipments is determined on the basis of state procurement plans and processing the grain into flour and groats by grain products. Grain deliveries to industry (alcohol, brewing, oil-pressing, combifeed and others) and also shipments for forage purposes are taken into account. The scope of flour and groats shipments is determined on the basis of their planned production and distribution by oblasts, krays and republics with deduction of part of the flour and groats not subject to shipment.

The scope of arrival of individual goods is established on the basis of the needs of enterprises of a region of attraction for raw material, fuel, materials and other products to provide a planned scope of production and turnover of merchandise.

9.4. Determining the Reception and Turnover of Goods

One must know the volume of shipments by import, export and transit to determine the reception and turnover of goods.

Railroads establish the scope of shipment and arrival and import and export of goods jointly with the organizations located in the sphere of influence of the railroad on the basis of transport-economic balances. Existing schemes of normal directions of freight traffic volumes and also other data obtained from materials of economic investigation are taken into account in this case.

Railroads themselves are unable to determine the volume of transit shipments since this would require that they know the scope of interrayon exchange on a countrywide scale and have a number of other data which the individual railroad usually does not have at its disposal. Therefore, the scope of reception and turnover of goods is established by MPS (based on data of interregional exchange for the basic mass goods and drafts of plans for import and export of goods by railroads) and reports them to the railroads.

Reception and turnover (general and individual types of goods) are determined for each junction point between adjacent railroad points. Reception of goods by the junction point of one of the railroads is equal to turnover by an adjacent railroad at the same juntion point.

The plan for reception and turnover of goods by junction points is established in tons for the year and in the average number of rail cars per day.

Example. The Eastern Siberian Railroad is supposed to ship 23 million tons of coal according to plan. The total need for coal of the sphere of influence of the railroad is equal to 13,200,000 tons. Let us assume that 700,000 tons is sent to points located east of Petrovskiy Zavod Station (Figure 9.2) according to the plan of interregional exchange and the remaining amount of coal, minus the needs of the region of the railroad according to the scheme of normal freight traffic volume, should be sent in the western direction through the junction points of Mariinsk and Mezhdurechensk.

Under the given conditions, the scope of turnover in the easterly direction through Petrovskiy Zavod Station comprises 700,000 tons, while it will be equal to 23 million minus (13,200,000 + 700,000) = 9.1 million tons in the westerly direction through junction points Mariinsk and Mezhdurechensk.

Export between these two points should be determined with the calculation that the shortest distance of shpping the coal to the customer is provided. In our example

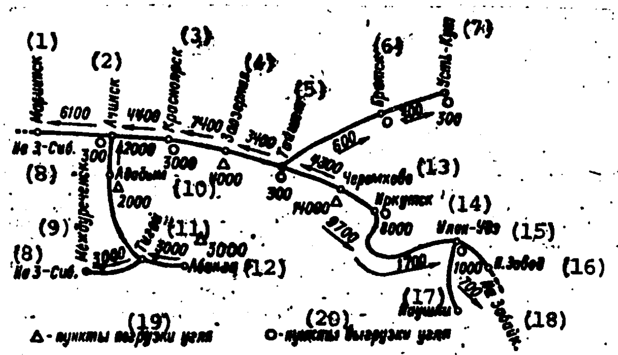

Figure 9.2. Diagram of Coal Shipment Over Eastern Siberian Railroad

Key:

1. Mariinsk
2. Ochinsk
3. Krasnoyarsk
4. Zaozernaya
5. Tayshet
6. Bratsk
7. Ust'-Kut
8. To Western Siberian Railroad
9. Mezhdurechensk
10. Adadym
11. Tigey
12. Abakon
13. Cheremkhovo
14. Irkutsk
15. Ulan-Udze
16. P. Zavod
17. Naushki
18. To Transbaikal Railroad
19. Coal loading points
20. Coal unloading points

three million tons of coal should be exported through Mezhdurechensk Station and 6.1 million tons should be exported through Mariinsk Station.

The scope of reception and turnover of coal through other railroads and junction points is established in similar fashion.

6521
CSO: 8144/0359

ECONOMIC ANALYSIS OF THE QUALITY OF UTILIZING THE HARDWARE OF RAILROADS

Moscow EKONOMIKA I PLANIROVANIYE ZHELEZNODOROZHNOGO TRANSPORTA: EKONOMIKA ZHELEZNODOROZHNOGO TRANSPORTA in Russian Part 1, 1978 signed to press 20 Sep 78 pp 135-154

[Chapter 14 from the book "Ekonomika i planirovaniye zheleznodorozhnogo transporta: ekonomika zheleznodorozhnogo transporta," Izdatel'stvo Transport, 15,000 copies, 352 pages]

[Text] 14.1. Characteristics of Economic Analysis of Utilization of Hardware

When comparing the operational plan and analysis of fulfilling it, economic analysis of a change of one or another qualitative indicators of the use of railroad hardware becomes necessary. This analysis is carried out on the basis of the general method of the comparative economic effectiveness of the planned measures (see Chapter 5). Operating expenses (the cost of shipments), capital investments and the cost of needed circulating funds for goods en route should be determined and compared for the operating conditions being compared.

The task of economic analysis essentially reduces to establishing the effect of variation of indicators on the level of cost of shipments, the extent of capital investments and also the time required for delivery and preservation of transported goods and the length and comfort of a trip for passengers. Analysis of the effect of the quality of using hardware on the financial results of railroad operation (income, profit and profitability) is of important significance.

The economic effect due to improving the qualitative indicators of operational work is usually achieved by implementation of various organizational-technical or reconstructive measures in transport and in the national economy which frequently require significant expenditures. For example, an increase of the weight and speed of freight trains in a given direction is frequently related to expenditures for lengthening the station receiving-dispatching tracks, introduction of more powerful locomotives, laying heavy type rails in the track and so on. An increase of the static load of rail cars is achieved by the cost of additional expenditures in transport of the freight shipper, related to an increase of the idle time of rail cars, building up their sides (during shipment of sugarbeets and peat, for example), packing bulk freight with rollers and so on. A reduction of cost in shipment of freight in large-capacity gondolas requires additional expenditures to reinforce the capacity of car dumpers. Special rail cars, operation of which usually makes transport more expensive than universal rail cars, are needed to increase the preservation of many transported goods.

When the achieved economic effect is compared to the additional expenditures by which it is achieved, one must observe the principle of a unified complex national economic approach to economic analysis of the quality of utilizing the hardware of railroads. This means that the saving must be commensurable with expenditures on the scale of the entire national economy and not only within the limits of transport or an individual enterprise.

Improving the quality of operational work can also be achieved by organization-technical measures that do not require additional expenditures. In this case the effectiveness of measures can be estimated by the extent of the effect (saving) achieved.

When comparing two operational measures, it is feasible to determine the additional expenditures and saving for one of them compared to the other. Implementation of a new measure will be effective if the saving achieved from it is greater than the additional expenditures.

Absolute expenditures must be determined for each of them when comparing several enterprises. The most effective will be the measure, expenditures on which are the least. It is sufficient in this case to take into account only those expenditures which vary according to the measures being compared.

Proper economic comparison of different measures permits one to select the most effective of them and to ensure high quality of operational work when reducing expenditures of the national economy for shipments.

Example. The average daily mileage will increase and the circulating time of a rail car will be reduced as a result of reconstructing a railroad line 3,000 km long. In this case the average rate of movement of the freight will increase from 250 to 283 km per day. The annual freight traffic volume on the line is 36.5 million tons and the average calculated price of one ton of transported freight is 200 rubles. A total of 65 million rubles is required to accomplish the reconstructive measures. By reducing the cost of shipments, the annual operating expenses of the railroads are reduced by five million rubles. One must determine whether the planned measures are effective.

If one does not take into account the saving from reducing the cost of circulating funds for freight en route, the reconstructive measures are ineffective since the calculated payback period of the additional capital investments (65:5 = 13 years) is higher than the normative period (10 years). However, this calculation is insufficient. One must also take into account the economic effect from acceleration of the circulation of the freight mass, which comprises

$$\frac{200 \cdot 36,5 \cdot 10^6}{365}\left(\frac{3000}{250}-\frac{3000}{283}\right)=28 \text{ million rubles}$$

The reconstructive measures will be effective with regard to the saving from reducing the cost of the freight mass simultaneously en route since the calculated payback period is less than the normative period [(65 - 28) ÷ 5 + 7.4 years].

14.2. Improving the Utilization of the Load Capacity of a Rail Car

The quality of utilizing the load capcity of rail cars is determined by their static and dynamic loads.

Static load is characterized by the amount of freight on the average per rail car during loading (dispatch). It is calculated by dividing the number of loaded tons of freight by the number of rail cars delivered for loading.

The dynamic load, unlike static load, shows the average load of the rail car with regard to its mileage. The dynamic load of loaded and operating rail cars is distinguished. The former is determined by the ratio of net ton-kilometers to rail car-kilometers of loaded rail cars, i.e., only the mileage of the rail cars in the loaded state is taken into account. The second takes into account the mileage of both loaded and empty rail cars. It is determined by the ratio of net ton-kilometers to the total mileage of the rail cars, i.e., to the sum of loaded and empty rail car-kilometers.

The indicator of the dynamic load of a loaded rail car more fully characterizes the utilization of its load capacity compared to the indicator of static load. These indicators cannot coincide. If rail cars with greater load are dispatched over longer distances, the dynamic load will exceed the static load and vice versa.

The dynamic load of a loaded rail car is always higher than that of an operating rail car. The difference, all things being equal, is less, the lower the percentage of empty runs of the rail car.

An increase of the static and dynamic loads of a rail car is one of the most important reserves for improving the utilization of its load capacity. The higher the load, the fewer rail cars and locomotives required in the fleets and the lower the expenses for their maintenance and repair and also for shunting work. Expenditures for maintenance of locomotive and forming-up brigades and for fuel and electric energy are also reduced. There is also an economy of capital investments required for acquisition with regard to reducing the need for rolling stock.

A total of 30-35 percent of operating expenses with electric traction and 26-31 percent with diesel traction is related to rail car load under average network operating conditions. An increase of rail car load by one percent reduces the cost of shipments by an average of 0.28-0.33 percent throughout the network.

The economic effect from increasing the rail car load depends largely on the distance of shipment. Under specific conditions of operation, the saving can be determined individually by initial-final operations and by operations of movement and reforming of trains with regard to the direction of shipment (loaded or empty).

Example. Determine the saving of operating expenses while increasing the static load of a boxcar at the dispatch station from 40 to 42 tons. The freight travels through the sections of the division in the freight direction counter to the flow of an empty boxcar. The shipping distance within the division is 200 km. The expenses per rail car, related to fulfillment of the initial operation, are equal to 5.14 rubles, the expense rate per rail car-kilometer of loaded run of rail cars is 1.58 kopecks and that of an empty car is 0.78 kopeck.

The saving of operating expenses for each 1,000 tons of freight for the railroad division comprises:

for the initial operation

$$\left(\frac{1000}{40}-\frac{1000}{42}\right)5,14=6,17 \text{ rubles};$$

for operations of movement and reforming of trails

$$\left(\frac{1000}{40}-\frac{1000}{42}\right)\left(\frac{1,58+0,78}{100}\right)200=5,66 \text{ rubles}.$$

The total sum for all operations is 6.17 + 5.66 = 11.83 rubles.

The saving of operating expenses depends not only on the shipping distance and the absolute scope of increasing the rail car load but also on the initial level of loading from which this increase occurred. For example, for the same conditions but with an increase of load from 30 to 32 tons, the saving will be almost twofold greater and will comprise 20.5 rubles.

The amount of the saving from increasing the load can be calculated on the basis of the number of car-kilometers saved and the consolidated expense rate related to this measure. An average of 2.4-3.2 kopecks is saved on each car-kilometer saved.

Example. Determine the saving of operating expenses upon loading of 1,000 tons of freight by the consolidated method at the station, the average shipping distance of which comprised 900 km. With 40 percent empty run to loaded rail cars and with an increase of load from 40 to 42 tons, the following will be saved

$$\left(\frac{1000\cdot 900}{40}-\frac{1000\cdot 900}{42}\right)1,4=1500 \text{ car-km}$$

The saving of operating expenses with a saving of 2.4 kopecks for each car-kilometer will comprise 2.4·1,500 ÷ 100 = 36 rubles.

If the load is increased from 30 to 32 tons per car upon shipment of 1,000 tons of a different, lightweight cargo from the station, then under the same conditions the following will be saved

$$\left(\frac{1000\cdot 900}{30}-\frac{1000\cdot 900}{32}\right)1,4=2625 \text{ car-km}$$

and the saving of operating expenses will comprise 2.4·2,625 ÷ 100 = 63 rubles.

The saved rail cars can be used for above-plan shipment with an increase of load. This will ensure that the station receives additional income according to the established calculated prices per ton of shipment and an increase of profits.

Moreover, if shipments are paid for by the car rate, the release of cars will provide a saving to the freight shipper in tariff payments.

14.3. Acceleration of Freight Car Circulation

The circulating time of a rail car is one of the most important indicators of its utilization. This indicator characterizes the time of the total operating cycle of the rail car from one dispatch to the next dispatch on the railroad network. However, not all rail cars complete a total operating cycle (from shipment to shipment on railroads and on railroad divisions). Therefore, the circulating time of a railcar is defined here as the average expenditure of car-hours or car-days per loaded and presumably loaded rail car. Division of it into individual components is of important significance for planning and analysis of fulfillment of the rail car circulating time. The circulating time of a rail car can be represented by three, four or five components. Five components characterize the time the rail car is:

in trains on waysides, i.e., in motion;

in trains at intermediate stations;

at service stations with transloading;

at service stations without transloading;

at loading and unloading stations.

All these components are contained in the indicated sequence in the developed formula for rail car circulation

$$O_{в}=\frac{1}{24}\left[\frac{l_{п}}{v_{т}}+\left(\frac{l_{п}}{v_{у}}-\frac{l_{п}}{v_{т}}\right)+\frac{l_{п}}{L_{м}}t_{пер}+\left(\frac{l_{п}}{L_{в}}-\frac{l_{п}}{L_{м}}\right)t_{тр}+\kappa_{м}t_{гр}\right], \qquad (14.1)$$

where O_v is the circulating time of the rail car, days, l_p is a complete trip of the rail car or the distance which the rail car covers during the circulating time, km, v_t is the average running speed of freight trains, km/hr, v_u is the average section speed of freight trains, km/hr, L_n is the route leg or average distance covered by the rail car between servicing stations with transshipment, km, L_v is the rail car leg or the average distance covered by the rail car between all servicing stations (with and without transloading), km, t_{per} is the average time a transit rail car is at servicing stations with transloading, hr, t_{tr} is the average time a transit rail car is at servicing stations without transloading, hr, k_m is the coefficient of local work which indicates the ratio of the volume of loading and unloading of rail cars to total work, i.e., to loading on the network or to the sum of loading and reception of loaded rail cars on the railroad and division. For a network $k_m = 2$ and for roads and divisions $0 < k_m < 2$, and t_{gr} is the average time a car is at loading and unloading stations for one freight operation, hr.

The circulating time of a car is frequently determined by a three-term formula, which has the following form:

$$O_{в}=\frac{1}{24}\left(\frac{l_{п}}{v_{у}}+\frac{l_{п}}{L_{в}}t_{тех}+\kappa_{м}t_{гр}\right), \qquad (14.2)$$

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000300080044-2

where t_{tekh} is the average time a transit car (with and without transloading) is at servicing stations, hr.

As can be seen from formulas (14.1) and (14.2), the circulating time depends to a large degree on a complete trip of the rail car, determined by the formulas:

$$l_{п}=l_{гр}\left(1+\alpha^{гр}_{пор}\right) \qquad (14.3)$$

or

$$l_{п}=\frac{l_{гр}}{\left(1-\alpha^{общ}_{пор}\right)}, \qquad (14.4)$$

where l_{gr} is the loaded weight of a car or the distance which the car travels during circulating time in the loaded state, km, α^{gr}_{por} is the ratio of empty run of cars to a loaded run, and α^{obshch}_{por} is the ratio of empty run of a car to the total run.

A complete trip of a car can also be represented in the form of the sum of loaded and empty trips.

A loaded trip of a car is directly proportional to the average distance of freight shipments, dependent on the distribution of productive forces in the country and on the quality of shipment planning. An empty trip characterizes the average distance which a car covers from the unloading point to the loading point.

Complete, loaded and empty trips are the ratio of the total, loaded and empty car-kilometers, respectively, to the operation of the network, road or division in cars. In 1975 a complete trip of a car in the network was increased by more than 4 percent compared to 1970 and comprised 1,480 km, while the loaded trip increased from 1,014 to 1,056 km.

The length the rail cars are at intermediate, servicing and freight stations, the running speeds of trains and the length of the rail car and route legs also have a significant effect on the circulating time of a car. The length of the route leg depends on the level of routing of shipments from the loading points and the quality of train forming-up plans. The level of the scope of loading by dispatch routing was increased from an average of 39.2 percent throughout the network in 1970 to 46.1 percent in 1975.

The time a transit car is at servicing stations with transloading characterizes the average idle time of transit cars at a single servicing station which are unhooked from through trains, i.e., they arrive with trains for reforming. In 1975 this indicator comprised 8.77 hr in the network compared to 8.46 hr in 1970.

The time a transit car is at servicing stations without transloading characterizes the average time a car is at a single servicing station in transit trains. This indicator increased from 1.55 to 1.83 hr throughout the network in 1975 compared to 1970.

The time a transit car is at servicing stations characterizes the mean weighted time transit cars are located at these stations with and without transloading.

In 1975 this indicator was equal to 4.29 hr throughout the network compared to 4.15 hr in 1970.

The time a rail car is at loading and unloading stations characterizes the mean idle time of a local car per freight operation. This time is sometimes determined on the average per car (idle time of a local car) without respect to a freight operation. The first indicator is usually employed for planning and analysis of rail car utilization at stations. Its value was equal to 20.78 hr in 1970, but increased to 22.66 hr in 1975.

The local work coefficient also has a significant effect on the circulating time of a car on railroads and divisions. Its value is determined by variation of the ratio of local and transit car traffic volumes on roads and divisions.

Thus, the circulating time of a car depends on many economic and operating factors. It is closely related to the quality of planning freight shipments and by the methods of organizing operational work, especially to a traffic schedule and the train forming-up plan, organization of work of servicing stations and maintenance points and to organization of freight operation at stations and on spur tracks. Therefore, the circulating time of a car is the most important indicator of the quality of car fleet utilization which encompasses almost all aspects of the operational and economic work of railroads.

The ratio of individual components of rail car circulation on USSR railroads varied significantly (Figure 14.1) during the period 1951-1975 with a total reduction by 22 percent (from 7.49 to 5.84 days). The fraction of time en route was increased from 18 to 23 percent, the fraction the car was at servicing stations was reduced (from 46 to 34 percent) and the fraction of rail car idle time at loading and unloading stations was increased from 25 to 34 percent. It should be noted that rail car circulation increased somewhat during the Ninth Five-Year Plan, but it should be reduced during the 10th Five-Year Plan.

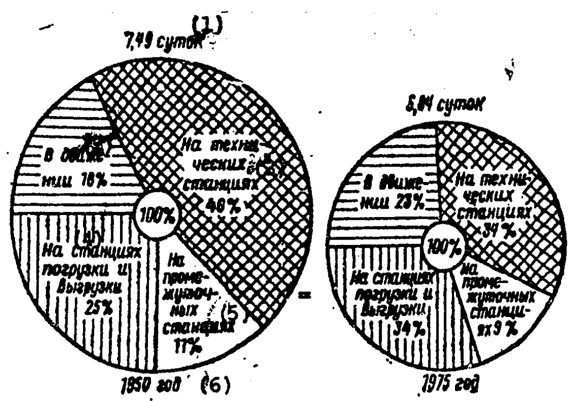

Figure 14.1. Circulating Time of Rail Car With Division By Elements

[Key on following page]

[Key continued from preceding page]

1. Days
2. En route
3. At servicing stations
4. At loading and unloading stations
5. At intermediate stations
6. Year

Acceleration of rail car circulation is characterized by high economic effectiveness since it permits one to provide a maximum increase of the carrying capacity for each ruble of basic production funds, i.e., it improves the index of fund payment.

When the rail car circulation is accelerated, the opportunity is provided to perform a large volume of work and to accelerate delivery of goods by the rail car fleet. For example, if the working rail car fleet comprises 2,700 units on a railroad division and the circulation time is two days, then the mean daily work of the division (dispatch plus reception of loaded rail cars) comprises 2,700 ÷ 2 = = 1,350 rail cars. If the rail car circulation is reduced by 10 percent, i.e., by 0.2 day, the division can dispatch and receive 2,700:1.8 = 1,500 rail cars with the same rail car fleet. Delivery of goods is also accelerated.

If the mean dynamic load of an operating rail car is equal to 35 tons, the volume of the freight mass simultaneously in shipment is reduced in the division by 2,700·35·0.2 = 18,900 tons. With an average calculated price of one ton of freight at 200 rubles, the cost of the freight mass is reduced by 200·18,900 = 3.78 million rubles.

The total economic effect from acceleration of rail car circulation is expressed by a saving:

operating expenses of railroads dependent on the volume of shipments;

capital investments in the rail car fleet, and development of its repair base and in station tracks (with reduction of the rail car idle time at stations);

circulating funds of the national economy for freight en route;

operating expenses of railroads not dependent on the volume of shipments if the saved rail cars are utilized for additional shipments.

Moreover, acceleration of rail car circulation contributes to an improvement of the financial results of railroad operation due to receipt of additional profits from above-plan shipments.

The saving of operational or reduced expenditures of railroads as a result of accelerating rail car circulation is usually determined as the product of the specific value of the corresponding expenditures per car-hour by the number of car-hours saved.

Expenditures per car-hour can be determined:

by the operating expenses for renovation and repair of rail cars during their service life;

by reduced expenditures with regard to the operating expenses and capital investments to the rail car fleet, to development of their repair base and to station tracks;

by reduced expenditures with regard not only to current expenses and capital investments but also with regard to the cost of the freight mass in the rail car, i.e., with regard to circulating funds for freight en route per car-hour.

The expenditures per car-hour fluctuate from an average of 5.5 to 40 kopecks for all types of rail cars, except constant-temperature cars. These expenditures vary in the range of 5.5-30 kopecks without regard to the cost of the freight mass and they vary in the range of 5.5-15 kopecks without regard to the cost of the freight mass and of capital investments in station tracks.

The number of car-hours saved per day $\Delta\Sigma nt_{ek}$ is calculated by the formula

$$\Delta\Sigma nt_{\text{эк}} = U_{\text{р}}\Delta O_{\text{в}}\cdot 24, \qquad (14.5)$$

where U_r is the average operation of the network, railroad or division per day, rail cars and ΔO_v is acceleration of rail car circulation, days.

Example. Determine the economic effect from acceleration of rail car circulation in the division with average daily dispatch of 1,500 rail cars prior to acceleration and reception of 2,500 loaded cars from other divisions. The circulating time of the rail car is reduced by 0.1 day (from 2.1 to 2 days) due to reduction of idle times at the stations.

The saving of car-hours per day comprises $(1.5 + 2.5)10^3\cdot 0.1\cdot 24 = 9{,}600$, while the saving of the car fleet is $9.6\cdot 10^3 : 24 = 400$ rail cars.

With an expense rate of 5.5 kopecks per car-hour, the annual saving of operating expenses for renovation and repair of rail cars comprises

$$\frac{5{,}5\cdot 9{,}6\cdot 10^3\cdot 365}{100} = 193 \text{ thous. rubles.}$$

With an average cost of a rail car of 6,550 rubles, the saving of capital investments in the rail car fleet will be $6{,}550\cdot 400 = 2.62$ million rubles and the saving of capital investments to its repair base (10 percent of the cost of the rail car fleet) will be $0.1\cdot 2.62\cdot 10^6 = 262{,}000$ rubles.

To ensure normal conditions of shipments per rail car, the station tracks should be no less than triple the length of each rail car (an average of 16 meters) i.e., $3\cdot 16 = 48$ meters. With the cost of 1 km of station tracks at 250,000 rubles, the saving of capital investments in their development comprises $(250\cdot 10^3\cdot 48\cdot 400):1{,}000 = 4.8$ million rubles.

The total saving of capital investments is determined by the sum

$$2{,}62 + 0{,}262 + 4{,}80 = 7{,}682 \text{ million rubles.}$$

With the calculated cost of one ton of freight at 200 rubles and with a dynamic load of an operating rail car at 35 tons, the saving from reducing the cost of the freight mass en route comprises 200·35·400 = 2.8 million rubles.

The saving of reduced expenditures with a normative coefficient of effectiveness of 0.1 will be equal to:

without regard to the cost of the freight mass

$$193 + 0{,}1 \cdot 7682 = 961{,}2 \text{ thous. rubles.}$$

with regard to its cost

$$193 + 0{,}1\ (7682 + 2800) = 1241{,}1 \text{ thous. rubles.}$$

The volume of additional freight traffic turnover $\Delta\Sigma Pl$ carried out by the operating rail car fleet saved as a result of accelerating circulation annually, in the annual saving of operating expenses ΔE_{nez} not dependent on the scope of shipments are determined by the formulas

$$\Delta\Sigma Pl = \frac{P^{\text{гр}}_{\text{дин}}\, S_{\text{в}}\, \Delta n_{\text{в}} \cdot 365}{(1+\alpha^{\text{гр}}_{\text{пор}})}; \tag{14.6}$$

$$\Delta Э_{\text{нез}} = \frac{c_{\text{нез}}\, \Delta\Sigma Pl}{10 \cdot 100}, \tag{14.7}$$

where P^{gr}_{din} is the dynamic load of a loaded car, tons, S_v is the average daily run of a rail car, km, Δn_v is the number of cars of the operating fleet saved and c_{nez} is the part of the cost related to expenses not dependent on the scope of shipment, kopecks/10 t-km.

For example, if the total cost of shipments is 2.5 kopecks/10 t-km, of which 60 percent (1.5 kopecks) goes to dependent expenses and 40 percent (1.0 kopecks) goes to independent expenses, then above-plan shipment in the part of operating expenses is only 1.5 kopecks rather than 2.5 kopecks per 10 t-km. This means that each additional 10 t-km will yield 1 kopeck of saving.

Additional profit $\Delta П$ from above-plan shipments can be calculated by the formula

$$\Delta П = \frac{(c_{\text{дох}} - c_{\text{зав}})\, \Delta\Sigma Pl}{10 \cdot 100}, \tag{14.8}$$

where c_{dokh} is the average income rate from freight shipments by tariff, kopecks/10 t-km and c_{sav} is the dependent part of the cost of freight shipments, kopecks/10 t-km.

Example. Determine the conditional economic effect from acceleration of rail car turnover of the operating fleet in a division if the average dynamic load of a loaded car is equal to 49 tons, the empty run of the car with respect to a loaded car is 40 percent and the average daily run of the car is 250 km. With the same initial conditions as in the previous example, we find

$$\Delta\Sigma Pl = \frac{49 \cdot 250 \cdot 400 \cdot 365}{(1+0.4)} = 1.28 \text{ billion t-km},$$

$$\Delta Э_{exp} = \frac{1.0 \cdot 1.28 \cdot 10^9}{10 \cdot 100} = 1.28 \text{ million rubles.}$$

With an average income rate according to tariff of 4 kopecks/10 t-km and with the dependent part of the cost at 1.5 kopecks/10 t-km

$$\Delta П = \frac{(4.0-1.5)\,1.28 \cdot 10^9}{10 \cdot 100} = 3.2 \text{ million rubles annually.}$$

Thus, each rail car of the operating fleet saved will yield $3.2 \cdot 10^6 : 400 = 8,000$ rubles annual profit, which comprises $8,000 : 365 \cdot 24 = 91.3$ kopecks per car-hour of physical rail car.

The additional economic effect from acceleration of rail car circulation related to making saved rail cars available for above-plan shipments cannot always be completely realized in practice. Therefore, there are suggestions that this saving be taken into account, for example, in one-half measure.

The expenditures caused by implementation of measures to accelerate rail car circulation must be taken into account in calculations. Thus, if the reduction of rail car idle time at the station is achieved by using an additional number of loading-unloading mechanisms, which results in an increase of expenditures for their maintenance and depreciation, these expenditures must be deducted from the saving achieved.

14.4. Reduction of Empty Run of a Freight Car

An empty run is related to unproductive operation of rail cars since transport production is not created as a result of its fulfillment. The percentage (coefficient) of empty run is determined by the ratio to loaded run and to the total run of rail cars. The first indicator is calculated by dividing the car-kilometers of an empty run by loaded car-kilometers and the second is calculated by dividing empty car-kilometers by the total car-kilometers of run of loaded and empty cars. The values of these indicators are very stable over time. During the period 1951-1975, the coefficient of empty run to total run varied in the range of 27-28.7 percent and the ratio to loaded run varied in the range of 37-41 percent.

The scope of the empty run of rail cars is determined mainly by the distribution of productive forces over the country's territory, by the nature of the economic ties between its individual regions and by the quality of regulation of the rail car fleet.

A reduction of empty run yields a large saving of operating expenses: expenditures for fuel and electric energy and maintenance of locomotive brigades and shunting work are reduced. Moreover, a saving of capital investments in rolling stock is achieved since the demand for rail cars and locomotives is reduced and accordingly expenditures for their repair and depreciation are reduced. A reduction of empty run for each 1,000 car-kilometers yields a saving of approximately 8 rubles. A reduction of empty run of a rail car by one percent under average network conditions reduces the cost of shipments by 0.18-0.20 percent.

Example. Determine the saving of operating expenses on the railroad with reduction of empty run of the rail car from 40 to 38 percent, i.e., by 2 percent, with respect to a loaded rail car. With an induction coefficient of 0.18, the cost of shipments will be reduced by 2·0.18 = 0.36 percent. With an average cost of shipments of 2.5 kopecks/10 t-km, this will yield a saving of 2.5·0.36:100 = 0.009 kopeck/10 t-km. If the average distance of freight shipments within the railroad is equal to 500 km, then a saving of operating expenses per million tons of shipped freight will be achieved in the amount

$$\frac{1 \cdot 10^6 \cdot 500 \cdot 0{,}009}{10 \cdot 100} = 4{,}5 \text{ thous. rubles.}$$

The percentage of empty run is different for different types of rail cars. It is least for boxcars and highest for tank cars. This is explained by the fact that boxcars are more universal. Many types of freight are shipped in them, whereas, for example, tank cars are used to ship only several types of liquid freight.

Development of optimum schemes for regulation of empty car traffic volume on the network and railroads, an increase of the number of double operations with loaded rail cars at stations and an increase of the load of rail cars in loaded shipping directions contribute to reduction of the empty run of cars. An effective means is also to find additional freight for shipment in empty directions, implementation of measures on enrichment of ores and fuel, dehydration of petroleum, briquetting and pressing of lightweight freight and improving the coordination of the operation of interacting types of transport.

14.5. Increasing the Productivity of Freight Cars

Rail car productivity is the most generalizing indicator of the quality of operational work. In the final analysis the demand rail car fleet is dependent on the value of this indicator. The average daily productivity of a rail car Π_v is characterized by the number of net ton-kilometers per rail car of the operating fleet per day

$$\Pi_в = \frac{\Sigma Pl_{год}}{365\, n_в}, \quad (14.9)$$

where ΣPl_{god} is the annual freight traffic turnover in net operational ton-kilometers and n_v is the operating fleet of rail cars.

The level of rail car productivity depends directly on three main qualitative indicators of its utilization--dynamic load, the coefficient of empty run and the average daily run. This dependence is expressed by the formulas:

$$\Pi_в = \frac{P^{гр}_{дин} S_в}{(1+\alpha^{гр}_{пор})}; \quad (14.10)$$

$$\Pi_в = P^{гр}_{дин}\,(1-\alpha^{общ}_{пор})\, S_в; \quad (14.11)$$

$$\Pi_в = P^{раб}_{дин}\, S_в, \quad (14.12)$$

where P^{rab}_{din} is the dynamic load of the car of the operating fleet, tons, and S_V is the average daily run of the car, km.

The average daily run of a freight car S_V is determined by the ratio of the complete trip to the circulating time of the car or by the ratio of the total car-kilometers to the operating fleet of cars. The less the circulating time of the car, the greater its average daily run and vice versa.

The average daily run of a loaded car can be used to judge the delivery rate of goods. Indicators of the average daily run, circulation, trips and coefficient of empty run of a car are related to each other by the following functions:

$$S_в = \frac{l_п}{O_в}; \qquad (14.13)$$

$$S_в = \frac{l_{гр}\left(1+\alpha^{гр}_{пор}\right)}{O_в}. \qquad (14.14)$$

On USSR railroads, the average daily run and productivity of an operating car increase constantly. During the period 1951-1975, the average daily run was increased by more than 70 percent and productivity was increased more than twofold. In 1975 the average daily run of a car decreased somewhat compared to 1970 and comprised 248.5 km.

The economic effectiveness of increasing freight car productivity is determined on the basis of complex economic analysis of the effect of all the main qualitative indicators indicated above on it. Car productivity should be increased by 4.3 percent during the 10th Five-Year Plan.

14.6. Improving the Use of Passenger Rail Cars

The use of passenger rail cars is characterized by their productivity, filling (population), average daily run and also by the speed of passenger trains and by the circulating time of the rolling stock.

The productivity of a passenger car is a more generalizing indicator of the quality of its utilization. It is measured by the number of passenger-kilometers per average passenger seat.

Filling of passenger cars is characterized by the index of mean population of them, which is determined by the ratio of passenger-kilometers to the run of cars in car-kilometers. The value of this index comprised approximately 32.8 persons per car in all types of passenger communications in 1975. An increase of car population should not lead to deterioration of the quality of passenger service. Filling cars to the norm is an important reserve for reducing the cost of passenger shipments. Under average network conditions, an increase of car population by one percent reduces the cost of passenger shipments by 0.41-0.47 percent.

The use of passenger cars is determined in time by the index of the average daily run of the car. Its value depends on the speed of the trains and the duration of their stops at all stations, including at the reserve.

The speed of passenger trains on USSR railroads is increasing continuously. The average section speed of all passenger trains throughout the network as a whole is higher than that of freight trains and comprises approximately 50 km/hr. The maximum speed reaches 120 km/hr on more than 10,000 km or the length of the network and it reaches 160 and 140 km/hr, respectively, on the Moscow-Leningrad and Moscow-Brest lines. The problem of increasing the maximum speed of passenger trains to 200-220 km/hr is being resolved successfully. New electric rolling stock is being introduced for this purpose, braking equipment is being improved and the upper structure of the track is being reconstructed. It has been suggested that special high-speed passenger mainlines be developed.

The indicator of rolling stock circulation is used instead of car circulation in passenger traffic. It characterizes the time from the moment the rolling stock is dispatched from the station of registration to the next dispatch from the same station. The circulating time of rolling stock, expressed in days, indicates how much stock is required for daily dispatch of trains of a given direction.

Improving the time indicators of passenger car utilization (average daily run of car and circulation of stock) reduces the expenses for their depreciation and routine repair and also maintenance of the train personnel and lighting and heating the rail cars. Reducing the idle time of a passenger car by one car-hr disconnected from trains yields a saving of approximately 36 kopecks, while reducing that of cars connected in trains yields a saving of approximately 1.44 rubles. Along with this, the need for passenger cars is reduced and capital investments directed toward construction of them, and toward development of the repair base and station tracks, are reduced. The fleet of passenger cars freed upon acceleration of stock circulation can be used for additional above-plan shipments of passengers.

14.7. Increase of the Weight and Speed of Freight Trains

The weight of a train is the most important qualitative indicator of locomotive utilization. A number (approximately 20) of factors affect its value. The main ones are the tractive power of the locomotive, the train speed, the profile and capacity of the track, tractive resistance, the length of the station, receiving-dispatching tracks and so on.

It is very important to select the optimum ratio of the weight and speed of a train. The essence of this selection is to establish with which combination of speed and weight the most economical utilization of the total capacity of a locomotive with given traction characteristics is achieved on a line with given technical power to weight ratio.

In other words, we are talking about the optimum method of intensifying the carrying capacity of the line since an increase of the weight of a train is usually accompanied by a decrease of speed and vice versa.

The running speed of a train characterizes the time of running on waysides without regard to the time for acceleration and slowing of the train. Running speed includes the entire running time of the train on waysides with regard to the time for acceleration and slowing down.

The section speed of trains between servicing stations, besides running on waysides, also reflects the stopping of trains at intermediate stations.

The route speed also reflects the stops of transit trains at servicing stations.

The weight and speed of freight trains on USSR railroads is increasing constantly (Figure 14.2). During the period 1951-1975, the average weight of a train increased by more than 90 percent while section speed increased by 66 percent. In 1975 the average gross weight of a train comprised 2,732 tons while the section speed comprised 33.4 km/hr.

An increase of the weight and speed of freight trains yields a significant saving: the carrying capacity of the railroad lines increases, operating expenses decrease, expenditures of work force (locomotive brigades) decrease and the demand fleet of locomotives decreases. Moreover, expenditures for fuel and electric power and also the shunting work at marshalling yards also decrease with an increase of train weight. There is economy of the car fleet with an increase of speed and expenditures on maintenance of it are reduced and the circulation of the freight mass is accelerated.

Under average conditions, the cost of shipments is reduced by 0.15-0.2 percent with an increase of train weight by one percent. An increase of section speed by one percent yields a reduction of cost by 0.032-0.067 percent.

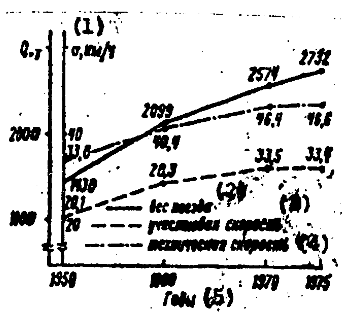

Figure 14.2. Increase of Weight and Speed of Trains

Key:

1. Km/hr
2. Weight of train
3. Section speed
4. Running speed
5. Years

Fuel and electric power economy is increased with an increase of train weight by reducing the specific consumption of them, reducing the number of stops with regard to reducing the number of trains and consequently reducing accelerations and slowing down. Reducing the number of trains with the same density of freight traffic volume reduces the need for locomotive brigades and the volume of shunting work. Each percentage of an increase of train weight permits a saving of up to 0.2-0.25 percent of shunting locomotives. With unpaired traffic, an increase of train weight in the loaded direction reduces a single run of locomotives.

Example. The density of freight traffic volume in the loaded direction comprises 22 million t-km net/km and 36.5 million t-km gross/km on a section extending 200 km. The gross weight of the train may be increased from 2,730 to 3,000 tons in the near future, i.e., by approximately 10 percent. Determine the extent to which the number of trains and the need for train locomotives in the operating fleet will be reduced and what will be the saving of operating expenses.

As a result of increasing train weight, the average daily traffic density (the number of train pairs) is reduced from $(36.5 \cdot 10^6)/(365 \cdot 2,730) = 37$ to $(36.5 \cdot 10^6)/(365 \cdot 3,000) = 33$ pairs of trains. If the circulating time of a locomotive remains unchanged and comprises 12 hours, the need for a fleet of train locomotives will be reduced from 37 (12:24) = 19 to 33(12:24) = 17, i.e., by two units. With an average cost of freight shipments of 2.5 kopecks/10 t-km and an induction factor of 0.2, the value will be reduced by (0.2 - (0.2/1.1))100 = 1.8 percent and will comprise 2.5·0.982 = 2.455 kopecks/10 t-km.

The saving of operating expenses on the section will be equal to

$$\frac{22 \cdot 10^6 \cdot 200\,(2,500-2,455)}{10 \cdot 100} = 198 \text{ thous. rubles.}$$

Let us assume that, all things being equal, along with an increase of train weight the section speed will increase from 33.5 to 35.2 km/hr, i.e., by approximately 5 percent. This will yield a cost reduction by (0.067 - (0.067/1.05))100 = 0.32 percent or by 2.5·0.32:100 = 0.008 kopecks/10 t-km with an induction factor of 0.067. The additional saving of operating expenses will comprise

$$\frac{4,4 \cdot 10^9 \cdot 0,008}{10 \cdot 100} = 35,2 \text{ thous. rubles.}$$

One should bear in mind that with an increase of train weight as well as their speed, additional expenditures may occur. The nature and extent of these expenditures depend on whether improvement of the considered indicators will be achieved as a result of which planning measures. If the train weight is increased due to the use of more powerful locomotives and lengthening of station tracks, additional capital investments in locomotives and station tracks are required and the operating expenses for maintenance of them also increase. With an increase of train weight by using double traction and pushing, the expenditures of locomotive-hours increase and additional expenses for maintenance and servicing of the second locomotives occur. In cases when an increase of train weight causes a change of the weight norm, additional expenses occur at the station of change related to uncoupling and coupling of rail cars. Moreover, expenditures of car-hours for accumulation of rolling stock at the forming-up station with any method of increasing train weight. The section speed of a train may increase as a result of using more powerful locomotives, introduction of automatic block systems and centralized traffic control and strengthening of the track superstructure.

This means that the additional expenditures must be subtracted from the saving achieved or the actual payback period of the additional capital investments must be determined and compared to the normative level to determine the effectiveness of increasing the weight and speed of trains.

14.8. Increasing the Productivity and Average Daily Run of a Locomotive

The use of train locomotives in freight traffic is most fully characterized by the index of the average daily locomotive productivity F_l. It is measured by the number of gross ton-kilometers per locomotive on the average per day

$$F_л = \frac{\Sigma Pl_{бр}}{365 M_л}, \qquad (14.15)$$

where ΣPl_{br} is the annual volume of gross ton-kilometers and M_l is the operating fleet of train locomotives.

Locomotive productivity is a generalizing indicator in which all aspects of the quality of utilization are reflected: in power (tractive force), time and by the degree of work productivity. The dependence of productivity on other indicators is clearly visible from the following formula:

$$F_л = Q_{бр} S_л (1 - \beta_{всп}), \qquad (14.16)$$

where Q_{br} is the average gross weight of the train, t, S_l is the average daily run of train locomotives, km, and β_{vsp} is the coefficient of auxiliary line run of train locomotives.

The effectiveness of increasing locomotive productivity is determined on the basis of complex economic analysis of the effect of the main qualitative indicators and primarily of the weight and speed of trains, the average daily run and the fraction of auxiliary run of locomotives on the increase of productivity. It is planned to increase locomotive productivity by 6.7 percent in 1976-1980.

The average daily run characterizes the quality of locomotive utilization in time. It depends on the length of the section of locomotive handling and the method of servicing it, on the sections speed of trains and the time the locomotives are in the depot.

The average daily run of a locomotive can be calculated for individual servicing sections by dividing double the length of the servicing section by the total circulating time of the locomotive. For example, the average daily run for a section 200 km long with total locmotive circulating time of 12 hours will comprise (2·200·24):12 = 800 km/day.

The locomotive circulating time is added from the time in motion and the idle time at intermediate and section stations and the stations of the main and circulating depot. The fraction of useful work of a locomotive during the day comprises an average of 12-13 hours throughout the network. The average daily run of a locomotive on USSR railroads increased more than twofold during the period 1951-1975 and reached 510 km in 1975.

An increase of the average daily run yields a saving of the locomotive fleet or permits the existing fleet to carry out a large volume of work. A saving of capital investments in acquisition of new locomotives is achieved in this case.

Along with economy of the locomotive fleet, an increase of the average daily run of locomotives yields a saving of operating expenses, the value of which depends on the factors affecting the average daily run. If the time a locomotive in motion is compared to trains on sidings, the same effect is achieved as with an increase of running speed. Operating expenses for fuel and electric power and also to pay the locomotive brigades and for renovation of locomotives are reduced with an increase of section speed due to reducing the idle times of locomotives at stations (with locomotive brigades). The extent of this saving comprises 4-5 rubles per locomotive-hour.

The extent of the saving of operating expenses per locomotive-hour comprises 0.8-1 ruble in the case of reducing the idle time the locomotive is in the depot, during resting of brigades and during outfitting (without the locomotive brigade).

Lengthening the servicing sections yields a large saving since the specific weight of productive work of comotives in traffic increases appreciably.

14.9. Methods of Improving the Utilization of Railroad Hardware

Improving the quality of utilizationof rail rolling stock must be considered together with development and utilization of the permanent hardware (devices). It is very important in this case to ensure technical conformity between the rolling stock fleet and the carrying (handling) capacity of all permanent devices of main-line and industrial transport (tracks, shunting devices, loading fronts with warehouses and means of mechanization and so on).

The dynamics of the main qualitative indicators of rolling stock utilization of USSR railroads during 1951-1975 is presented in Table 14.1.

Table 14. Dynamics of Qualitative Indicators of Rolling Stock Utilization

	Years			
Average circulating time of freight car, days	7.49	5.59	5.57	5.84
Average time a car is, hr:				
in a single freight operation	26.0	20.50	20.78	22.66
at a single servicing station	6.90	3.98	4.15	4.29
Average dynamic load of loaded car, t/car	18.6	21.4	23.5	24.5
Average daily run of freight car, km	146.4	227.0	255.2	248.5
Empty run of car to loaded car, percent	37.0	39.7	40.4	40.2
Average daily run of locomotive in loaded traffic, km	245.0	367.2	499.6	510.0
Average gross weight of freight train, tons	1,430	2,099	2,574	2,732
Average speed of freight train, km/hr				
running	33.8	40.4	46.4	46.6
section	20.1	28.3	33.5	33.4

The task of further increasing the operating efficiency of transport is faced during the 10th Five-Year Plan. To do this, it is planned to implement a number of measures to improve the utilization of transport facilities, to reduce the idle times of rail cars, more complete utilization of their load-carrying capacity and volume and to reduce empty runs. Interaction of various types of transport will be improved, the level of complex mechanization of loading-unloading operations will be increased and the volume of freight shipments in specialized rolling stock and containers will be increased.

Among the measures directed toward reducing the idle time of freight cars and acceleration of the circulation should be noted:

intensification of technical equipping of stations and improvement of their operating technology;

improving the quality of regulation and traffic control management of trains and locomotives;

further concentration of freight and shunting work with cars;

increasing the level of dispatcher routing and also wider use of combined routes of loaded and empty cars;

increasing the section speed of trains.

Further reconstruction of the car fleet, as a result of which the specific weight of large-capacity cars will increase, efficient distribution of cars for loading according to the type of freight, the use of leading methods of consolidated loading of cars and reduction of the empty run of cars on the basis of development and introduction of optimum schemes of regulation will contribute to an increase of the static and dynamic load of a car.

A significant increase of train weight will be provided by increasing the power of locomotives and strengthening the track superstructure, extending receiving-dispatch tracks at stations, expansion of the use of eight-axle gondolas and tank cars which provide higher linear loads and by introduction of leading methods of driving trains.

The average daily run of a locomotive will be increased by lengthening the servicing sections and reducing the specific weight of unproductive idle times of locomotives in the main and circulating depots.

High reliability of all hardware is the guarantee of stable and efficient operation of rail transport.

6521
CSO: 8144/0359

THE ECONOMIC EFFECTIVENESS OF RECONSTRUCTING TRACTION ON RAILROADS

Moscow EKONOMIKA I PLANIROVANIYE ZHELEZNODOROZHNOGO TRANSPORTA: EKONOMIKA ZHELEZNODOROZHNOGO TRANSPORTA in Russian Part 1, 1978 signed to press 20 Sep 78 pp 180-189

[Chapter 18 from the book "Ekonomika i planirovaniye zheleznodorozhnogo transporta: ekonomika zheleznodorozhnogo transporta," Izdatel'stvo Transport, 15,000 copies, 352 pages]

[Text] 18.1. Development of Progressive Types of Traction on Railroads

Introduction of electric and diesel traction on USSR railroads began with Soviet power.

It was planned to develop powerful electrified mainlines on the main lines of the railway network in the first national economic plan--the plan of GOELRO, developed by the initiative and under the supervision of V. I. Lenin in 1920.

The country's first electrified line, which connected Baku to the oil field at Apsheron (Baku-Sabunchi-Surakhany), was constructed in 1926. The suburban lines of the Moscow junction, the most difficult mountain sections of the railroads of the Transbaikal and the Urals, the Murmansk-Kandalaksha arctic section, the Zaporozh'ye-Dolgintsevo line, a number of sections in the Kuzbass and so on were electrified in subsequent years.

However, the rates of electrification were insufficient until the 20th CPSU Congress. By 1956 there were only 5,400 km of electrified lines. The Congress devoted serious attention to the lag of rail transport in the rates of introducing new types of traction. According to the general plan for electrification of railroads, confirmed the same year, the Moscow-Kuybyshev-Omsk-Tayshet-Karymskaya-Petrovskiy Zavod (6,100 km), the Leningrad-Moscow-Khar'kov-Rostov-Tbilisi-Leninakan-Norashen (3,600 km), the Moscow-Gor'kiy-Sverdlovsk-Kurgan (2,200 km), the Moscow-Kiev-L'vov-Chop (1,300 km), the Moscow-Kochetovka-Rostov (1,200 km) and the Novosibirsk-Novokuznetsk-Abakan-Korshunikha (2,000 km) electrified mainlines having no equal in length and traffic and carrying capacity appeared in our country.

By the beginning of 1976, approximately 39,000 km of railroads were electrified. Electrification remains an important section of technical re-equipping of rail transport during the 10th Five-Year Plan, as before, which permits an increase of the carrying and traffic capacity of the lines within short periods. The USSR occupies first place in the world in electrification of railroads.

Electrification of railroads means not only introduction of electric traction. It is used extensively for mechanization of operations and for organization of public services and amenities for railroad workers, for electrification of industrial enterprises, kolkhozes and sovkhozes located in the region of railroads. Thus, electrification of railroads under socialism is a significant contribution to electrification of the entire country and an important step on the path toward communism.

Construction of the first diesel locomotives was begun in the USSR shortly after the Great October Socialist Revolution. At the suggestion of V. I. Lenin in 1922, the Soviet government decided to produce diesel locomotives and development of the world's first diesel locomotive was completed in Leningrad in 1924. However, only 6,500 km of railroads were converted to diesel locomotive traction prior to 1956. The rates of introduction of diesel locomotive traction increased sharply after the 20th CPSU Congress. By the beginning of 1976 the length of lines operated on diesel locomotive traction exceeded 90,000 km.

The total length of railroads with electric and diesel locomotive traction now comprises approximately 130,000 km or almost 94 percent of the operational length of the railway network. Steam locomotives still remained on some low-active sections.

The majority of freight and passenger transport is carried out by progressive types of traction (Figure 18.1). Electrified lines, which comprise 28.1 percent of the operational length of railroads, carry out more than half of the freight traffic turnover (Table 18.1). Moreover, more than 60 percent of long-range passenger transport and approximately 80 percent of suburban passenger transport go to them. The remaining part of transport is accomplished mainly by diesel locomotive traction (Figure 18.2).

Steam traction in shunting work is being replaced at rapid rates. In 1975, 88.6 percent of shunting work was carried out by diesel locomotives. The conversion of railway transport to diesel and electric traction will be fully completed during the 10th Five-Year Plan.

Extensive electrification and conversion of railroads to diesel locomotive traction are accompanied by constant improvement of the technical and economic indicators of locomotives. The main technical and economic indicators of some of the most powerful electric and diesel locomotives being operated are presented in Table 18.2.

It is planned to organize production of two-section mainline diesel freight locomotives with rating of 8,000 horsepower, of passenger diesel locomotives with section rating of 6,000 hp and of shunting-removal diesel locomotives with rating of 2,000 hp during the 10th Five-Year Plan. It is also planned to organize production of mainline electric freight locomotives with rating of more than 10,000 hp.

18.2. The Efficiency of Electric and Diesel Locomotive Traction

One of the determining technical and economic advantages of electric and diesel locomotive traction is the high efficiency. As is known, this coefficient is the ratio of usefully utilized energy to all expended energy. Useful work is measured on the hook of the locomotive.

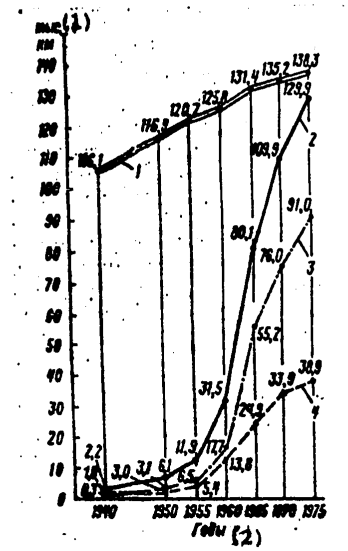

Figure 18.1. Increase of Length of Lines With Electric and Diesel Locomotive Traction: 1--total operational length of railroads; 2--length of lines with electric and diesel traction; 3--length of lines with diesel traction; 4--length of electrified lines

Key:
1. Thousand km
2. Years

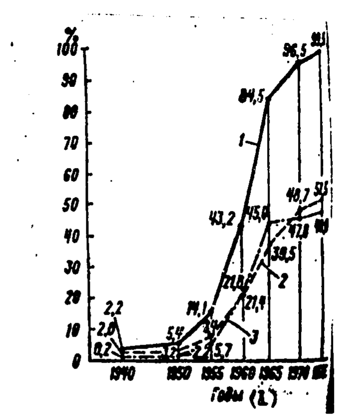

Figure 18.2. Specific Weight of Electrified and Diesel Traction in Freight Traffic Turnover of Railroads: 1--electric and diesel traction; 2--electric traction; 3--diesel traction

Key:
1. Years

Table 18.1. Length of Lines With Electric and Diesel Traction and Their Specific Weight in Freight Traffic Turnover of Rail Transport

Years	Operating Length of Railroads, thous. km.	Electric Traction			Diesel Traction		
		Thous. km	Percent		Thous. km	Percent	
			Of Operational Length	Of Freight Traffic Turnover		Of Operational Length	Of Freight Traffic Turnover
1940	106.1	1.9	1.8	2.0	0.3	0.28	0.2
1950	116.9	3.0	2.6	3.2	3.1	2.9	2.2
1955	120.7	5.4	4.1	8.4	6.5	5.4	5.7
1960	125.8	13.8	11.0	21.8	17.7	14.1	21.4
1965	131.4	24.9	19.0	39.5	55.2	42.2	45.0
1970	135.2	33.9	25.1	48.7	76.0	56.2	47.8
1975	138.3	38.9	28.1	51.5	91.0	65.8	48.0

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000300080044-2

Table 18.2. Technical-Economic Indicators of Electric and Diesel Locomotives

Series of Locomotive	Axle Formula	Wheel Rim Rating, hp	Calculated traction, t-f	Design Speed, km/hr	Adhesion Weight, t-f	Price, Thous. Rubles	Specific Rating, hp/g
Electric Freight Locomotives							
VL8	$2_0+2_0+2_0+2_0$	5,570	46.5	100	184	157.6	30.3
VL10	$2_0-2_0-2_0-2_0$	6,890	47.6	100	184	Not available	37.5
VL80[k]	$2_0-2_0-2_0-2_0$	8,480	49.6	110	184	Not available	45.9
VL60[k]	3_0-3_0	6,240	37.2	100	138	164.0	45.4
Electric Passenger Locomotives							
ChS2[t]	3_0-3_0	5,590	27.0	160	125	Not available	45.0
ChS4[t]	3_0-3_0	6,930	27.0	160	125	Not available	55.1
Diesel Locomotives							
2TE10L	$2(3_0-3_0)$	4,800	54.0	100	258	318.0	23.2
TE3	$2(3_0-3_0)$	3,140	40.4	100	254	226.0	15.9
TEP60	3_0-3_0	2,400	12.5	160	126	255.0	23.2
TEM2	3_0-3_0	900	21.5	100	120	136.0	10.0
TGM3A	2-2	567	12.0	70	68	83	11.0

Note: The specific diesel rating is given for diesel locomotives.

With electric traction, the expended energy is assumed equal to the thermal energy produced upon combustion of the fuel at electric power plants. The total efficiency of electric traction is determined with regard to the energy losses at all stages of its movement and conversion. It is equal to the product of the efficiency of the electric power plant itself, the electric power transmission line, the traction substation, the contact network and of the electric locomotive and comprises 22-27 percent.

The efficiency of a diesel locomotive is equal to 25-30 percent and it is equal to 18-20 percent with regard to the losses during production, refining and transport of fuel.

Under real operating conditions, a steam locomotive can utilize only 4-5 percent of the energy of burned fuel.

Mass electrification and extensive introduction of diesel locomotive traction on the railroad network permitted reduction of the consumption of energy resources for traction of trains by a factor of 7. Calculated to comparison fuel, the specific consumption of electric resources was reduced from 358 kg per 10,000 gross t-km in 1950 to 51 kg in 1975.

Electric and diesel locomotive traction increases the traffic and carrying capacity of railroads. With electric traction, the traffic capacity is increased 2-3-fold and with diesel traction it is increased 1.5-2-fold compared to steam traction.

Progressive types of traction have a significant effect on reduction of the cost of shipments. With electric traction the cost is 25-30 percent lower and with diesel traction it is 20-25 percent lower than with steam traction.

Cost reduction occurs mainly by reducing expenditures for fuel, repair of locomotives and rail cars and payment of labor.

A reduction of expenditures for fuel is explained by higher efficiency of electric and diesel locomotives. Expenditures for repair of locomotives are reduced with regard to the relative reduction of their total run, determined by increasing the weight of trains and also by longer runs of electric and diesel locomotives between repairs compared to steam locomotives. A reduction of expenditures for repair of cars is related to a reduction of the need for a car fleet for the same freight traffic turnover due to the higher speeds of trains.

Saving expenditures on wages for locomotive brigades and other categories of workers is determined by the fact that labor productivity is increased with progressive types of traction (for example, it increases approximately 1.5-2-fold for workers of locomotive facilities). The total staff engaged in shipments with diesel and electric traction is 20-30 percent less than that with steam traction.

Electric and diesel traction provides higher technical and economic indicators of rail transport operation: the greater weight of trains and speed, increase of locomotive and car productivity, stable operation of railroads during the winter season difficult for operation and so on. The working conditions of a number of worker categories improve significantly with these types of traction. For example, the work of the assistant engineer is sharply facilitated compared to steam traction and such a heavy occupation as stoker is generally eliminated.

183.. Advantages of Electrification on Alternating Current

Two current systems--direct with voltage of 3 kV and alternating on commercial frequency with voltage of 25 kV, are used on electrified railroads. The DC system was used on approximately 23,300 km and the AC system was used on 15,500 km of railroad lines at the beginning of 1976.

The DC system is inferior to the alternating system in the indicators of capital expenditures, operating expenses, locomotive productivity, total efficiency and so on. Each of these indicators is an average of 3-5 percent better with alternating current than with direct current. The distance between substations comprises 10-25 km with direct current and 30-50 km with alternating current. In this case the AC traction substations are considerably simple, more reliable and less expensive. The contact wire cross-section is almost one-half and consequently copper consumption is also less. Electric energy losses in the energy supply devices are lower. Moreover, greater opportunities for use of automation are provided with alternating current. Therefore, intensive freight lines are now being electrified primarily on alternating current.

The presence of two current systems makes it necessary to have specially equipped stations with joining of the contact network or requires construction of DC-AC electric locomotives (dual power supply). These electric locomotives provide a reduction of train idle time upon conversion from one current system to another and are significantly more economical than the expensive and complex switching devices at the junction stations. However, the use of an AC system interrupts the normal operation of overhead communications lines and therefore the latter must be replaced by cables buried underground. This results in additional capital investments. Expenditures for reconstruction of communications and STsB [Signalization, centralization and block system] comprise approximately 10,000-13,000 rubles per kilometer of track. But these expenditures are subsequently repaid by a saving of expenditures on maintenance of the communications line. With regard to expenditures for cabling of communications lines, the capital investments in electrification on alternating current are still somewhat less than those on direct current.

18.4. Spheres of Effective Use of Electric and Diesel Traction

Electric and diesel traction have high economic effectiveness. The advantage of using each of these types of traction depends on a number of factors. The main ones of them are the freight intensity of the line and prospects for its increase, difficulty of track profile, length of locomotive handling sections, price for diesel fuel and electric power, number of main tracks, cost of energy supply devices, the type and cost of locomotives and so on. The scope of capital and operating expenses and consequently the spheres of feasible use of electric and diesel traction and dependent on these factors.

Capital investments to electrification are repaid within approximately 3-4 years on railroads with high train traffic intensity serviced by steam locomotiges. The return of capital investments to the locomotive fleet and re-equipping of depot devices on lines converted from steam to diesel traction comprises 1.5-2 years. There is every opportunity forhighly efficient use of both electric and diesel traction in the Soviet Union with an exceptional variety of natural and economic conditions.

Capital investments in permanent devices with electric and diesel traction calculated per kilometer of operating length of track without accompanying expenditures comprise (in thousand rubles):

	Single-Track Line	Double-Track Line
Electric traction:		
with direct current	Up to 80	Up to 100
with alternating current	Up to 70	Up to 100
Diesel traction	Up to 6	Up to 10

Capital investments in permanent devices are added from expenditures for construction of traction substations, the contact network, sectioning stations and for re-equipping of locomotive depots with electrification of railroads. Expenditures for reconstruction of STsB and electrified communications lines and other so-called accompanying expenditures are also now included in the estimated cost of electrification. These expenditures include reorganization of stations, lengthening the receiving-dispatching tracks, construction of high platforms, crossing bridges and so on.

More than two-thirds of expenditures for electrification go to construction of traction substations and erection of the contact network.

Capital investments in rolling stock are considerably less with electric traction than with diesel traction. This is explained by the fact that the prices of a diesel locomotive is higher than that of an electric locomotive with identical rating.

Electric traction provides lower cost of shipments (under comparable conditions) compared to diesel traction. The saving of operating expenses and reduction of cost are achieved due to a number of factors.

There are fewer expenses for all types of locomotive repair with electric traction. Expenditures for repair depend on the run of locomotives while the run depends on the weight of the train. Electric locomotives pull a train of greater weight under comparable conditions, which permits a given freight traffic turnover to be carried out with shorter run of locomotives at the head of trains. Moreover, the normal run between repairs is greater for electric locomotives than for diesel locomotives and the repair expenditures are fewer.

Deductions for renovation (complete restoration) of electric locomotives is less than that for diesel locomotives. The extent of these deductions depends on the cost and service life of the locomotive. Electric locomotives are less expensive but are in service longer than diesel locomotives. If the recovery cost of locomotives and the annual decrease in the cost of all types of repair for them are taken into account, the optimum service life of electric locomotives is approximately 1.8 times greater than that of diesel locomotives.

Expenditures for wages of locomotive brigades are lower with electric traction. This is explained by the fact that labor productivity of electric locomotive brigades is higher than that of diesel locomotive brigades since electric locomotives move trains of greater weight and at higher speed compared to diesel locomotives.

Expenditures on routine maintenance of the roadbed and the superstructure of main tracks, single replacement of superstructure components on main tracks and on shock absorption of the superstructure of these tracks are reduced somewhat with electric traction. The expenditures of this group are related to the number of gross ton-kilometers of the cars and locomotives. With electric traction the value of gross ton-kilometers of locomotives for the considered volume of freight traffic turnover is less since the service weight of an electric locomotive is lower than that of a diesel locomotive.

Expenditures on shock absorption and depot repair of cars is less with electric traction. This is explained by the fact that the demand fleet of cars for identical freight traffic turnover is less with electric traction than with diesel traction with regard to the higher speeds. However, one should bear in mind that additional routine expenditures for repair, maintenance and shock absorption of the traction substations and contact network occur with electric traction.

The cost of shipments during 1975 on sections serviced by different types of traction is presented in Table 18.3.

With regard to the fact that part of the operating expenses on railroads is hardly dependent or completely independent of the scope of freight traffic volume (so-called conditional-permanent expenses), the freight traffic intensity of the line has a greater effect on the cost of shipments. By the beginning of 1976, the average freight intensity of lines with electric traction was almost two times greater than that of lines with diesel traction.

Table 18.3. Cost of Shipments, Kopecks

Measuring Unit	Type of Traction		
	Electric	Diesel	Steam
10 t-km	2,052	2,875	9,150
10 passenger-km	5,092	7,566	16,381
10 reduced t-km	2,260	3,179	10,028
10 passenger-km of electric trains	4,645	--	--
10 passenger-km of diesel trains	--	11,273	--

The difference in the total scope of capital investments in permanent devices and rolling stock decreases with an increase of freight intensity with electric traction compared to diesel traction and the saving of operating expenses increases simultaneously. Therefore, electric traction can be used on lines with high freight intensity.

The efficiency of electric traction also depends on the track profile. It is economically feasible to replace diesel locomotives with electric traction on single-track lines with an increase of shipments under conditions of average difficulty of track profile with freight intensity of not less than 9-10 million t-km/km in the loaded direction and not less than 18-23 million t-km/km on two-track lines.

The use of electric traction under conditions of difficult track profile is especially effective. An electric locomotive can realize higher tractive force with lesser reduction of speed with difficult profile compared to a diesel locomotive. In this regard, the gap in carrying capacity increases in favor of electric traction.

Energy recovery is possible with electric traction. When moving down a slope, especially on lingering descents, the traction motors of an electric locomotive are switched to the electrogenerator operating mode. The accumulated live force of the train is used to generate electric power, which is fed to the contact network. The return of recuperated energy comprises 20-28 percent of its consumption on mountainous profile and 8-15 percent with less complicated profile. Elastic braking of the train is provided in this case. Energy recuperation contributes to a reduction of the wear of the brake shoes and a reduction of expenditures for repair of the running parts of trains. The use of recuperative braking is very efficient in suburban traffic since it contributes to a reduction of brake losses due to frequent stops.

Electric traction has fundamentally altered the suburban traffic of large cities. The speeds and scopes of train traffic have increased, the number of stopping points has increased and the travel conditions of passengers have improved.

The use of diesel traction is efficient in shunting work. One diesel locomotive replaces approximately 1.5 steam locomotive in shunting. A diesel locomotive can operate more than 95 percent of the time during 24 hours, whereas a steam locomotive can operate only 70-75 percent of the time. In 1975 diesel locomotives performed 88.6 percent of shunting work.

Contact-storage battery locomotives with storage batteries being recharged when moving along sections with contact network will be used in shunting work in the future. Diesel-contact shunting locomotives are most efficient in cost indicators with heavy weights of trains and high specific weight of the autonomous operating mode.

It is planned to develop experimental models of essentially new self-contained locomotives--gas turbine locomotives. They have lower weight than diesel locomotives and can operate on oil-refining wastes with high sulphur content. The cost of this fuel is 1.5-2 times lower than the cost of diesel fuel. However, gas turbine locomotives still have low efficiency. Therefore, the question of introducing them will be resolved as a function of the results of using these locomotives under operating conditions.

6521
CSO: 8144/0359

THE ECONOMIC EFFECTIVENESS OF DEVELOPING CONTAINER FACILITIES

Moscow EKONOMIKA I PLANIROVANIYE ZHELEZNODOROZHNOGO TRANSPORTA: EKONOMIKA ZHELEZNODOROZHNOGO TRANSPORTA in Russian Part 1, 1978 signed to press 20 Sep 78 pp 197-203

[Chapter 20 from the book "Ekonomika i planirovaniye zheleznodorozhnogo transporta: ekonomika zheleznodorozhnogo transporta," Izdatel'stvo Transport, 15,000 copies, 352 pages]

[Text] 20.1. The Significance of Container Facilities and the Main Trends of Developing It

Containerization is one of the important trends of technical progress in organization of freight shipments. It makes fundamental changes in the shipping process and permits shipments on a higher qualitative level without overloading of freight en route, with total provision of preservation and the least total expenditures for transport from the warehouse of the shipper to the warehouse of the customer.

Development of a highly efficient unified container transport system (KTS) in our country requires joint and coordinated efforts of all types of transport and other sectors of the national economy. The unity of the container transport system is provided by different forms of coordination: technical, economic, production, organizing and legal.

The complex of KTS hardware includes container stock together with pallets and other devices for forming freight up into packets, rolling stock for transport of containers, means of mechanization for loading, unloading and transloading them, container platforms for storage and a repair base.

The container stock, which is an important integral part of the KTS, consists of universal and special containers. The main technical-economic indicators of universal containers are presented in Table 20.1.

Approximately 1.5 million universal and special containers are now handled on all types of mainline and industrial transport. The stock of universal containers in rail transport numbers approximately one million units. In 1975, more than 50 million tons of freight, including approximately 42 million tons in rail transport, almost 36 million tons of which was shipped in universal containers, were shipped in containers in all types of mainline transport.

Table 20.1. Technical-Economic Characteristics of Universal Containers

Indicator	Type of Container					
	AUK-1.25	UUK-3	UUK-5	UUK-10	UUK-20	UUK-30
Gross weight, tons	1.25	3.0	5.0	10.16	20.32	30.48
Tare weight, tons	0.225	0.56	1.08	1.20	2.10	3.60
Load capacity, tons	1.025	2.44	3.92	8.96	18.22	26.88
Tare coefficient	0.220	0.230	0.276	0.134	0.115	0.134
Internal volume, m^3	1.25	5.16	10.65	14.10	29.6	60.90
Specific volume, m^3/t	1.25	2.11	2.72	1.57	1.62	2.27
Price, rubles	Unavailable	207	325	650	900	Unavailable

Table 20.2. Increase in Volume of Shipments and Number of Container Terminals

Years	Volume of Shipments, million tons	Number of Terminals		
		At Stations	On Spur Tracks	Total
1950	2.0	129	5	134
1960	16.4	765	222	987
1970	26.4	1,017	142	1,159
1975	36.0	1,100	150	1,250

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000300080044-2

The dynamics of growth in the volume of freight shipments in universal containers and the number of container terminals in rail transport during 1951-1975 is shown in Table 20.2. Rail transport will as before play an important role in container shipments in the future.

A new step in development of container shipments, beginning in 1972, was the use of large-capacity containers with gross weight of 20 tons. The volume of freight shipments in them will increase especially rapidly in rail and maritime transport. It comprised approximately six million tons in 1975.

The main trends for further development of the hardware of the container transport system are:

an increase of the amount of container stock and improvement of its structure to provide more complete conformity of the stock to the structure of freight traffic turnover;

acceleration of the rates of introduction of large-capacity containers with gross weight of 10, 20, 30 or more tons;

expansion of the sphere of application of special containers of various types and the load capacity especially for those goods in which losses due to no conservation are especially high during transport;

reconstruction of existing container terminals and construction of new large specialized container stations;

intensification of the means of mechanization of loading, unloading and transloading of containers with wider introduction of cranes, heavy forklifts, self-loading trucks and also light highly maneuverable automatic lift trucks and electric lift trucks and other hoisting-transport equipment;

wider use of universal and special rolling stock adapted for container shipment, of standard and specialized cars, trucks, truck-tractors and truck-trailers, ocean-going and river vessels and also aircraft and helicopters;

completion of introducing means of semi-automatic and automatic strapping and unstrapping of containers at container terminals of transport and industrial enterprises;

development of an automated system for planning and control of container shipments (ASU Konteyner) as one of the elements of an automated transport management system (ASUT).

A significant increase in the volume of freight shipped in containers, primarily in large-capacity containers, and also in packaged form is planned in 1976-1980. Container shipments will increase 1.4-fold throughout the national economy as a whole and will comprise approximately 80 million tons by the end of the five-year plan. Shipments in large-capacity containers will increase twofold and will reach 16 million tons. It is planned to ship 45 million tons of freight in universal containers, including 9 million tons in large-capacity containers, in rail transport in 1980.

20.2. The Economic Effectiveness of Using Containers

Containers are a highly effective means of transport which at the same time carry out functions of multi-use transport packaging.

The use of containers provides acceleration of freight delivery and reduction of the cost of the freight mass "en route" due to this. When containers are used, the laboriousness of transport-warehouse operations is reduced, labor productivity increases and the working conditions of transport workers and industrial enterprises are improved and the degree of preservation of freight being shipped is increased. A significant saving of monetary, material and labor resources is achieved not only in transport but in other sectors of the national economy as well.

The main element of economy in container shipments is economy in tare and packaging. It comprises approximately 23 rubles per ton of gross freight. Expenditures related to shock-absorption of the container during its service life are equal to a total of 70-75 kopecks per ton of shipped freight.

The use of containers permits complex mechanization of loading-unloading operations, significant reduction of their volume and a reduction of cost. As a result the need for mechanisms is reduced, their utilization is improved and specific capital expenditures in means of mechanization are reduced. The average cost at container terminals equipped with electric hoisting cranes is equal to 7-8 kopkecs per ton of container-operation or 4-5 kopecks per ton-operation. The cost of one ton-operation for all types of goods handled in open warehouses comprises 14-18 kopecks with mechanized handling and 25-33 kopecks with manual handling. Expenditures on loading-unloading operations during a single shipping cycle on railroads comprise 2.1-2.5 rubles per ton with shipments in boxcars and 0.7-0.8 rubles per ton in containers. The national economy receives 70-80 million rubles annually due to the saving alone in loading-unloading operations.

Containerization of shipments sharply reduces the laboriousness of all transport, transloading and warehousing operations. Labor productivity is increased approximately fourfold. The need for a work force is reduced even more when large-capacity containers are used, with development of through container-packet shipments, introduction of specialized rolling stock and other innovative KTS hardware.

A large economic effect is achieved from acceleration of freight delivery and containers as a result of reducing the number of freight sortings en route and acceleration of transloading and other operations at stations. The delivery time is reduced by approximately 1-2 days with regard to the increase in the rate of moving goods in containers. The saving from reducing the cost of the freight mass "en route" comprises 7-14 rubles per ton.

Supply and service conditions are improved significantly with introduction of the container system of shipments. The possibilities of using the transit form of customer supply with goods are being expanded. This sharply reduces the total costs for transport.

The cost of container shipments fluctuates considerably as a function of the type of freight, the distance of shipment and the nature of the shipments. Some part of the operating expenses of railroads, related to transport of small shipments, is completely eliminated or considerably reduced upon transfer of shipments to KTS. There are no expenditures for weighing and expenditures for sorting of goods are reduced significantly. At the same time additional expenditures for shock absorption of containers and maintenance of an additional staff of workers involved in organizatin of container shipments occur. Nonproduction expenditures on shipment of empty containers and performing technical and commercial operations with them at the initial-final terminals are significant.

The cost of transporting small shipments in containers can be lower or higher than the cost of shipping them in preassembled boxcars. Everything depends on the ratio of the gross loads and the number of sortings en route. The use of containers may provide some reduction of the cost in transport of car-lot shipments. But this is related only to those goods in the gross mass of which the specific weight of the transport tare is high and shipment of which in boxcars is accomplished over short distances. The cost of shipments in boxcars is lower than in containers for the main mass of car-lot shipments.

Some increase in the cost of container shipments is completely compensated for by the enormous saving due to improvement of quality. The effect is manifested mainly beyond transport--for freight shippers and customers.

Container shipments increase to a significant degree the preservation of goods being shipped, especially during transloading, handling and storage. The use of universal containers for shipping tare-piece goods almost completely eliminated losses of them. Shipment of mineral fertilizers in special containers reduces losses by three percent and yields a saving of 3-5 rubles per ton. Losses of tomatoes are reduced from 7 to 0.8 percent when containers are used. The use of special containers for transport and storage of potatoes is effective.

There is no need to construct expensive closed warehouses when goods are shipped in containers. Containers are stored on open platforms, construction of which is one-fourth to one-fifth as expensive. Some saving of capital investments is also achieved with regard to the use of platforms instead of boxcars, the construction cost of which is 18 percent higher, in container shipments. The specific capital investments in means of mechanization are also reduced, although more expensive mechanisms are used in loading-unloading operations with containers. This is explained by the fact that the productivity of the mechanisms on container platforms is 3-5 times higher than that in closed warehouse.

However, containerization of shipments requires higher capital investments in the container stock and development of its repair base. These investments exceed approximately twofold the saving of capital expenditures as a result of constructing open container platforms instead of closed warehouses. The total specific capital investments in container shipments by rail are 40-60 percent higher than during freight shipments in boxcars. Additional capital expenditures per ton of transported freight comprise 2.3-2.5 rubles, but they are returned very rapidly (within less than one year) due to the saving of current expenses of the freight shippers in transport.

When the container method of shipment is compared to other methods by capital investments, the possible saving of capital expenditures in related sectors of the national economy must be taken into account. The saving of material resources upon conversion to non-tare shipment of products in containers reduces capital investments in the timber and woodworking industry upon procurement and sawing of round timber, in construction of lumber-packing combines and also in hardware for transport of lumber and finished tare.

Container shipments provide a high saving of both current expenses and capital expenditures throughout the national economy as a whole. The economic effectiveness of containerization of shipments increases even more if the saving from acceleration of the circulability of circulating funds in the national economy is taken into account.

The use of large-capacity containers yields a significant additional saving. In this case the problem of complex mechanization of loading-unloading operations is resolved for a wider nomenclature of small-capacity and car-lot shipments of goods and labor productivity is increased even more. The best conditions are provided when products are transported in lightweight packaging. Platforms with large-capacity containers are handled in special express trains and usually pass through marshalling yards without handling. As a result the danger of damage to goods is reduced, which occurs when rolling stock is broken up from humps, and a high degree of preservation of goods is provided. Expenditures on marshalling of the large-capacity containers themselves is completely eliminated when car-lot shipments are transported. The flatcar circulating time in special container trains is reduced almost one-half in this case.

Large-capacity containers permit two-level stacking, which contributes to a saving of warehouse area at container terminals. The number of transloading container operations by the same volume of freight shipments is sharply reduced when large-capacity containers are used. And although the cost of each container operation for large-capacity containers is higher, the additional expenses are completely recovered by a much greater increase of their useful load. Therefore, the comparable cost of a ton-operation in reloading a single amount of freight in large-capacity containers is lower by a factor of 3.5-4 than in medium-capacity containers.

An increase of the load capacity of containers requires even more expensive means of mechanization, which increases the absolute scope of capital investments in these means several times. But at the same time the handling capacity of the container terminals increases sharply. Therefore, the specific scope of capital investments in mechanization per unit of freight traffic volume may be lower than when medium-capacity containers are used. General capital expenditures related to one 10-ton container comprise 3,000 rubles and those related to one 20-ton container comprise 4,500 rubles. But the additional expenditures per 20-ton containers are recovered within 1.5-2 years.

The maximum saving from use of large-capacity containers can be achieved during their primary use on rail lines with large scope of container traffic volume.

The use of special containers of different types and capacity on railroads is very effective. However, the scales of freight shipments in special containers are still insufficient and should be increased in the future.

Economically feasible bounds of specialization of the container stock are determined by calculations for each type of special container as a function of the freight traffic volume, the size of the freight lots and the shipping distance. Specialization is effective if the additional expenditures in transport and beyond it are completely covered by a saving from reduction of freight losses, acceleration of freight delivery and introduction of progressive means of mechanization of loading-unloading operations.

The use of special long-base flatcars without sides having capacity of 60 tons for container shipments yields a significant saving. The use of the capacity of these flatcars compared to universal four-axle flatcars increases by an average of 36 percent, operating expenditures are reduced by 20 percent and capital investments are reduced by 30-35 percent.

Universal introduction of automatic strapping and unstrapping of medium-capacity containers using automatic straps of the TsNII-KhIIT system will have important economic significance. Labor productivity will be increased and the cost of loading-unloading operations will be reduced as a result of this measure. The heavy and dangerous work of strap workers will be eliminated. The idle time of flatcars and containers will be reduced and the productivity of hoisting cranes will increase. The use of cranes equipped with automatic spreader-grabs is very efficient for handling large-capacity containers.

Complex implementation of various reconstructive and organizational-technical measures in the field of container shipments in rail transport will contribute to an increase of the economic effectiveness of functioning of the container transport system in the national economy.

6521
CSO: 8144/0359

EFFECTIVENESS OF CONSTRUCTING NEW RAILROADS AND SECOND TRACKS

Moscow EKONOMIKA I PLANIROVANIYE ZHELEZNODOROZHNOGO TRANSPORTA: EKONOMIKA ZHELEZNODOROZHNOGO TRANSPORTA in Russian Part 1, 1978 signed to press 20 Sep 78 pp 212-217

[Chapter 22 from the book "Ekonomika i planirovaniye zheleznodorozhnogo transporta: ekonomika zheleznodorozhnogo transporta," Izdatel'stvo Transport, 15,000 copies 352 pages]

[Text] 22.1. The Significance of New Railroad Construction

Construction of railroads is required to solve a number of important national economic problems: to develop new regions and to create a developed industry in them, to ease the load of intensively operating railroads, to reduce the time that freight is en route and to detour large overloaded railway junctions. New railroads contribute to more efficient distribution of shipments among different types of transport, improve transport communications and reduce expenditures for shipment and also strengthen the country's defense capability.

Each new construction project usually resolves several rather than one of the indicated problems. The length of the USSR railroad network increased approximately twofold during the period 1913-1975 and reached 138,300 km. The general-purpose railroad lines turned over for operation during these years are of enormous significance in the country's transport service. Many deficiencies in distribution and development of the railroad network of prerevolutionary Russia were eliminated as a result of constructing them. Outlets from the Donbass to the Center and to Leningrad are enlarged, the ties of the western and eastern parts of the network are improved, many dead-end lines are converted to through lines and so on.

Extensive railroad construction was carried out in the national republics to create the necessary transport conditions for rapid elimination of their previous economic backwardness and for further political and cultural development.

The network was considerably developed in the region of the second coal-metallurgical base (the Urals and the Kuzbass) for development of the country's natural resources. A railroad was constructed to Vorkuta, which made it possible to put a new coal basin of All-Union significance (the Pechora Basin) into operation. Extensive construction was carried out in regions of development of the virgin lands and also in Siberia, in the Far East and in Kazakhstan and Central Asia.

The USSR occupies second place in the world after the United States in the operational length of railroads, but is inferior to most developed countries in the industrial sense by the density of the network (with respect to territory). The railroad network is insufficiently developed specifically in the eastern regions of the country.

The railroad network of the eastern regions achieved considerable development after completion of construction of such important mainlines as the Southern Siberian and Central Siberian and also the Mointy-Chu line and others.

The 25th CPSU Congress planned a program of new railroad construction for 1976-1980. Construction of the Baykal-Amur Mainline Railroad (BAM) is continuing during the 10th Five-Year Plan. This mainline stretches from Ust'-Kut on the Lena River to Komsomol'sk-Amure. The meridianal Berkakit-Tynda-Bam (Skovorodino) line with length of 400 km intersects it at Tynda. The total length of the Baykal-Amur Mainline Railroad will comprise 3,145 km.

Together with the existing Tayshet-Bratsk-Ust'-Kut railroad lines in the west from the mainline and the Komsomol'sk-Sovetskaya Gavan' (Vanino Port) line in the east, the BAM forms the second railroad outlet to the Soviet Pacific ports.

Besides the BAM, the most important new railroad construction projects of the 10th Five-Year Plan are the following lines:

The Tobol'sk-Surgut-Nizhnevartovsk (710 km) will link the oil-producing regions of the Western Siberian lowland to the existing railroad network;

The Beloretsk-Karlaman (203 km) provides a direct outlet from the Southern Siberian Mainline to Povolzh'ye and the Center and eases the load of the Chelyabinsk and Orsk railway junctions and also the Chelyabinsk-Ufa and Orsk-Orenburg lines and will reduce the shipping distance of metal from the Magnitogorsk Metallurgical Combine to the west;

The Agryz-Krugloye Pole (118 km) will create an outlet for products of the Kama Motor Vehicle Plant (KamAZ) and the petrochemistry of the Nizhnekamsk industrial junction to the Kazan' line which links the Center to the Urals.

The Dolinskaya-Pomoshnaya (133 km) will create the shortest outlet of Krivoy Rog ore and of Donetsk coal to the Black Sea port of Il'ichovsk and to the Chop and Uzhgorod border stations;

The Krasnodar-Tuapse (97 km) provides the shortest outlet from the Rostov junction to the Black Sea coast of the Caucasus.

22.2. The Effectiveness of Constructing New Railroads and Methods of Determining It

When analyzing the effectiveness of new railroad construction, one proceeds from the state and national economic significance of new construction projects. Many aspects of the effectiveness of new railroads cannot be expressed in cost indicators. For example, the effect of new construction projects on increasing the cultural level of the populace, on strengthening the country's defense capabilities and so on cannot be measured in terms of money, although these factors are of important significance when evaluating the effectiveness of new construction.

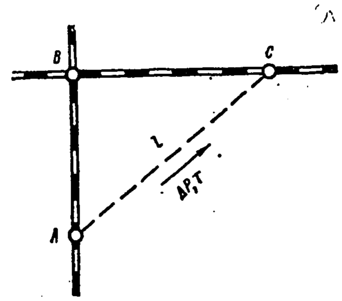

Figure 22.1. Diagram for Determination of the Effectiveness of Constructing a Straightening Line

The main part of the effect can be taken into account by using cost indicators. For example, the economic effect from construction of new railroads can be measured in some cases by the fraction of increase of industrial production at enterprises developed in the region of influence of the new line. This is related primarily to so-called pioneer roads and also the railroads which are constructed in new, remote regions, not sufficiently developed economically due to the absence of good communication routes.

When analyzing the economic effectiveness of constructing pioneer railroads, one proceeds from the fact that development of industry and an increase of the national income in the new regions would be impossible without construction of the railroad. However, one should bear in mind that the increase of production and of the national income in the new region is the result of capital investments in the entire national economy of the region, rather than in transport alone. Therefore, to determine what the fraction of product is per ruble of capital investments in transport, the cost of the increase of the entire national economic production in the region of influence, including the cost of shipments, must be related to the aggregate capital investments in development of the given region.

The effectiveness of constructing lines which provide development of natural resources can also be established by comparing the aggregate expenditures for production and shipment of the corresponding types of products with and without the presence of the line being evaluated. In the latter case expenditures to increase production of the same types of products in other regions with different shipping distance and also expenditures to increase the capacity of the existing routes of communication or construction of another railroad line are required.

Some railroads, along with development of new regions, at the same time make existing transport communications more efficient. The economic effectiveness of these lines is expressed not only in the increase of production in the region of influence but also by the relative reduction of transport work.

Reduction of transport work as a result of straightening freight transport routes permits a reduction of current expenditures for shipments. The scope of the saving of current expenditures can be determined in the following manner.

Let us assume that the freight flow in direction AC (Figure 22.1) will increase by ΔP tons. To develop it, the capacity of direction ABC with total length of L km (the first version) must be developed or a new straightening line AC with length of 1 km (the second version) must be constructed.

If the first version is adopted, the additional expenses for shipment will comprise

$$\Delta C' = \Delta P L c_э, \quad (22.1)$$

where c_e is the fraction of the cost in part of the additional operating expenses, kopecks/1 t-km. With the second version

$$\Delta C'' = \Delta P l c_п, \quad (22.2)$$

where c_p is the total cost of shipments on the new line, kopecks/1 t-km.

The saving of operating expenses when goods are shipped over the shortest route, replacing junction B, will comprise

$$\Delta C = \frac{\Delta P L c_э - \Delta P l c_п}{100}. \quad (22.3)$$

It will occur only if L/1 > cp/ce.

If construction of a new straightening line requires capital investments K_2 which exceed those K_1 in development of the existing route through junction B, the return of additional capital investments by the second version will be equal to

$$T_{ок} = \frac{K_2 - K_1}{\Delta C}. \quad (22.4)$$

Besides reducing shipping expenses, construction of straightening lines permits acceleration of freight delivery and consequently a reduction of the need of the national economy for circulating funds for goods "en route." A reduction of the freight mass "en route" M can be determined by the formula

$$\Delta M = \frac{\Delta P}{365} (T'_{дост} - T''_{дост}), \quad (22.5)$$

where ΔP is the number of goods shipped during the year over the new line, million tons, T'_{dost} is the delivery time of goods in the old direction and T''_{dost} is the delivery time of goods in the new direction.

Knowing the structure and cost of the goods being shipped, one can calculate the saving of circulating funds in monetary terms, which will be the result of acceleration of freight delivery.

Reducing the shipping distance of goods usually reduces the need for rolling stock. This yields a saving of capital investments in the car and locomotive fleets, which should also be taken into account.

A very important indicator of their effectiveness for many new construction projects is the achieved saving in expenditures on shipments by other types of transport, specifically, motor transport. For example, railroad lines constructed in regions of development of virgin and idle lands reduced the distance of hauling goods by motor transport to railway stations by more than 100 km in many cases. Expenditures for construction of these lines are returned within short periods, including those due to a saving for motor transport.

The effectiveness of new so-called load-easing lines is expressed primarily in the fact that they eliminate the need for large capital expenditures for development of the carrying capacity of existing sections. For example, the Novosibirsk-Leninsk-Kuznetskiy line postponed the need to construct second tracking 216 km long on the Proyektnaya-Yurga section; the Tselinograd-Kartaly line made it possible to postpone construction of the second tracking on the Tselinograd-Petropavlovsk section 419 km long and so on.

One or several of the indicated types of effect acquires decisive significance as a function of the nature of the new line, but most frequently new construction projects permit realization of a saving to one or another degree for all indicators.

Construction of new railroads requires very large capital investments at considerable material and labor resources. Depending on the terrain conditions, construction of 1 km of new line costs 200,000-500,000 rubles and in some regions of the Arctic it costs 600,000 to 1 million rubles. Up to 200 tons of metal, approximately 1,000 m^3 of timber and a large amount of other materials are required for each kilometer of new railroad. The economic effectiveness of constructing a new line must be universally and carefully justified in each specific case with regard to this. The effectiveness of all capital investments directed toward development of rail transport depends on this to a significant degree since capital investments in new railroad construction comprise a significant part of them.

22.3. Effectiveness of Constructing Second Tracks

Construction of second tracks is one of the most radical, but at the same time most expensive means of intensifying the carrying and traffic capacity of existing lines. Stations are usually developed simultaneously with laying of second track, traction equipment is intensified, more improved STsB and communications systems are introduced and the layout and profile of the line are improved. Therefore, the technical level of the railroad line is increased sharply after construction of double tracking and operating conditions are fundamentally changed. The carrying capacity increases 2-5-fold in this case.

Double tracking contributes to significant improvement of the qualitative indicators of operational work. For example, section speed is increased by an average of 20-25 percent (there are no train stops on a double-track line for crossing and only stops of freight trains for passenger trains to overtake them remain). Accordingly, the number of accelerations and slowing are reduced, due to which the running speed of trains also increases.

An increase of section speed accelerates car and locomotive circulation. As a result the need for rolling stock and for expenditures to acquire it is reduced. At the same time operating expenses are relatively reduced.

The labor productivity of locomotive brigades is increased and expenditures to maintain them are reduced with an increase of section speed and reduction of the number and also the duration of stops. A reduction of the number of accelerations leads to reduction of fuel consumption and a reduction of the amount of slowing down and the related brakings reduces the wear of rolling stock and expenditures for repair of it.

At the same time additional expenditures appear to maintain double tracking to develop stations. However, as indicated by practice and calculations, the cost of shipments on a double-track line is much lower with a large scope of freight traffic turnover than on two single-track lines having the same total amount of freight traffic turnover as a double-track line.

Construction of double tracking requires large capital investments. Expenditures for construction of double tracking comprise 65-70 percent of the cost of a new single-track line. The cost of laying double tracking under conditions when extensive work must be accomplished to develop junctions and stations and to strengthen the existing main track is especially high. In this case construction of one km of double tracking costs more than construction of one km of new single-track line. In this regard construction of double tracking is usually feasible in those cases when all other possibilities of increasing the carrying capacity of an existing single-track line are exhausted.

The length of double-track lines in the USSR increased more than twofold during the years of Soviet power.

6521
CSO: 8144/0359

PLANNING CAPITAL INVESTMENTS AND MAJOR OVERHAUL

Moscow EKONOMIKA I PLANIROVANIYE ZHELEZNODOROZHNOGO TRANSPORTA: EKONOMIKA ZHELEZNODOROZHNOGO TRANSPORTA in Russian Part 1, 1978 signed to press 20 Sep 78 pp 217-225

[Chapter 23 from the book "Ekonomika i planirovaniye zheleznodorozhnogo transporta: ekonomika zheleznodorozhnogo transporta," Izdatel'stvo Transport, 15,000 copies 352 pages]

[Text] 23.1. Main Problems of Planning Capital Investments

More than three billion rubles are expended annually on development of the material and technical base of rail transport. Therefore, proper planning of capital investments on railroads is of important national economic significance.

Planning capital investments solves a number of important problems. At the modern stage they are determined by the Main trends for development of the national economy of the USSR for 1976-1980 and by the decree of the CPSU Central Committee and the USSR Council of Ministers "On measures for development of rail transport in 1976-1980."

The main problem of planning capital investments in rail transport is to provide for the needs of the national economy and the populace for shipments with regard to creation of the necessary reserves of carrying and traffic capacity of railroads with minimum expenditures of funds.

A number of measures must be implemented to increase the effectiveness of capital investments. Complex development of all sectors of rail transport, a high level of development of technology and bringing the technical equipping of the entire railroad economy into agreement with the operational capabilities of new types of traction must be provided in planning. Dispersion of funds on numerous construction projects cannot be permitted and concentration of capital investments on the most important and starting objects must be provided and by doing so the construction deadlines must be reduced. Wide introduction of industrial methods of construction using reinforced concrete structures should be envisioned in the plans. Excesses in drafts and estimates must be eliminated, planning time must be reduced and construction by standard designs must be widely implemented to increase the quality and to reduce the cost of construction.

Planning of capital investments should also provide complex construction of objects of production significance and of housing, service enterprises and educational, cultural and health facilities.

The most important task of the plan of capital investments is to tie it to the plan of material and technical support. Construction that has begun should be provided with capital investments and material and labor resources in total coordination with the established volume of work.

23.2. The Content of the Plan of Capital Investments

The plan of capital investments is an integral part of the overall plan of rail transport. It determines the volume and direction of capital investments. The basis of this plan is the future plan of freight and passenger shipments.

The plan of capital investments includes three parts:

the volume of capital investments, including construction and installation work;

introduction of basic funds and production capacities into operation;

the title pages of objects of capital construction.

Moreover, the plan of capital investments contains technical-economic justifications, summary economic indicators on construction projects, calculation of the effectiveness of capital investments and other materials.

The overall sum of investments in the plan of capital investments and construction-installation work is distributed to objects of production significance, objects of nonproduction significance and planning-research work for construction of future years.

Capital investments in objects of production significance are in turn divided into two types:

expenditures for modernization of rolling stock and acquisition of spare parts;

expenditures for capital construction with distribution by sectors of the economy (electrification and power engineering, tracks, locomotives, rail cars, traffic, STsB and communications, freight, passengers, material and technical support and so on).

Expenditures for new rail lines and double tracking are specially allocated.

Capital investments in objects of nonproduction designation include expenditures for construction of housing and public facilities, culture, education, health and so on.

The plan of capital investments is compiled not only for sectors of the economy but for types of work as well (capital construction, construction and installation work, acquisition of equipment and inventory and so on) and also by directions for use of capital investments (new construction, expansion of existing enterprises, reconstruction and technical re-equipping of existing enterprises).

Distribution of the total sum of capital investments by sectors of the economy, types of work and directions for use is called the structure of the plan of capital investments.

Capital investments directed toward acquisition of equipment, tools and inventory include expenditures for acquisition of rolling stock, track machines and machinery, containers, spare parts and for modernization of morally obsolescent and physically worn out equipment.

Capital expenditures on environmental protection and efficient utilization of natural resources (capital investments of ecological significance) are now allocated in the total volume of capital investments and construction-installation work.

The cost of facilities turned over for operation and their physical volume or capacity are indicated in the plan of introducing basic funds and production capacities into operation. For example, putting such construction projects as new roads, double tracking, electrification of railroads, electric power transmission lines, development and lengthening of station tracks, equipping lines with the latest means of STsB and communications into operation is planned in kilometers. Introduction into operation for industrial enterprises is planned in units of the product produced by them. The unit of volume for housing construction facilities is square meters of total and living area or the number of apartments; the unit for educational and health facilities is the number of seats in schools and kindergartens, the number of beds in hospitals and so on.

The deadlines for putting basic funds into effect should be tied to the deadline for putting enterprises, structures and buildings into operation and should correspond to the norms for the length of construction.

The initial document for determining the volume of capital investments and construction-installation work and also putting basic funds and production capacities into operation is the title list.

The title list contains a list of the construction objects and their characteristics. The name and location of the construction projects, their design capacity, estimated cost and time of beginning and completion of construction are indicated in it; data are presented on the volumes of work completed by the beginning of the planning year and on introduction of basic funds and production capacities into operation; the anticipated fulfillment during the year preceeding the planning year is indicated.

The volume of capital work on the estimated cost with allocation of construction-installation work and putting into operation by capacity and by basic funds with indication of the deadline for introduction is established for the planning year.

What technical documentation is available and by whom and when it was confirmed is indicated for each object.

The volume of construction and installation work is distributed by the executors among organizations of the Ministry of Transport Construction (Mintransstroy), the construction organizations of MPS and other ministries and agencies. Organizations of Mintransstroy carry out the greatest volume of construction-installation work in rail transport. A significant part of the work is completed by construction organizations of MPS (railroad construction trusts, road-building trusts and so on).

The title lists are compiled separately for newly begun and transient construction projects.

Title lists for newly begun construction projects of production significance with estimated cost of three million rubles and above are confirmed by the USSR Council of Ministers upon presentation of Gosplan of the USSR, those for construction projects costing from one million to three million rubles are confirmed by the Minister of Railways or his deputies and those for construction projects costing up to one million rubles are confirmed by the chiefs of railroads.

Title lists of estimated cost from five million rubles and above on transient objects of production significance are confirmed by the Minister of Railways or his deputies upon coordination with Gosplan of the USSR, those costing up to five million rubles are confirmed by the Minister of Railways or his deputies and those costing up to one million rubles are confirmed by the chiefs of railroads.

Summary technical-economic indicators--the estimated cost of construction, the volume of gross product output, capacity put into operation, specific capital investments per ruble of gross product output, the cost of product output, profits, profitability, payback period and fund return--are calculated from title lists.

23.3. Order of Developing the Plan of Capital Investments

The plan of capital investments is developed in the following order.

Based on future planned freight and passenger traffic volumes by directions and sections, the planned scope of train traffic in the loaded direction for the calculating period is established. The demand carrying capacity of the lines, which is then compared to the available capacity by the beginning of the planning period, is determined from data on the scope of traffic. The comparison is made for all the main elements which limit traffic capacity--sidings, stations, energy supply (with electric traction), depot devices and so on.

The need to increase the carrying capacity for each section is determined as a result of comparison and measures are worked out to develop those elements which limit it. These measures are the basis for determining the volumes of work and the total sum of capital investments to intensify the carrying capacity of existing lines.

Along with measures to increase the carrying and traffic capacity of existing lines and to develop the network by construction of new railroads, work which contributes to an increase of labor productivity and reduction of the cost of shipments, provision of traffic safety and increasing the quality of shipments, on housing and cultural-service construction, improvement of working and safety conditions, work on construction of schools, sanitary-therapeutic institutions and so on is provided in the plan of capital construction.

Selection of measures to strengthen the carrying capacity of existing railroads, variants of newly constructed lines and other facilities is made on the basis of detailed multivariant technical and economic calculations. The planned task and estimate confirmed in established order are compiled for each object included in the plan.

When planning capital investments for railroads, one proceeds from the basic directions of the technical policy in the area of rail transport as a whole. The limits of funds allocated for technical re-equipping of railroads and also the extent of deliveries of rolling stock, materials of track superstructure and other hardware are taken into account. Capital investments in development of the carrying capacity of the most important lines are planned in centralized procedure to achieve a high level of technical equipping of mainline railroad directions.

The applications of enterprises, divisions and railroads for capital investments are reviewed in superior planning bodies from the viewpoint of their conformity to solution of the main problems.

The need for rolling stock and containers is determined by calculation on the basis of the presence of the stock of them, the growth in the volume of shipments and variation of the qualitative indicators of locomotive, rail car and container utilization during the planning period.

The need for locomotives is calculated separately for freight and passenger traffic, shunting work and for types of traction and series of locomotives. One is guided in this case by the plan for electrification of railroads and development of diesel traction. The scope of deliveries of new locomotives is established with regard to the part of locomotives that should be under repair and reserve, while obsolescent and low-powered locomotives will be gradually eliminated from the inventory.

The need for new freight cars is calculated by the types of cars on the basis of the structure of freight traffic turnover, with regard to the seasonality of shipments of individual types of goods.

The scope of deliveries of new passenger cars is determined on the basis of the planned scope of passenger shipments. The calculation is carried out separately for first class, second class, baggage and mail cars, dining cars and so on. The need for cars for multiunit traction, diesel trains, refrigerator trains and cars and also for refrigerator cars is established separately.

When determining the need for new cars, it is taken into account that obsolescent cars not corresponding to the operational requirements of general-purpose railroads should be eliminated from the inventory.

The need for containers of various types is determined the same as for new freight cars.

The number of locomotives and cars for narrow-gauge railroads is calculated separately.

The need for new heavy track machines--track-layers, snow-removal and sloping macines and snow blowers--is determined on the basis of future volumes of track work and work on snow removal.

Expenditures for acquisition of spare parts for locomotives, wheel pairs for cars and manufacture of experimental models of rolling stock are also included in the volume of capital investments for acquisition of rolling stock.

Expenditures for modernization are planned simultaneously with expenditures for acquisition of rolling stock. Expenditures for modernization consist of those for equipping locomotives and cars with more improved automatic brakes, roller bearings and so on.

A compulsory condition of high-quality planning of capital investments for all sectors of the economy is reduction of the volume of uncompleted construction. Therefore, when determining introduction of basic funds and production capacities into operation for transient objects, the size of uncompleted construction is universally analyzed and measures are planned to reduce it. It is necessary that the maximum possible number of objects and equipment be put into operation within the planning period.

23.4. Planning of Major Overhaul

Major overhaul of railroad hardware is carried out to maintain it in a functioning state throughout the entire service life.

Replacement or complete restoration of individual structural components of objects being repaired, for example, replacement or restoration of engine parts and assemblies, replacement of a roof, rafters, window sashes and so on is usually carried out during general maintenance. During general maintenance, tracks are completely replaced with new rails and wood crossties, the tracks are installed on crushed stone or existing crushed stone ballast is cleaned with supplementation of the support and dirty sand ballast is also replaced and other work is carried out.

General maintenance is usually carried once every several years, i.e., its frequency is more than a year and is carried out at the expense of depreciation deductions. The latter consist of two parts: of deductions for total restoration of worn-out basic funds (renovation) and their deductions for general maintenance.

The annual sum of deductions for general maintenance is determined in the following manner. Let us assume that the service life of an object of basic funds is 30 years and the frequency of general maintenance is 6 years. Then four major overhauls (30 ÷ 6 - 1) will be carried out during the entire service life. The number of repairs is reduced by one since the last repair prior to writing the object off due to wear is usually not carried out. If the cost of the object comprises, let us say, 100,000 rubles and the cost of one major overhaul is 20,000 rubles, then 20·4 = 80,000 rubles will be expended for major overhaul during the entire service life and an average of 80,000 ÷ 30,000 = 2,700 rubles will be expended during one year, which comprises 2.7 percent of the total restoration cost of the given object. The latter figure is also the norm or the quota of annual deductions for major overhaul.

The norm of deductions for major overhaul is established by the types of structures, devices, rolling stock, equipment and other hardware on the basis of their service life, intensity of utilization and consideration of the need to replace morally obsolescent equipment.

The scope of depreciation deductions depends to a significant degree on the service life of the object. The annual deductions for complete restoration are reduced and those for major overhaul increase with an increase of service life. In this regard it is very important to establish the optimum service life of an object at which a minimum total of annual deductions for renovation and major overhaul would be provided.

Service lives, the annual norms of deductions for major overhaul and the cost or price of a single major overhaul are established for all the most important types of basic funds of railroads. Annual deductions for major overhaul of basic production funds are included in the operating expenses and consequently in the cost of shipments. Expenditures of nonproduction basic funds for major overhaul are not included in operating expenses. Basic production funds comprise approximately 90 percent of the total value of the basic funds of railroads.

The norm of depreciation deductions for major overhaul comprises 3.4 percent of their cost on the whole for all hardware of rail transport, but it fluctuates considerably for individual types of equipment. For example, the annual norm of depreciation for major overhaul comprises 1.2 percent for the roadbed, 5.3 percent for the track superstructure, 6.2-6.7 percent for electric locomotives and 9 percent for constant-temperature cars.

When the major overhaul plan is compiled, the repair program is determined in natural and monetary units on the basis of the planned volume of work and the frequency of repairs by the types of hardware and the cost of a single repair.

The frequency of major overhaul is established for each type of hardware and is planned either in years--for freight and passenger cars, shunting, transfer and removal locomotives, buildings and so on or in millions of gross tons in all types of traffic--for track repair, or in thousands of locomotive-kilometers of total run--for repair of train locomotives. There may also be other measuring units. For example, major overhaul of rolling stock is carried out:

on the average every 2,160,000 km of run for electric train locomotives, including every two million km for DC locomotives and every 2.3 million km for AC locomotives;

on the average every 2,175,000 km of run for diesel train locomotives, including every 2,160,000 km for diesel locomotives of series TE 3, 2TE10 and TEP10 and every 1.8 million km for series TEP60;

on the average 10-15 years for shunting, removal and transfer diesel locomotives, including every 10 years for diesel locomotives of series TE1, TE2 and TGM3 and every 15 years for locomotives of series TEM1, TEM2, ChME3 and M62;

every 10 years for freight cars--boxcars, flatcars and tank cars, every 7 years for gondolas, every 4 years for oxygen tank cars, every 6 years for sections of refrigerator trains and refrigerator cars and every 4 years for all-metal passenger cars.

The normal frequency of major overhaul of track is different for main and station tracks. They also vary as a function of the type of rails, the type of cross-ties and the type of ballast. For example, this norm is 500 million gross tons of freight carried in all types of traffic for R65 rails for crushed stone and gravel ballast and 315 million gross tons for R50 rails.

The plan and actual volume of major overhaul for railroads and divisions may differ significantly from that of annual deductions for these purposes. The Ministry of Railways has the right to redistribute part of the deductions for major overhaul among the railroads and to use them according to the centralized plan of MPS. Part of these funds is used, for example, for work to extend station tracks, to equip lines with automatic blocking systems and centralized traffic control which yield the greatest effect when they are accomplished on an entire line.

The plan for major overhaul consists of the summary plan, title lists and explanatory notes. The summary plan is worked out by the indicators established by sectors of the economy and main types of work. The indicators reflect the physical volume of work and the cost of it. The title lists are compiled for the important work on major overhaul of basic equipment (repair of track, bridges and so on).

Work for major overhaul of track and repair and modernization of rolling stock occupy the greatest specific weight in the plan. More than 70 percent of the funds for major overhaul goes to this type of work.

All objects included in the plan for major overhaul should be provided with the necessary technical documentation, namely: detailed plans of the repair and calculation of its cost are compiled for complex objects and only calculation is compiled for repair work massive in nature and having standard technique of being performed. Moreover, drafts of organizing work on major overhaul are compiled for complex type of repair with the estimated cost above 25,000 rubles per object and also for work related to train traffic. Major overhaul costing less than 2,000 rubles per object is accomplished by the cost schedule of work.

Careful evaluation of the actual status of an object should precede without fail compilation of the plan for major overhaul since there is a need in some cases for ahead of schedule major overhaul and in other cases of postponing it. This largely depends on the operating conditions of the object and the quality of its routine maintenance.

More than two billion rubles are expended annually for major overhaul of the basic stock of rail transport. Therefore, correct planning of expenditures for major overhaul is of important national economic significance.

6521
CSO: 8144/0359

LABOR PRODUCTIVITY IN RAIL TRANSPORT

Moscow EKONOMIKA I PLANIROVANIYE ZHELEZNODOROZHNOGO TRANSPORTA: EKONOMIKA ZHELEZNODOROZHNOGO TRANSPORTA in Russian Part 1, signed to press 20 Sep 78 pp 241-245

[Chapter 25 from the book "Ekonomika i planirovaniye zheleznodorozhnogo transporta: ekonomika zheleznodorozhnogo transporta" Izdatel'stvo Transport, 15,000 copies, 352 pages]

[Text] 25.1. Indicators of Labor Productivity

Labor productivity is the most important indicator of labor efficiency in any sector of the national economy and at any enterprise. V. I. Lenin especially noted the significance of labor productivity for the victory of the new social order. He indicated that "capitalism can be finally conquered and will be finally conquered by the fact that socialism creates a new, much higher labor productivity."*

The level of labor productivity is determined by the number of products produced per unit time by a single worker or by labor expenditures for production of a unit of product. The ratio between expenditures of live and materialized labor varies with regard to scientific and technical progress. In many cases the fraction of materialized labor expended per unit of product increases but at the same time the fraction of live labor decreases to a greater extent. Total labor expenditures per unit of product are reduced and consequently its cost is reduced. Therefore, when comparing the indicators of productivity of all social labor, one must take into account expenditures not only of live but of materialized labor as well.

Expenditures of only live labor are practically determined and taken into account in plans and accounting reports since the methods of determining expenditures of materialized labor have not been worked out and the available initial materials are insufficient. Expenditures of live labor related to a unit of product are frequently called labor productivity. But this name is inaccurate. The index of the effectiveness of live labor is usually called output in the plans and accounts of railroads and line enterprises, which more correctly determines the content of this indicator.

Freight and passenger shipments are the product of the main activity of railroads. In this case output is determined by the number of reduced ton-kilometers per

*V. I. Lenin, "Polnoye sobraniye sochineniy", [Complete Works], Fifth edition, Vol 39, p 21.

worker of the operational contingent per year. The value of this indicator is established in the plans and accounts for the network, railroads and divisions.

The reduced ton-kilometers for the network as a whole and for railroads are found by adding the freight tariff ton-kilometers and passenger-kilometers and those for railroads divisions are found by adding the operating freight ton-kilometers and passenger-kilometers. Output in reduced ton-kilometers does not yield the correct concept of the true labor expenditures since one passenger-km requires labor expenditures 2.5-3-fold higher than one t-km. Therefore, special coefficients must be used in calculations for more correct evaluation of labor expenditures for railroads and divisions.

Output is measured in natural indicators in main line enterprises of transport: gross ton-kilometers per work at locomotive depots, by the number of rail cars dispatched and received at marshalling yards, by the number of dispatched and unloaded tons at freight stations, by the number of dispatched passengers at passenger stations, by the number of repaired rail cars or car-kilometers at car depots and so on. Only workers related to the operating contingent are taken into calculation in each line enterprise.

Different indicators are also used to determine the output of workers of individual occupations. For example, the output of locomotive brigades can be measured by gross ton-kilometers per worker or by locomotive-kilometers and that of conductor brigades can be determined by train-kilometers. Where output cannot be measured by a product in natural expression (for example, in repair work), the cost indicator or indicator of expenditure of man-hours for a specific volume of work is used.

Growth of labor productivity is a law of socialist economics. Output in reduced ton-kilometers increased more than fourfold during 1951-1975 in rail transport (Table 25.1).

Table 25.1. Number of Operating Contingent and Growth of Output

Indicators	Years					
	1950	1955	1960	1965	1970	1975
Operating contingent, thousand persons	1,712	1,980	2,011	1,981	1,997	2,070
Reduced product per worker of operating contingent, thous. t-km	403	562	833	1,088	1,382	1,715
Growth of annual output, percent of 1950	100	139	207	270	343	426
Reduced product per worker of operating contingent per hour of working time, t-km	164	229	356	524	665	827
Growth of hourly output, percent of 1950	100	139	217	320	405	504

The main trends of development of the national economy of the USSR for 1976-1980 provide for an increase of labor productivity by 18-20 percent in rail transport. Output per worker of operating contingent will comprise approximately 2,020,000 to 2,060,000 reduced t-km by the end of the five-year plan.

One should bear in mind that comparison of the annual output of transport workers of different countries (or of one country but for a number of years) inaccurately reflects the real growth of labor productivity. Differences in the length of the working day are not taken into account in this comparison; therefore, it is more correct to compare indicators of hourly output. Although the expenditure of man-hours in labor and accounting plans has not been established, the hourly output can be determined approximately by dividing the annual output by the normal working time per worker per year.

Thus, in 1964 the output throughout the railroad network comprised 1,032,000 reduced t-km and in 1965 it comprised 1,088,000 reduced t-km. Hence, the annual output during this period increased by (1,088,000 - 1,032,000) ÷ 1,032,000 x 100 = = 5.4 percent. But in 1964 the normal working time was equal to 2,093 hours and in 1965 it was equal to 2,077 hours. The hourly output in 1964 comprised $1{,}032 \cdot 10^3 \div 2{,}093 = 493$ reduced t-km and in 1965 it comprised $1{,}088 \cdot 10^3 \div 2{,}077 =$ = 524 reduced t-km. Consequently, the hourly output during the same period increased by (524 -493) ÷ 493·100 = 6.3 percent.* The difference between the growth of annual and hourly output in the given example is explained by a reduction of the annual normal working time due to establishment of two additional holidays per year (8 March and 9 May).

There is the concept of laboriousness along with the concept of output. Laboriousness indicates the expenditure of labor per unit of product or volume of work. This is a value inverse to productivity and output. Thus, if output in ton-kilometers is determined by dividing the reduced product ΣPl_{priv} by the operating contingent Ch_{ekspl}

$$П_р = \frac{\Sigma Pl_{прив}}{Ч_{экспл}}, \qquad (25.1)$$

then the laboriousness of one reduced ton-kilometer is established by an inverse ratio

$$T_р = \frac{Ч_{экспл}}{\Sigma Pl_{прив}}. \qquad (25.2)$$

The indicator of laboriousness is frequently used in rail transport to determine the need for the work force. In this case laboriousness is the normal expenditure of work force. Laboriousness is usually established in man-hours or in man-days. For example, the laboriousness of routine maintenance of locomotives is determined by the expenditure of man-hours per repair, while the laboriousness of routine track maintenance is determined by the number of persons per kilometer of track.

25.2. Methods of Increasing Labor Productivity

Scientific and technical progress in rail transport and mechanization and automation of labor have a decisive effect on the level of output and labor productivity

---

*It is assumed in these calculations that the relative value of overtime work does not change significantly throughout the years.

as a whole. Especially great opportunities for increasing output are provided upon conversion of railroads to new types of traction--electric and diesel.

The continuous growth of shipments creates favorable conditions for increasing output in a socialist economy. This is explained by the following. Part of the operating contingent of railroad workers (the dependent contingent) varies in proportion to the increase of the volume of shipments. They include locomotive brigades, electric fitters, passenger train conductors, forming-up brigades at stations, workers for routine repair of rolling stock, engineers-brigade leaders of passenger trains, workers involved in outfitting locomotives, forming-up trains and so on. The specific weight of this contingent comprises approximately 30-35 percent throughout the network, 40 percent on roads with high freight traffic turnover and approximately 25 percent on roads with low freight traffic turnover.

The remaining, greater part of the operating contingent (approximately 65-75 percent) hardly depends on the volume of shipments if the scope of traffic increases within the limits of existing carrying capacity. Therefore, the growth of shipments must lead to an increase in the level of output. For example, if the scope of traffic increases by 10 percent, the total number of operating contingent increases by only 3 percent ($70 + 30 \cdot 1.1 = 103$) while output due to an increase of the scope of traffic alone increases by 6.8 percent ($110:103 \cdot 100 = 106.8$).

Actually, the dependent part of the contingent increases somewhat more slowly than the scope of shipments since the weight of trains and speed increase from year to year, equipment and so on is improved and this reduces the need for a dependent contingent of workers.

The level of organization of operational work, the degree of mechanization of labor, automation of control and qualifications of workers have an important effect on the value of output throughout the network and roads. A combination of individual occupations is effective, for example, combination of the positions of station duty officer and ticket cashier, the posts of signal operator and caller of locomotive and train brigades or of electric fitter of the contact network, inspector of cars and receiver-dispatcher of freight and baggage, of technical clerk and rail car lister and so on on low-activity lines. The combination is permissible if high quality of main work and the work performed by the combined occupation is provided.

Organization of the socialist competition and dissemination of leading methods of labor is of the most important significance for a continuous growth of output and labor productivity of railroad workers.

An increase of output depends to a significant degree on organization of wages and also on creative cooperation of scientific and production workers and a number of other factors.

The majority of the increase of shipments in rail transport from year to year was developed by an increase of output. During the period 1961-1970 the increase of shipments was developed by 100 percent due to this factor and by more than 96 percent in 1970-1975. It is planned to develop a 95 percent increase of freight traffic turnover during the 10th Five-Year Plan by increasing output.

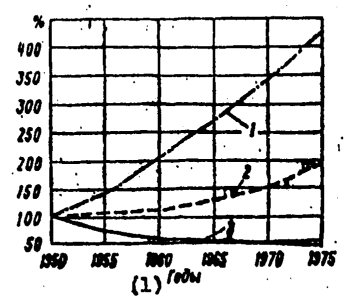

Figure 25.1. Growth of Annual Output, Average Monthly Wage and Reduction of Cost of Shipments During the Period 1950-1975: 1--annual output in reduced ton-kilometers; 2--average monthly wage, rubles; 3--cost of shipments, kopecks/10 t-km

Key:
1. Years

Moreover, the structure of freight shipments by types of service (transit, import, export and local service) and the level of technical equipment have an effect on output on individual railroads. It fluctuated significantly on railroads with average network output of 1,714,000 reduced t-km in 1975. For example, output comprised 2,870,000 reduced t-km on the Southern Urals Railroad, 2,506,000 km on the Western Siberian Railroad, 1,273,000 km on the Moscow Railroad and 620,000 reduced t-km on the Trans-Caucasian Railroad. Therefore, comparisons between railroads by the value of output must be made with regard to correcting coefficients.

The level of output on railroads also depends on the structure of shipments by types of traffic (freight and passenger). Since labor expenditures per passenger-kilometer are greater than per ton-kilometer, then output is higher on railroads with lower specific weight of passenger traffic, all things being equal.

The layout of the railroad also affects output. The simpler the layout, the higher the output that can be achieved. An vice versa, the presence of a large number of junctions, branches and dead-end lines, freight and marshalling yards and junction stations considerably complicates the work of the railroad. An additional work force is required to service them.

The level of output is higher on wide-gauge railroads and lower on narrow-gauge railroads.

The growth of labor productivity is a decisive condition for increasing the operating efficiency of rail transport. Specifically, an increase of output significantly reduces the cost of shipments. The dependence between output and cost is shown in Figure 25.1.

6521
CSO: 8144/0359

WAGES IN RAIL TRANSPORT

Moscow EKONOMIKA I PLANIROVANIYE ZHELEZNODOROZHNOGO TRANSPORTA: EKONOMIKA ZHELEZNODOROZHNOGO TRANSPORTA in Russian Part 1, signed to press 20 Sep 78 pp 246-254

[Chapter 26 from the book "Ekonomika i planirovaniye zheleznodorozhnogo transporta: ekonomika zheleznodorozhnogo transporta" Izdatel'stvo Transport, 15,000 copies, 352 pages]

[Text] 26.1. The Essence of Wages

The wage of socialist production workers is the fraction in social production expressed in monetary form. But the fraction of workers in social production is not limited by wages. Besides wages, the state allocates extensive funds for health, education, printing of manuals and other sociocultural measures. These funds form the social funds of consumption.

The scope of wages is established by the state in planned procedure according to the number and quality of work of each worker and with regard to the real capa il- ities of the state. The personal incentives of workers are achieved by this in the results of their labor and the opp rtunity to correctly combine personal interests of workers with the interests of social production.

Nominal and real wages are distinguished. The nominal wage is characterized by the number of monetary units received for work. The real wage is determined by the number of material goods and services which can be acquired with a given nominal wage. The real wage can be increased by increasing the nominal wage or by reducing the prices for goods and rates for different services. In 1975 the average wage of a worker of the operating contingent of railroads comprised 148 rubles (without regard to payments from the material incentives fund) and it comprised 159 rubles with regard to these payments. The individual wage and social consumption funds per fraction of workers and salaried employees comprised their total income.

The increase of wages should be in specific conformity to the growth of labor productivity and the growth of labor productivity should constantly surpass the growth of wages. Only with this condition is a continuous increase of social production and a systematic increase of real wages possible. The rates of growth of labor productivity and wages are determined by planned calculations. The level of labor productivity in rail transport increases faster than the wage level (see Figure 25.1).

A further increase of wages was provided by the decisions of the 25th CPSU Congress. The average wage of workers and salaried employees will increase by 16-18 percent during the 10th Five-Year Plan and will reach no less than 170 rubles per month in 1980. Payments and taxes to the population from social consumption funds will increase by 28-30 percent. An increase for payment of nighttime labor and an introduction of bonuses to the wage for length of service in regions of the Far East is envisioned. Measures are planned to improve working conditions.

Part of the planned measures has already been implemented. In 1977 the wage of more than half the workers of the operating contingent increased (additional payments for nighttime work, for work on sections with intensive traffic and some others were increased). As a result the wage of workers of the operating contingent increased by an average of more than 3.7 percent.

Beginning in 1979, a bonus is being introduced for prolonged meritorious service of workers engaged in jobs on the main activity of rail transport.

26.2. The Tariff System

The wage in rail transport is regulated by a tariff system which includes a tariff scale, tariff rates and tariff-qualification guides (TKS) and also duty rates.

A unified tariff scale established in 1971 now exists on the entire railroad network. Workers of the majority of the operating contingent are paid by the rates of this scale.

The tariff scale containing the tariff rates for payment of workers involved in operational work, in jobs on track maintenance and repair, structures, rolling stock and other means of transport has six ranks. The entire contingent paid by rates of this scale is divided into three groups.

The first group includes workers directly involved in the process of shipments and which represent the main, leading part of the operating contingent. Workers involved in uncoupling repair of cars and locomotives in the depot, workshops and other similar jobs are allocated to the second group. Work of this job category is different in nature compared to the first group and the tariff rates for it are established approximately 3.5 percent lower. The third group includes machine operators. The labor of these workers is usually standardized with high accuracy and the intensity of their labor is higher than that of many workers of other categories. Machine operators should have comparatively high skills. Therefore, rates 2-8.5 percent higher have been established for their wage compared to workers of the first group.

The tariff rates established for each group of workers are differentiated by the working conditions, qualification ranks and forms of payment. Differentiation by working conditions has three varieties. The greater part of workers work under normal conditions. Workers involved in jobs with heavy and harmful working conditions are related, for example, to inspectors-access workers, train compilers and so on and workers engaged in especially heavy jobs and jobs with especially harmful conditions are related to casters of lead-tin alloys, tank car washers-cleaners and so on. The tariff rates of workers engaged in jobs with heavy and harmful working conditions are approximately 12.5 percent higher and those for workers engaged in especially heavy jobs and jobs with especially harmful conditions are 23-27 percent higher compared to normal working conditions.

The value of tariff rates also depends on the tariff rank. The tariff rank is established as a function of the nature of the work and the qualifications of the worker. The first tariff rank provides the lowest wage rate. The ratio of the wage rates for each subsequent tariff rank to the rate of the first rank is called the tariff coefficient.

As a result of measures to increase wages implemented in 1971, the value of tariff coefficients was reduced. The tariff coefficient of rank 6 is now equal to 1.715, whereas it comprised 1.788-1.897 previously. This indicates that the gap in the wage of low-paid and high-paid workers was reduced.

When an identical job is performed by piece workers and time workers, the tariff rates are established somewhat higher for piece workers than for time workers. This is done because the labor of piece workers is more intensive than that of workers on a fixed time wage.

Hourly rather than monthly tariff rates are established in the tariff scale. Payment for labor is made for the number of hours per month actually worked.

Average values of the tariff coefficient and of the tariff rank are frequently used in planning calculations.

The ranks of qualified workers and ranks of jobs performed by them are established by tariff-qualification references. The characteristics of the jobs related to different ranks are given in these manuals and the requirements placed on the executor for assigning him a specific qualification rank are indicated. Two tariff-qualification manuals--the unified national economic and special railroad manual--are used on railroads. The majority of jobs and workers in rail transport have a tariff rate set according to a special TKS. The labor of locomotive brigades has significant features. Workers of these brigades should have varied knowledge in the field of mechanics, electrical engineering, heat engineering, organization of traffic, signalling and so on. The wage of locomotive brigades is paid by special increased tariff rates.

The tariff rates for locomotive brigades are differentiated by types of traffic--passenger, freight and shunting work. The tariff rates are also differentiated by the types of trains in passenger and freight traffic and by the classes and sections of stations in shunting work.

The highest tariff rates have been established for workers of locomotive brigades in passenger traffic when working with long-distance trains which travel through a servicing section at an average running speed of more than 100 km/hr. The tariff rates are 8-12 percent lower than the maximum rates when working with other long-distance passenger trains and also with suburban passenger trains on sections with dense traffic (more than 100 pairs of trains of all types per day). The tariff rates are 19-21 percent below the maximum when working with remaining suburban trains. Work with passenger trains is more complicated and responsible. The most experienced and qualified workers usually perform it. Therefore, their wage is higher.

Only time payment for labor is used in passenger traffic. A precise operating schedule of brigades can be constructed within the limits of the established monthly normal run with rigid train traffic schedule. Therefore, there is no need to use a piecework wage rate.

The maximum rates have been established in freight traffic for payment of heavy and complex work--work with preassembled and transit freight trains. The tariff rates are 5-11 percent lower than the maximum on less complicated work--work with transfer and export trains and for pushing. The tariff rates are 11-17 percent below the maximum for payment of work with housekeeping and other trains and work on individual locomotives. The work of brigades of shunting locomotives on the main sections of large stations (unclassified and classes 1 and 2) is paid according to the same rates.

The labor of locomotive brigades has no qualification ranks since the complex of jobs and their complexity are approximately identical for each worker of the corresponding production group. But the experience of workers and their production skills are taken into account by assigning a qualification class to engineers. Additional payment to engineers of class 1 comprises 15-25 percent, that for engineers of class 2 comprises 10-20 percent and that for engineers of class 3 comprises 5-15 percent of the tariff rate of a time worker. Additional payment of 5-10 percent of the tariff rate of a time worker is paid to assistant engineers having the right to drive a locomotive.

Official monthly rates have been established to pay managers and engineering and technical personnel, salaried employees and service personnel. The official rates of workers depend on the class or group of the enterprise of rail transport which are established as a function of the volume and complexity of work.

Official monthly rates have been established for some categories of time workers (drivers of transport-harvest machines, freight and baggage handlers, boiler workers and so on).

The tariffs and official rates are supplemented by bonuses and additional payments.

Railroad workers of the Arctic, Far East, Siberia, the Urals and other regions with severe natural climatic conditions receive an increased wage. Regional coefficients have been established which taken into account the degree of wage increase. Thus, the regional coefficient for Sakhalinskaya Oblast is equal to 1.6, that for Vorkuta is equal to 1.5, that for Sovetskaya Gavan' is equal to 1.4, that for Gur'yevskaya Oblast is equal to 1.2, that for Chelyabinskaya Oblast is equal to 1.15 and so on.

A bonus in percent of the monthly wage has been established for workers engaged in regions of the Arctic and adjacent locales, besides additional payments according to the regional coefficient.

26.3. Forms and Systems of Payment Used in Rail Transport

There are two forms of payment: piecework and time work. Each unit of manufactured product or a specific volume of work performed is paid with the piecework form. The working time (working day, month or hour) is paid with the time form. Piecework payment is used on those jobs where labor can be normalized. Time payment is used if precise normalization is impossible or if the work performed cannot be accounted for anc checked.

The forms of payment of individual groups of workers have varieties which are usually called systems. Use of them should provide the maximum incentives to workers to increase labor productivity, improve product quality and to improve their own qualifications.

The following systems of piecework payment are used in rail transport: direct piecework, piecework-bonus, and piece rate-bonus. The most widespread in railroad operation are piecework-bonus and time-bonus systems.

Workers of locomotive brigades engaged in freight traffic with transit and built-up trains and also with export and transfer trains on sections with high stable volume of work, workers of complex brigades at large stations, workers engaged in routine repair of locomotives and so on are paid by the piecework-bonus system.

The labor of workers of locomotive brigades in passenger traffic, in export and transfer work (on low-activity sections and at junctions) and on shunting locomotives, workers of maintenance stations (besides PTO at large stations) and so on is paid by the time-bonus system. Approximately 55 percent of all workers of the operational contingent are paid on a time basis.

Wage rates per unit of product or work are established to determine the wage with the piecework-bonus system of payment (the same as with direct piecework payment). For example, the wage rate for locomotive brigades has now been established for 1 km of run, that for complex and shunting brigades at stations has been established for one dispatched train or rail car, that for workers hired at maintenance terminals at large stations has been established per formed-up train, a train technically ready for dispatch and so on.

Wage rates are determined by multiplying the hourly tariff rate by the time norm in hours. Thus, if the time norm for repair of the carriage of a four-axle car comprises 1.5 hours, the rank of work is four, the hourly tariff rate of a machinist, rank 4 (finisher) is 61.6 kopecks, then the piecework wage rate will be $61.6 \cdot 1.5 = 102.4$ kopecks.

In some cases wage rates are established by dividing the monthly tariff rate by the monthly wage norm. The average monthly tariff rate, which is calculated by multiplying the hourly tariff rate by the average monthly working time norm, is taken. For example, if the average monthly tariff rate of an engineer is equal to 201.35 rubles and the monthly wage norm is 5,500 km, then the piecework wage rate will comprise 20,135 5,500 = 3.661 kopecks per kilometer.

Additional payments for work on holidays, at nighttime and for overtime work are determined individually. Work on holidays is paid for at double rate. Additional days off may be offered to the worker instead of additional payment.

Payment at the rate of 35 percent of the tariff rate of a pieceworker (with piece work payment) or of a time worker (with time payment) is established for each hour of nighttime work. All workers have this type of additional payment regardless of how they are paid--by tariff rates or monthly rates.

Time workers receive additional payment at the rate of 50 percent for the first two hours of overtime work and 100 percent of their hourly tariff rate for subsequent hours. Pieceworkers are paid at the rate of 50 percent for the first two hours of overtime work and 100 percent of the hourly tariff rate of a time worker of the corresponding rank for subsequent hours. Thus, if a time worker, rank 4, worked 3 hours overtime, then his daily wage at an hourly tariff rate of 57.6 kopecks and a 7-hour working day will comprise $(7 \cdot 57.6) + 2(57.6 \cdot 1.5) + 1(57.6 \cdot 2) = 6.89$ rubles.

Additional payment at the rate of 20-30 percent of the tariff rate or of the official rate of the worker whose post is being filled is authorized with combination of occupations or duties.

Awarding bonuses is widely distributed in rail transport. Bonuses are an important type of material incentive and are paid both with piecework and time payments. The main problem of awarding bonuses is that of creating the maximum incentives for each worker as a result of his labor and also as a result of the labor of the collective of the brigade, shop and enterprise as a whole. Enterprises are given the right to develop their own regulations on awarding bonuses and to establish the range of workers awarded bonuses, the size of the bonuses and the indicators for awarding bonuses.

A bonus is awarded from two sources--the wage fund and the material incentives fund. The size of this part of the wage fund, which is designated for awarding bonuses, is determined by the plan according to labor. The size of the material incentives fund depends on the level of profitability and growth of profits and is created by deductions from profits according to specially established norms. Bonuses from the wage fund are paid to workers and to some engineering and technical personnel and those from the material incentives fund are paid to workers, salaried employees and engineering and technical personnel.

The following have been established by the typical regulation on awarding bonuses to rail transport workers, confirmed in 1978:

the main indicators of awarding a bonus which characterize the final results of production or which have a decisive effect on achieving the results. A bonus is not paid if the main indicators are not fulfilled;

additional indicators of awarding a bonus, established if necessary along with the main indicators for stimulating various aspects of labor activity. The amount of the bonuses is reduced if they are not fulfilled ;

the main conditions of awarding a bonus which contain the most crucial requirements on workers. Bonuses are not paid if the main conditions are not fulfilled;

additional conditions for awarding a bonus containing less important requirements. The size of the bonuses is reduced if they are not fulfilled.

The number of indicators for awarding bonuses should be minimum. The size of the bonuses is increased for overfulfillment of both the main and additional indicators.

Regulations on awarding bonuses in which indicators for awarding bonuses are recommended for specific categories of workers, the rational amount of bonuses and so on, are worked out by the main sector administrations of MPS in development of the standard regulation.

The workers of rail transport enterprises, pieceworkers and time workers are awarded bonuses for individual and collective results of work for fulfillment and overfulfillment of quantitative and qualitative indicators, reducing the periods of work carried out, good maintenance of hardware, fulfillment and overfulfillment of established norms and also assimilation of new norms and saving of materials, fuel and spare parts.

Bonuses may be awarded to workers only for fulfillment of the established indicator or only for overfulfillment of it or for the total of fulfillment and overfulfillment.

Bonuses are paid for quantitative indicators provided that the qualitative indicators have been fulfilled and they are paid for qualitative indicators provided that the quantitative indicators have been fulfilled to create incentives to increase quantitative production with high quality.

Bonuses are usually established for workers in percent of the piecework wage or tariff rate (for the indicator as a whole or for each percent of improving it) and they are paid for the results of work during the month. A bonus is distributed among workers in proportion to the wage of each of them if it is awarded for collective work.

The total amount of bonuses received by workers from the wage fund cannot exceed 40 percent of their monthly wage. The size of the bonuses from the material incentives fund is unlimited.

Engineering and technical personnel and salaried employees directly involved in production (in shops, on shifts and on sections) are awarded bonuses mainly from the material incentives fund. The indicators for awarding bonuses to them may be fulfillment and overfulfillment of the profit and profitability plans, reducing operating expenses and cost, improving the indicators of rolling stock utilization and so on. The size of the bonuses is established in percent of the official rate for fulfillment of the indicators and for each percent of overfulfillment.

Besides piecework-bonus and time-bonus systems of payment, the piece rate-bonus system is used in rail transport. The labor of workers in track maintenance is paid by this system. Wage rates with the piece rate-bonus system are established for a specific volume of work performed by a brigade of workers rather than per unit of production.

The essence of the piece rate-bonus system consists in the following with respect to current track maintenance.

An operating section of track several kilometers long is assigned to each brigade. The distance of the track determines the number of workers in the brigade and the total piece rate of payment. One proceeds in this case on the established norms of the consumption of the work force per kilometer of track and of the wage fund. The norms of consumption of this fund will be different for different categories of track. The total monthly piece rate is established by calculation for each brigade to which an operating section is assigned.

If the task to improve the condition of the track is fulfilled and the track is maintained normally, the total monthly piece rate is paid completely and is distributed among the members of the brigade as a function of the time worked by each of them and the qualification rank assigned. The number of workers in the brigade can be less than the calculated number by approximately 15 percent if its members agree to this. Consequently, the total piece rate is divided in this case among a lesser number of workers and each of the brigade members receives a larger fraction. This procedure contributes to an increase of labor productivity.

If the volume of work is underfulfilled and the number of workers in the brigade is less than the calculated number, then the total piece rate is reduced in proportion to the percentage of underfulfillment of work.

A bonus is paid monthly to the brigade for fulfillment of the established tasks to improve the condition of the track. The size of the bonus depends on the evaluation of the quality of track maintenance. A bonus is not paid with unsatisfactory evaluation of maintenance of at least one kilometer of main or station track or of one facility.

All monies designated for workers for labor form the wage fund. One-time bonuses (bonuses for socialist competition, for development of inventions, innovative suggestions and so on) are not included in the wage fund, i.e., those not provided by existing systems of payment. Such payments as detached duty, pensions and allowances for social insurance, allowances and subsidies from the material incentives fund, surcharges to wages for social insurance and so on are not included in the wage fund.

Planning and accounting for all monetary payments are accomplished separately by the following types: payment of permanent and temporary workers, one-time bonuses, miscellaneous payments and surcharges to wages.

6521
CSO: 8144/0359

PLANNING THE OPERATING EXPENSES OF RAILROADS

Moscow EKONOMIKA I PLANIROVANIYE ZHELEZNODOROZHNOGO TRANSPORTA: EKONOMIKA ZHELEZNO-DOROZHNOGO TRANSPORTA in Russian Part 1, signed to press 20 Sep 78 pp 259-265

[Chapter 28 from the book "Ekonomika i planirovaniye zheleznodorozhnogo transporta: ekonomika zheleznodorozhnogo transporta" Izdatel'stvo Transport, 15,000 copies, 352 pages]

[Text] 28.1. Classification of Railroad Expenses. The Nomenclature of Expenses

Railroad expenditures are divided into capital and current. Capital expenditures are those for erection of buildings and structures, acquisition of equipment, rolling stock and other basic stock which participate repeatedly in the production process. Current expenditures are related to those for wages, fuel, electric power, materials and depreciation deductions. All these elements of expenditures are necessary to provide the production process of the current period. Current expenditures of railroads for shipment of freight, passengers, mail and baggage are called operating expenses.

With respect to the production process, operating expenses are divided into main and general economic.

Main expenses are related directly to the production process, i.e., to shipments. For example, they include expenses for fuel and electric power for train locomotives, for maintenance of locomotive brigades and so on.

Main expenses are divided into main expenses specific for individual sectors of the railroad economy (related to repair of rail cars, locomotives, to maintenance of the station staff and so on) and main expenses general for all sectors of the economy. The main expenses common to all sectors of the economy include additional wages of production personnel (payment for leave, payments for fulfillment of state and public duties, answering military musters and so cn), deductions for social insurance, expenses for safety, detached duty and so on.

General economic expenses are related to management of enterprises and servicing of the production process. These expenses are divided into general economic without expenses for maintenance of management apparatus and expenses on maintenance of management apparatus. General economic expenses include those on wages of shop personnel, maintenance of buildings, structures and inventory of general economic significance, on personnel training and so on.

According to average network data, main expenses comprise 91 percent of the total operating expenses (including 10 percent of the main expenses common to all sectors of the economy) and general economic expenses comprise 9 percent.

Depending on the method of relating expenses to the cost of shipments, they are divided into direct and indirect.

Expenses related to output of some single type of product are called direct expenses. They can be completely related to the cost of this type of product. Indirect expenses are related to output of several types of product. These expenses are related to a specific type of product after preliminary distribution of them. A high specific weight of indirect expenses in the total sum is typical for railroads.

The operating expenses of railroads are divided into dependent and conditional-permanent.

Dependent expenses are those which vary in direct proportion to variation of the volume of shipments. For example, expenses for maintenance of locomotive brigades vary the same as the volume of shipments. Expenses for fuel, electric power, repair and shock absorption of rolling stock and so on are the same function of the volume of shipments.

Conditional-permanent expenses do not vary or vary little with an increase or decrease of the volume of shipments. Conditional-permanent expenses include the greater part of expenses for maintenance and depreciation of permanent equipment.

The operating expenses of railroads are planned and taken into account by a specific system called the nomenclature of expenses. According to the nomenclature, expenses are accounted for and planned according to the main (operational) and auxiliary activity. Current expenditures related to shipments of freight and passengers are taken into account according to main activity. Current expenditures financed at the expense of miscellaneous sources are taken into account according to auxiliary activity. These are expenditures of mechanized railway divisions for loading-unloading work, ice plants, fuel depots, materials warehouses, quarries and so on.

All expenses related to main activity are planned and taken into account by facilities: passenger, freight, traffic, locomotive, rail car, track, signalling and communications, electrification and power engineering and several structures. The specific weight of expenses of individual facilities is not identical in the total sum. The structure of the operating expenses of railroads by facilities during 1977 is presented below (in percent):

Passenger	1.2
Freight	2.6
Traffic	6.5
Locomotive	35.3
Rail Car	20.3
Tracks	21.6
Signalling and Communications	4.4
Electrification and Power Engineering	2.4
Civilian Structures	1.3
Expenses of Divisions and Administrations of Railroads and General Railroad	4.4
Total	100.0

As can be seen, expenses for locomotive facilities occupy the highest specific weight. Together with expenses for track, rail car and traffic facilities, they reach 83.7 percent of the total sum.

The structure of operating expenses by railroad facilities varies in time. For example, the fraction of expenses of locomotive facilities comprised 40.5 percent in 1950. A reduction of it to 35.3 percent occurred due to the effect of technical reconstruction and also due to organizational and technical measures carried out in the locomotive facilities.

Expenses are planned and taken into account by items in each facility. Expenses for one or several jobs of the same type or production operations are taken into account in an individual item. For example, expenses for wages and materials which are necessary to carry out work on routine maintenance and technical inspection of freight cars at points where they are prepared for loading are taken into account in the expense item "Inspection and routine maintenance of freight cars during preparation of them for loading."

Moreover, operating expenses of railroads are taken into account and planned by elements of expenditures: wages, deductions for social insurance, fuel, electric power, materials, depreciation deductions and miscellaneous expenditures. Wages and depreciation deductions occupy the greatest specific weight.

The structure of the operating expenses of railroads by elements of expenditures for 1977 is presented below (in percent):

Wages With Deductions for Social Insurance		40.1
Depreciation Deductions		31.6
Fuel		8.6
Electric Power		7.0
Materials		7.0
Miscellaneous Expenses		5.7
	Total	100.0

The specific weight of individual elements of expenditures in the total sum of operating expenses also varies in time. The specific weight of depreciation deductions, which is related to the high rates of technical re-equipping of railroads, increased especially significantly during the past few years.

The structure of the operating expenses of railroads depends on the volume of shipments, technical equipping, level of labor productivity, norms of expenses and the level of prices for materials, fuel and electric power.

28.2. Method of Planning the Operating Expenses of Railroads

The plan of operating expenses is an integral part of the operational plan of railroads. It is worked out on the basis of data of the shipments plan, the plan of rolling stock operation, the labor plan, the planned size of basic funds, the norms of depreciation deductions, norms of consumption and prices for fuel, electric power, materials and so on. The planned growth of labor productivity, improvement in utilization of basic funds and rolling stock of railroads and other reserves for reducing the cost of shipments are taken into account.

Monetary funds to support the production program are provided in the plan of operating expenses. These funds are required for payment of wages, to acquire materials, fuel and electric power and to accomplish other expenditures.

The plan of operating expenses is worked out for line enterprises, divisions, railroads and for the network as a whole. The procedure for working out the plan of operating expenses is as follows.

Line enterprises work out a draft of the plan and present it to the planning-technical-economic department of the railroad division. The drafts of the plans are checked here, the expenses of the division are added to the expenses of line enterprises and the summary draft of the plan for the division is presented to the planning department of the railroad administration.

The plans of the operating expenses of divisions are reviewed and corrected in the planning department of the railroad. The general railroad expenses and expenses for maintenance of railroad control apparatus are added to the confirmed value of expenses by divisions. The total expenses for the railroad are determined as a result.

The methods of planning the expenses in line enterprises, divisions and on railroads are different. But there are general principles on which planning of operating expenses in all subdivisions of rail transport is based. Let us consider the order of planning expenses in the railroad by the elements of expenditures.

Wages. All types of payment of both permanent and temporary railroad workers are taken into account by this element of expenditures. The wage fund is determined on the basis of the number of workers and their average monthly wage. The method of planning these indicators is considered in Chapter 27.

Deductions for social insurance. Funds for deductions for social insurance of workers and salaried employees are transferred to social insurance organizations and are used to pay pensions and allowances upon loss of work capacity, to support workers with passes to sanitoria and rest homes and to implement other rehabilitation measures.

Deductions for social insurance are determined at the rate of 7.5 percent of the wage fund.

Moreover, deductions for social insurance are calculated from the total bonuses paid from the material incentives fund which are not included in the wage fund.

Depreciation deductions. The basic stock of railroads wears out during operation. Monetary expenditures, which are called depreciation deductions, are necessary to restore it.

The planned value of depreciation deductions is determined on the basis of data on the presence of basic funds for the beginning of the planning period and on proposed introduction of them into operation and taking out of operation. The basic production stock of railroads, with the exception of least stock, and also dining cars, mail cars and so on, are taken into the calculation.

The total value of depreciation deductions consists of two parts: deductions for total restoration (renovation) and deductions for major overhaul.

Depreciation deductions for total restoration A_v are intended for complete replacement of basic stock taken out of operation and are calculated by the formula

$$A_в = \Phi q_в, \tag{28.1}$$

where ϕ is the balance-sheet cost of basic stock, rubles, and q_v is the norm of depreciation deductions for renovation, fraction of a unit.

The norm of depreciation deductions is the specific fraction (percent) of the cost of basic stock which approximately reflects the value of the annual wear. The annual amount of depreciation deductions is calculated by it.

Depreciation deductions for major overhaul are intended to restore individual basic parts and assemblies of equipment, machines and so on, i.e., to carry out major overhaul. Medium overhaul is carried out on some basic stock, for example, on locomotives at the expense of depreciation deductions and medium and hoisting repair is carried out on the track superstructure.

The size of these deductions $A_{k.r}$ is calculated by the formula

$$A_{к.р} = \Phi q_{к.р} = \frac{an}{t}, \tag{28.2}$$

where $q_{k.r}$ is the norm of depreciation deductions for major overhaul, fraction of a unit, a is expenses per major overhaul, rubles, n is the number of major overhauls during the service life of basic stock and t is the service life of basic stock, years.

The total sum of depreciation deductions A can be determined by the formula

$$A = \Phi q, \tag{28.3}$$

where q is the average norm of depreciation deductions for renovation and major overhaul, fractions of a unit.

The average norm of depreciation deductions for all types of basic stock now comprises 5.1 percent throughout the railroad network, including 3.4 percent for major overhaul and 1.7 percent for restoration. These values are different and fluctuate over a wide range for different types of basic stock.

Fuel. More than 90 percent of the total expenses for fuel on railroads goes to train traction and approximately 10 percent goes to other production needs (heating of production buildings and so on).

Expenses for fuel for train traction are determined on the basis of the volume of work in gross ton-kilometers (rail cars) and the norm of fuel consumption per 10,000 gross t-km and the price of one ton of fuel.

Expenses for fuel for miscellaneous production needs are determined as a function of the prices for fuel, the norm of consumption for the index and the rating and operating time of the units.

Electric Power. Expenses for electric power, like those for fuel, are taken into account and planned individually for train traction and miscellaneous production needs. The specific rate of expenses for train traction comprises 85 percent and that for miscellaneous needs comprises 15 percent of all expenses for electric power.

The method of determining expenses for electric power for train traction is similar to that for determining expenses for fuel.

Expenses for electric power for miscellaneous production needs (operation of the equipment of machine shops, STsB and communications devices, lighting station yards, service buildings and so on) are determined by different methods.

The amount of these expenses can be calculated on the basis of the number of different users of electric power (electric motors, devices, electric signalling semaphores and so on), their rating, length of operation and price of 1·kW hr of electric power.

The method of calculation by consolidated norms may also be used.

Materials. Expenses for raw materials and also for cancellation of the wear of low-value and rapid-wearing objects and special clothing in operation are taken into account by this element of expenditures. The total expenses for materials is indicated in the railroad with determination of expenditures for a single estimate of the elements of track superstructure. The specific weight of individual facilities in expenses on materials is different and comprises 0.4 percent for passenger, 2.3 percent for freight, 2.7 percent for traffic, 30 percent for locomotive, 44 percent for rail car, 16 percent for track, 0.9 percent for civilian structures, 2 percent for signalling and communications, 1 percent for electrification and power engineering and 0.7 percent for miscellaneous.

One part of expenses for materials is determined on the basis of the volumes of work, norms of expense per unit of volume and prices for materials. For example, expenses for lubrication for locomotives and rail cars and for materials for repair of rolling stock can be calculated by this method.

Another part of expenses is determined by the norms of consumption of materials per object or device and by the number of these objects and devices. Expenses for materials by a single estimate of elements of track superstructure, on maintenance and repair of the contact system, STsB and communications devices and so on can also be calculated. In this case the norms are established per kilometer of developed length of track, kilometer of developed length of contact system and per kilometer of length of automatic blocking.

Another part of expenses for materials is determined on the basis of established norms per worker, for example, expenses for special soap, special milk and special clothing. Thus, expenses for special clothing are calculated by the norms of issuing it, the cost, periods of wearing and number of workers having the right to receive special clothing.

Miscellaneous expenses. Miscellaneous expenses include those which are difficult to include in any of the elements enumerated above. These are mail and office

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000300080044-2

expenses, stipends to workers detached for training, deductions from the cost of uniforms, payment of the accounts of other organizations for work performed and so on.

Expenses for uniforms are calculated on the basis of the numberof workers receiving them at a discount, the size of the discount, the periods of wearing and the cost of the clothing.

Part of miscellaneous expenses is determined by the level during the past period with regard to possible reduction during the planned period.

The total of miscellaneous expenses is indicated in the railroad plan with determination of expenses for snow, sand and water control and centralized expenses. Expenses for snow, sand and water control are planned on the basis of actual expenditures per kilometer of developed length of track during the past three years with regard to some increase of labor productivity due to mechanization of this work. Centralized expenses contained in the "miscellaneous" element are planned by MPS and are included in the specific fraction calculated by reduced ton-kilometers in the planned extent of operating expenses of the railroad.

The total sum of operating expenses for the railroad is indicated with determination of expenses for depot repair of rail cars.

Expenses for depot repair of rail cars. These expenses are calculated separately by freight and passenger cars on the basis of data on the stock of cars, frequency of repairs and prices per unit of repair. The number of passenger cars subject to repair is determined by the registered stock by the railroad and the number of freight cars is calculated by MPS and is reported to the railroad with indication of the type of cars and the number of axles.

6521
CSO: 8144/0359

FINANCES AND COST ACCOUNTING

Moscow EKONOMIKA I PLANIROVANIYE ZHELEZNODOROZHNOGO TRANSPORTA: EKONOMIKA ZHELEZNO-DOROZHNOGO TRANSPORTA in Russian Part 1, signed to press 20 Sep 78 pp 292-294

[Excerpt from Chapter 31 from the book "Ekonomika i planirovaniye zheleznodorozhnogo transporta: ekonomika zheleznodorozhnogo transporta" Izdatel'stvo Transport, 15,000 copies, 352 pages]

[Excerpt] 31.4. The Basic Stock of Railroads

Basic stock is required by railroad enterprises to accomplish the transport process. It participates in multiple fashion in the production process, retaining a natural-real form. The cost is partially transferred to the manufactured product according to the amount of wear and is included in the type of depreciation deductions in its cost.

Basic stock is divided into production and nonproduction. Basic production stock includes the means of labor of production designation--locomotives, rail cars, track structures, workers and power machines, equipment, buildings, signalling devices and so on. Basic nonproduction stock is apartment buildings, cultural-service buildings and sports buildings and so on. They comprise 10 percent of the basic stock of railroads.

The structure of the basic production stock of railroads is presented below (in percent):

Buildings	7.6
Structures	55.5
Switching Devices	5.2
Machines and Equipment	5.2
Transport Equipment	25.9
Tools, Inventory and Other Stock	0.6
Total	100.0

Structures (roadbed, track superstructure and artificial structures) and transport equipment (locomotives, rail cars, motorcar sections and so on) occupy the highest specific weight. More than 80 percent of basic production funds goes to them.

Scientific and technical progress accomplished in rail transport determined the high rates of increase in the cost of basic stock. Thus, it increased from 50.9 billion to 63.8 billion rubles during the period 1971-1975.

The cost of basic stock of rail transport will increase by an additional 21.5 percent during the 10th Five-Year Plan.

Basic stock is assigned to cost-accounting enterprises of railroads and is reflected on their balance sheet. An estimate of objects of basic stock is made:

by the initial cost, i.e., by the cost at the moment of development or acquisition;

by restoration cost, i.e., by the cost which is required to reproduce objects of basic stock under modern conditions based on existing prices;

by the residual cost, which is the initial or restoration cost of basic stock with deduction for wear.

The basic stock used by rail transport enterprises is put into operation in different years; therefore, its initial cost is added on the basis of different prices for equipment, materials and so on. Basic stock is re-evaluated periodically to obtain a one-time evaluation. This re-evaluation was carried out as of 1 January 1972. As a result of the re-evaluation, the cost of basic stock of rail transport increased by 26.4 percent.

During use, basic stock wears physically, i.e., part of the material-real properties is expended. Besides physical wear, there is also moral wear, the value of which increased especially under conditions of scientific and technical progress.

There are two forms of moral wear. The first is caused by a reduction in the cost of new means of labor compared to existing means due to an increase of social labor productivity. The second is related to introduction of more productive and more efficient rolling stock, machines and so on, which determines the need to replace still physically suitable means of labor with new means. For example, steam locomotives were replaced by more economical locomotives--electric and diesel locomotives.

Improving the use of production stock is one of the important conditions for increasing production and increasing its efficiency. The need for a significant increase in the level of utilization of basic stock was noted at the 25th CPSU Congress.

The indicators for the use of the basic stock of railroads are:

stock return--the number of reduced ton-kilometers per ruble of basic production stock;

stock capacity--the cost of basic production stock per 1,000 reduced t-km;

stock ratio--the cost of basic production stock per worker of operating contingent of railroads.

The stock ratio of railroad workers increased as a result of scientific and technical progress in rail transport. Thus, whereas the stock ratio comprised 16,600 rubles in 1965, it reached 30,800 rubles in 1975, i.e., it increased by 88 percent.

The stock return, which comprised 55.7 t-km per ruble of cost of basic production stock in 1975, is increasing systematically. The growth of the stock return permits assimilation of a large volume of shipments without additional investments in basic stock. The level of stock return depends to a significant degree on the use of rolling stock. An increase of locomotive and rail car productivity, especially acceleration of freight car circulation, an increase of the weight and speed of train traffic, an increase of loading of freight cars and an increase of the population of passenger cars are main factors for an increase of the stock return on railroads.

Payment for stock was introduced by decision of the September (1965) Plenary Session of the CPSU Central Committee to increase the responsibility of enterprises for utilization of basic production stock. Payment is made to the profits budget of the enterprise. The norm of payment for the railroad network as a whole is established at the rate of 6 percent of the average annual cost of basic production stock and the normalized circulating funds. It is differentiated by individual railroads and fluctuates from 1 to 8 percent. Moreover, the railroads contribute an additional payment at the rate of 100 rubles per month per physical rail car of the freight fleet for surplus fleet of freight cars formed as a result of slowing down rail car circulation. The total payment for production stock is reduced at the same rate for each rail car saved upon acceleration of rail car circulation.

The following main funds are released from the payment:

those created at the expense of the production development fund--over a period of two years;

those created due to bank credit--until the credit is completely used up;

of newly operational enterprises and shops--for the normative period of assimilation of design capacity;

those preserved by decision of the state;

those intended for purification of water and air basins.

The better enterprises utilize basic production stock, the smaller the fraction of profits that is put into the budget in the form of payment for them and consequently the higher the profits remain at the disposal of the enterprise and are deducted to the economic incentives funds.

6521
CSO: 8144/0359

RAILROAD TARIFFS AND DETERMINATION OF PAYMENTS FOR SHIPMENTS

Moscow EKONOMIKA I PLANIROVANIYE ZHELEZNODOROZHNOGO TRANSPORTA: EKONOMIKA ZHELEZNODOROZHNOGO TRANSPORTA in Russian Part 1 signed to press 20 Sep 78 pp 300-304

[Excerpt from Chapter 32 from the book "Ekonomika i planirovaniye zheleznodorozhnogo transporta: ekonomika zheleznodorozhnogo transporta" Izdatel'stvo Transport, 15,000 copies, 352 pages]

[Excerpt] 32.2. Existing Tariffs for Freight Shipments

Existing tariffs in rail transport are divided into general, local and exceptional.

General tariffs are used in shipments of the majority of freight on the entire railroad network. Local tariffs are established by the chiefs of railroads in shipments of freight on lines not included in the general network of railroads, in stable empty directions (local traffic), on river crossings and so on. Exceptional tariffs may be higher or lower than general tariffs as a function of the task posed by the state.

There is a small number of exceptional, primarily reduced tariffs on USSR railroads. For example, reduced tariffs are applied to freight shipments in mixed rail-river traffic, to shipments of some freight to remote regions and so on. For example, a tariff for shipment of automobiles in disassembled form by rail for a distance up to 300 km is increased (in these cases it is more feasible to transport the automobiles under their own power).

Table 32.1. Differentiation of Tariffs by Types of Freight Upon Shipment to Distance of 900 km

(1) Род груза	(2) Тарифная ставка, коп/10 ткм	(1) Род груза	(2) Тарифная ставка, коп/10 ткм
Кокс (3)	2,61	Зерно (7)	3,53
Песок (4)	2,67	Стекло листовое (8)	4,09
Прокат (5)	3,12	Хлопок-сырец (9)	7,54
Лесные (круглый, пиломатериалы) (6)	3,26	Керосин (10)	5,63

[Key on following page]

[Key continued from preceding page]:

1. Type of freight
2. Tariff rate, kopeck/10 t-m
3. Coke
4. Sand
5. Rolled steel
6. Forest (timber and lumber)
7. Grain
8. Plate glass
9. Raw cotton
10. Kerosene

Two-rate tariffs for all freight are used in rail transport. The tariff rates are established with these tariffs for initial-final operations for a total of 10 tons and for traffic operation per 10 t-km. Two-rate tariffs permit the railroads to have equal profitability of shipments at any distances. They create conditions for more efficient distribution of shipments by types of transport and for mechanization and automation of tariff payment calculation. Income from shipments with two-rate tariffs is distributed more regularly throughout the railroads than with single-rate tariffs and conditions are created to eliminate losses in shipments of some freight over short distances.

As indicated, existing tariffs are differentiated by types of freight, the distance of shipments, types of shipments and speed of shipments.

An example of tariff differentiation by types of freight is presented in Table 32.1.

Two-rate tariffs are differentiated by distance of shipments automatically at any distance since the tariff payment is added from the two components of the values (see formula (32.1)).

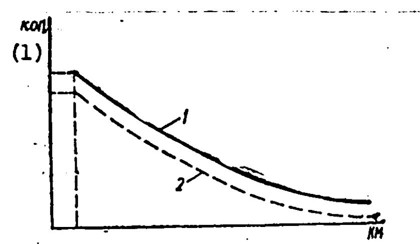

Figure 32.1. Variation of Cost and Tariff Rate as a Function of Distance: 1--tariff rate per 10 t-km; 2--cost of shipments of 10 t-km

Key:
1. Kopecks

As distance increases, the fraction of the tariff for initial-final operations in the total value per 10 t-km is reduced, but everything remains rather significant (for example, it comprises approximately 18 percent in shipments of grain for a distance of 1,800 km).

The nature of variation of tariff rates is identical for all freight as the distance increases. This variation corresponds to variation of cost (Figure 32.1). The gap between the curve of the tariff rate and the cost curve indicates the

[redacted]

level of profitability of shipments for a given type of freight. The level of profitability is identical at any distance.

Tariffs by types of shipments are differentiated so that their level when calculated per 10 t-km of given freight is least for separate rail car shipments and greatest for small shipments.

Tariff rates by single car shipments are calculated per car and the distance of shipment regardless of the amount of freight loaded into the car. This stimulates more complete utilization of the carrying and load capacity of the cars.

Tariff rates in shipment of freight in containers is higher than in separate car shipments. Thus, when shipping confectionery articles (except flour) in containers weighing five gross tons, the tariff payment is approximately 40 percent higher compared to separate car shipments. The difference in tariff payments will be even higher when shipping in containers of smaller capacity. Shipments of freight in containers requires special expenditures related to expediting operations, maintenance of container platforms and repair and maintenance of containers. Expenses for container shipments increase even more compared to shipments in cars because empty containers travel long distances.

Tariff rates in shipment of freight in containers have been established for initial-final operations per 10 tons or per container and those for traffic operation have been established per 10 t-km or per container-km. The capacity of the containers is taken into account in the rates. The tariff payments in container shipments is recovered for the total calculated capacity of the container regardless of the actual weight of the freight.

A unified tariff scheme which provides differentiation of rates as the weight of the shipment varies has been established for payment of freight shipments in small lots. It is taken into account that expenditures per unit of shipments related to deterioration of the capacity and volume of the car increase as the weight of the shipment decreases, expenditures for sorting shipments, formulation of documents and so on increase.

Tariff rates are differentiated for small shipments up to one ton with the weight being rounded off to 0.1 ton. With small shipments weighing from 1 to 10 tons, the tariff rate per ton is constant, but it is higher than in separate car shipments.

Tariff rates in freight shipments in constant-temperature cars with and without refrigeration is higher than during shipments in ordinary boxcars. Thus, when canned goods are shipped in separated car shipments in constant-temperature cars without refrigeration over a distance of 300 km, the tariff rate is 2.3-fold higher and when they are shipped in constant-temperature cars with refrigeration, it exceeds 3.8-fold the tariff rate compared to shipment in boxcars. This increase of rates is explained by the higher cost of freight shipments in constant-temperature cars compared to ordinary cars.

Tariff rates also increase during express freight shipments.

It has been established by existing regulations that freight owners pay for shipment by the shortest distance regardless of the actual distance covered by the freight.

So-called planned roundabouts are provided in the shipping plans of railroads on some lines of the network. But even in these cases the tariff payment is recovered for the shortest direction of travel rather than for the roundabout direction. Exceptions to this rule are permissible only in cases provided by tariff manuals.

The name of the freight should be brief and precise in documents presented by the freight shipper. The amount of the tariff payment frequently depends on the correctness of indicated name. Thus, shipments of stone are paid according to different tariffs as a function of whether this is quarrystone, slag or asphalt stone. The tariffs in shipments of construction and refractory brick are different: higher tariff rates have been established for shipment of refractory brick than for shipment of construction brick for the same distance.

Freight which has no name in the nomenclature is presented for shipment in some cases. The distinctive feature of the freight must be indicated in the shipping documents to relate this freight to some specific tariff group. For example, "valokordin" freight is presented for shipment. This name of freight is not included in the nomenclature. But it is sufficient to write that valokordin is a medicine to relate it to the group "Miscellaneous medicinals not named in the alphabet."

Table 32.2. Distance Belts Adopted on USSR Railroads

Shipping Distance, km	Length of Distance Belt, km	Number of Belt
From 1 to 50	50	1
From 50 to 100	10	5
From 101 to 300	20	10
From 301 to 600	30	10
From 601 to 1,000	40	10
From 1,001 to 1,500	50	10
From 1,501 to 5,500	100	40
From 5,501 to 13,500	200	40

When determining the tariff rate, the weight of the freight is rounded off. A shipping weight up to 10 tons is rounded off to full 100 kg. Shipping weight of more than 10 tons is rounded off to total tons. Thus, a shipment weighing 15.4 tons is rounded off to 16 tons. The weight of packaging is included in the shipping weight. The minimum distance when determining freight fees is determined at 50 km.

To simplify tariff calculations, the shipping distances are taken into account by distance belts (Table 32.2). The tariff rate is each belt is levied at an identical rate regardless of the actual shipping distance. The distance of the belts also increases with an increase of shipping distances.

Rail transport bears additional expenditures in some cases which should be covered by the freight owners. These expenditures are levied in the form of special duties, the name and value of which are established by the existing tariff system.

The following types of duties are now used: for storage of freight in railroad warehouses and on platforms above the established deadline, for weighing freight and checking the weight, for disinfection of rail cars and door panels, for delivery of rail cars to extraordinary-use spur tracks, for informing freight consignees of the approach of freight (by agreement), for taking freight across the Amur River and Kerch' Strait, for use of metal straps in timber shipments, for accompanying freight by a railroad conductor, for expediting operations and for loading-unloading operations using railroad equipment.

Mutual responsibility for adhering to plans, rules and procedures for organization of freight shipments is provided for material action on the freight owners and the railroads. A system of fines paid by freight owners or railroads in cases provided by the rules has been established. Payment of fines affects the cost-accounting indicators of enterprises.

6521
CSO: 8144/0359

PLANNING THE FINANCES OF RAILROADS

Moscow EKONOMIKA I PLANIROVANIYE ZHELEZNODOROZHNOGO TRANSPORTA: EKONOMIKA ZHELEZNO-DOROZHNOGO TRANSPORTA in Russian Part 1, signed to press 20 Sep 78 pp 309-323

[Chapter 33 from the book "Ekonomika i planirovaniye zheleznodorozhnogo transporta: ekonomika zheleznodorozhnogo transporta" Izdatel'stvo Transport, 15,000 copies, 352 pages]

[Text] 33.1. Planning of Income

Monetary funds received for completed shipments, operations or services rendered are called income.

Railroads receive income from shipments, sales of the products of auxiliary enterprises and for rendering services to passengers and freight owners at stations. The main part of railroad income (approximately 85 percent) is comprised of income from shipments. It consists of income from freight, passenger, baggage and mail shipments, of miscellaneous income and supplementary fees (for loading, unloading and storage of freight and so on). The structure of railroad income from shipments is presented below (in percent):

Income from Shipments:	
freight	79.9
passengers	17.3
baggage	0.2
mail	0.3
Miscellaneous Income	0.3
Supplementary Fees	2.0
Total	100.0

The planned total income is determined on the basis of the planned volume of freight, passenger and baggage shipments and the existing tariff system. The level of average income rates is determined on the basis of tariffs for each type of shipment.

The total freight fee per unit of shipments is called the income rate. It is calculated per 10 t-km of freight shipments, 10 passenger-km of passenger shipments and for 10 t-km of reduced expenditures.

The level of the average income rate for freight shipments depends on the structure of the freight, the distance and speed of shipment, the type of shipment, the degree of loading rail cars and other factors which affect the size of freight levies.

The content of the income plan from freight shipments is presented in Table 33.1.

Table 33.1. Plan of Income From Freight Shipments

Item of Income	Unit of Measurement of Volume of Shipments	Volume of Shipments	Income Rate, kop/10 t-km or Kop/ton	Income, Million Rubles
Income from freight shipments (traffic operation)	Million t-km	95,000	3,271	310.7
Income from initial freight operations:				
coal, ore and ferrous metals	Million ton	76.0	20	15.2
petroleum products	Million ton	--	--	--
remaining freight	Million ton	43.0	30	12.9
Income from final freight operations:				
coal, ore and ferrous metals	Million ton	20.5	20	4.1
petroleum products	Million ton	16.0	50	8.0
remaining freight	Million ton	54.0	30	16.2
Supplementary fees	--	--	--	7.3
Total	--	--	--	374.4
Average income rate per 10 t-km, kopecks	$\frac{374.4 \cdot 10^6 \cdot 10^2 \cdot 10}{95,000 \cdot 10^6} = 3.941.$			

The passenger traffic turnover with division into direct, local and suburban traffic, the income rate per 10 passenger-km for each type of traffic and the total income from passenger shipments are indicated in the income plan from passenger shipments. Moreover, income from forming-up of trains is determined by multiplying the number of formed-up direct trains by the established calculated prices per train. Income from baggage and mail shipment are calculated here as well. The average income rate per 10 passenger-km is determined after adding all income from passenger shipments by dividing the total income by passenger-kilometers.

In fulfilling shipments, railroads render different services to passengers and freight shippers (preliminary sale of tickets, delivery of tickets and baggage to the home, storage of baggage, providing information about the arrival of freight and so on). The railroads receive income from these services, which is called local income of stations. This income is used to cover expenses to render services and also for development and repair of terminals. This income comprises approximately 0.6 of the income received from shipments.

33.2. Planning of Profits.

The profit of railroads is the monetary expression of the cost of the surplus product created by workers of transport enterprises.

Making profits is not the purpose of socialist production since social development is subordinate to the task of more complete satisfaction of the needs of the Soviet man. At the same time profit is of important significance for successful development of socialist society. It is the main source of expanded production. The higher the profits in the national economy, the greater the opportunities for raising the material and cultural level of the Soviet people. The size of profits reflects the financial results of the economic activity of an enterprise and the contribution of each enterprise to the financial resources of society.

Profit is determined by comparing the income of the enterprise received from shipments or performing other work to expenses to perform these shipments and work. If income exceeds the total expenses, the difference determines the sum of the profit received. In cases when expenses are greater than income, an enterprise has a loss. All railroads and divisions are profitable.

Profit is an artificial indicator which provides the generalized characteristic of the economic activity of an enterprise: fulfillment of the plan in the volume of shipments, the quality of utilizing rolling stock and other basic stock, labor productivity, adhering to the norms of consumption of materials, fuel, electric power and so on.

The profit on railroads is increasing at high rates. It increased by 49 percent during the Ninth Five-Year Plan. In 1976 rail transport received approximately seven billion rubles of profit.

The total balance-sheet profit is confirmed as a directive indicator for the railroads. It includes profits from shipments, from sale of operations and services of auxiliary enterprises (loading-unloading operations, transport-expeditious operations, sale of electric and thermal power and water to the populace and so on) and also a profit or loss from miscellaneous operations (penalties, fines, forfeits, losses from writing off unreliable debts and so on). Profits from shipments comprises the majority (almost 90 percent).

The total profits from shipments can be determined by two methods: by direct calculation and by analysis.

The method of direct calculation is the main one and permits more precise determination of the total profit. If this method is used, the profit per 10 reduced t-km is calculated as the difference between the average income rate and the cost of shipments. This difference is multiplied by the planned total shipments to determine the total profits.

Profit is calculated by direct accounting by the formula

$$П = Д - C = \Sigma Pl(\partial - c) : 10 : 100, \qquad (33.1)$$

where D is income from shipments, C is expenses for shipments, ∂ is the income rate per 10 reduced t-km, kopecks and c is the cost of 10 reduced t-km, kopecks.

For example, if the income rate per 10 reduced t-km according to the 1978 plan is equal to 4.2 kopecks, the cost is equal to 2.5 kopecks and the volume of shipments is 103 billion t-km, the planned profit comprises 103 billion$\cdot 10^9$(4.2 - 2.5) ÷ ÷ 1,000 = 175.1 million rubles.

The analytical method of calculating profit consists in the fact that the effect of economic factors (the volume and structure of shipments, cost and income rates) on the amount of profit of the planned year is established compared to the previous year. Let us assume that the profit of the year preceding the planned year comprised 164.8 million rubles. A reduction of shipping cost by 0.1 kopecks is provided in the planned year. Because of this, the profit with volume of shipments of 103 billion t-km will increase by (103 billion$\cdot 10^9 \cdot$0.1) ÷ 1,000 = 10.3 million rubles. The profit of the planned year will be (164.8 million + 10.3 million) = = 175.1 million rubles.

The profit from sale of the products of auxiliary enterprises is determined on the basis of the planned volume of operation (services), the level of prices and the cost of a unit of work (services).

33.3. Distribution and Use of Profits

Not only the total profit received but its distribution to the profit remaining at the enterprise's disposal and to the profit transferred to the state budget are of important significance to an enterprise.

The procedure for distribution of profit is determined by state decrees. The profit is first directed toward obligatory payments to general state funds: on installment to the payment budget for basic production funds and normalized circulating funds and installment of fixed payments,* and also on payment of percentages for bank credit.

The profit remaining after exclusion of obligatory payments is called the calculated profit. Deductions to the economic incentives funds are initially taken from the calculated profit, then part of it is directed toward financing of capital investments, cancellation of long-term credits, to increase circulating funds, to cover planned losses on housing-communal facilities and expenses on economic maintenance of cultural-service institutions and to create a reserve to render financial assistance to enterprises. The total remaining after all these payments and deductions is the free remainder of profit which is transferred to the budget.

The distribution of profit is shown in Figure 33.1.

Enterprises receiving a profit greater than was provided by that planned have an above-plan profit. It is used for above-plan installments of payment to the funds and percentages for bank credit, for supplementary deductions to the economic incentives funds, for payment of bonuses awarded by MPS for results of the All-Union socialist competition and to cancel credits received to introduce new equipment. The free remainder of above-plan profit is paid into the budget.

---

*Fixed payments are established for enterprises under specially favorable natural or other exceptional conditions. These payments are not used in rail transport.

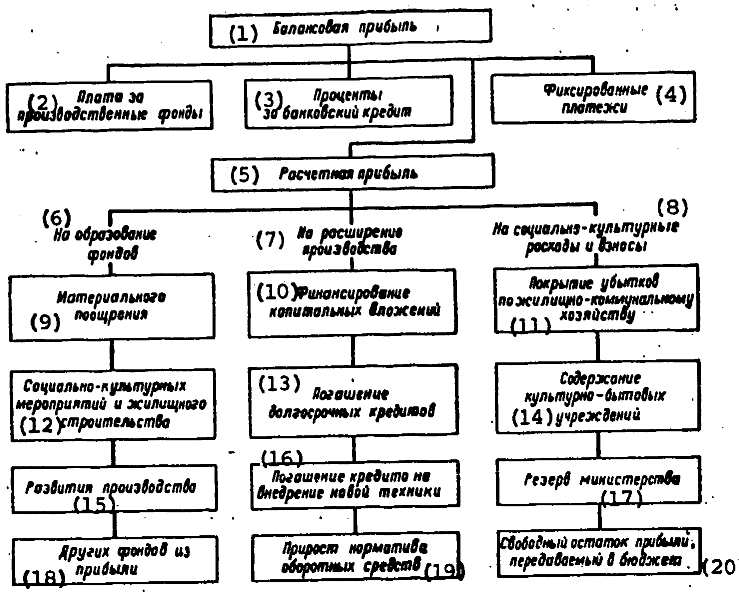

Figure 33.1. Diagram of Balance-Sheet Profit Distribution

Key:

1. Balance-sheet profit
2. Payment for production funds
3. Percentages for bank credit
4. Fixed payments
5. Calculated profit
6. To formation of funds
7. To expansion of production
8. To social-cultural expenses and installments
9. Material incentives
10. Financing of capital investments
11. Covering losses to housing-communal facilities
12. Social-cultural measures and housing construction
13. Cancellation of long-term credits
14. Maintenance of cultural-service institutions
15. Development of production
16. Cancellation of credit for introduction of new equipment
17. Reserve of ministry
18. Other funds from profit
19. Increase of norm of circulating funds
20. Free remainder of profit transferred to budget

If enterprises do not fulfill the profit plan, they receive fewer funds for their needs compared to those provided by the plan.

Distribution of railroad profits during the past few years has been characterized by the following data (in percent):

Profit Transferred to General State Funds:	
Payment for basic production funds and normalized circulating funds	47.0
Percent for bank credit	0.3
Free balance of profit	18.5
Total	65.8
Profit Remaining at the Railroad's Disposal:	
Deductions to economic incentives funds	10.2
Financing of capital investments and cancellation of long-term credit	19.0
Covering losses for housing-communal facilities	1.3
Bonuses from socialist competition	0.3
Other types of expenditures	3.4
Total	34.2
Total	100.0

The railroads transfer a significant part of profits (more than 65 percent) to the budget in the form of payments to funds and of free balance of profit.

Approximately 35 percent of all profit is at the railroad's disposal, of which more than 10 percent is used to form economic incentives funds and approximately 20 percent is used to finance capital investments.

33.4. Planning the Level of Profitability

Socialist society is interested not only in the mass of profit but also in the size of it with respect to monies invested in basic production funds and circulating funds, i.e., the level of production profitability. The indicator of profitability is established by railroads as a state planned task. Total and calculated production profitability are distinguished.

Total profitability R_0 is determined in percent by relating the balance-sheet profit to the cost of basic production funds and normalized circulating funds. It can be calculated by the formula

$$R_0 = \frac{\Pi_б}{\Phi_{о.пр} + O_{с.н}} 100, \qquad (33.2)$$

where Π_b is balance-sheet profit, $\Phi_{o.pr}$ is the cost of basic production funds and $o_{s.n}$ is the cost of normalized circulating funds.

Total profitability is a criterion for evaluating production efficiency.

In 1976 the total profitability of railroads was 10.3 percent or 10.3 kopecks of profit per ruble of basic production funds and circulating funds.

Calculated profitability R_r is determined in percent by relating the calculated profit to the cost of basic production funds and normalized circulating funds. Basic production funds released from payment according to established taxes are not used in the calculation in this case. The amount of calculated profitability is determined by the formula

$$R_p = \frac{\Pi_p}{\Phi_{o.пр} - \Phi^{л}_{o.пр} + O_{o.н}} 100, \qquad (33.3)$$

where Π_r is calculated profit and $\Phi^{1}_{o.pr}$ is the cost of basic production funds freed from payment to the budget.

Calculated profitability shows how much profit remaining to the enterprise after payment to funds and payments of percent for bank credit goes per ruble of cost of basic production funds and circulating funds. Calculated profitability comprised 4.5 percent in 1976 for all railroads.

The total and calculated profitability are determined according to plan and accounting of the railroad. Comparison of the planned and accountable profitability characterizes the level of fulfilling the planned tasks.

33.5. Economic Incentives Funds

An important role in solution of the problems posed by the 25th CPSU Congress to improve the economic effectiveness of production belongs to economic incentives. Through correct construction of a material incentives system, finances actively affect acceleration of scientific and technical progress, an increase of product quality, improvement of material and labor resources and in the final analysis an increase of the economic effectiveness of production.

Material stimulation of railroad workers is achieved from monies of economic incentives funds: the material incentives fund, the fund for social-cultural measures and housing construction and the production development fund.

The main one of these funds is the material incentives fund, to which two-thirds of deductions to the economic incentives funds go. It is intended to create the material interests of each worker and collective of the enterprise as a whole to achieve the maximum production effect. The source of formation of the material incentives fund is enterprise profits. The total profit deducted to the material incentives fund is determined by comparison of the five-year plan, the annual plan and upon totalling the results of enterprise operation during the year.

The size of the material incentives fund for the five-year plan is established by a superior organization according to years of the five-year plan. When the annual plan is compared, enterprises can adopt higher or on the contrary lower pledges than was provided by the five-year plan. The total material incentives fund is increased by an increase of indicators in the annual plan compared to the five-year plan and is reduced by reduction of indicators.

The indicators on which the size of supplementary deductions to the material incentives fund depends are called fund-forming indicators. These indicators for railroads and divisions are usually an increase of labor productivity, reduction of shipping cost, an increase of calculated profit and acceleration of rail car circulation. In this case the number of fund-forming indicators should not be greater than three.

A norm of deductions of profit to the material incentives fund is established for each fund-forming indicator. These norms are expressed in percent of the total material incentives fund according to the 1975 plan.

Example. The norms of deductions from profit to the material incentives fund for the railroad have been established in the following amounts: 1.9 percent per 1 percent of increase of labor productivity, 2.5 percent for 1 percent reduction of shipping cost and 0.5 percent for 1 percent growth of calculated profits. The material incentives fund is equal to 17 million rubles according to the 1975 plan. Upon comparison of the annual plan for 1978, the railroad envisioned an increase of labor productivity by 0.4 percent compared to the task for this year according to the five-year plan, a decrease of shipping cost by 0.3 percent and an increase of calculated profits by 1.2 percent.

The material incentives fund provided by the five-year plan for the given year in the amount of 19 million rubles will be increased:

due to an increase of labor productivity by

$$(0.4 \cdot 1.9 \cdot 17{,}000) \div 100 = 129{,}200 \text{ rubles;}$$

for reduction of shipping cost by

$$(0.3 \cdot 2.5 \cdot 17{,}000) \div 100 = 127{,}500 \text{ rubles;}$$

for an increase of calculated profit by

$$(1.2 \cdot 0.5 \cdot 17{,}000) \div 100 = 102{,}000 \text{ rubles.}$$

The total increase will comprise 358,700 rubles. As a result the material incentives fund according to the annual plan will increase to 19 million + 358,700 = = 19,358,700 rubles.

The actual total of the material incentives fund depends on the level of fulfillment of the plan according to fund-forming indicators. If the plan is overfulfilled, the supplementary deductions are made according to the norms reduced by not less than 30 percent. If the plan is underfulfilled according to fund-forming indicators, the planned total of the material incentives fund is reduced according to the norms increased by no less than 30 percent.

A decrease of the norms of the material incentives fund when calculating supplementary deductions for overfulfillment of the plan and an increase of them upon calculation of the total decrease of the fund for underfulfillment of the plan create incentives among enterprises to adopt intensive, but realistic planned tasks. Besides deductions from profits, funds allocated for awarding bonuses to workers from the wage fund are included in the material incentives fund.

When planning the material incentives fund, one must provide a proper ratio between an increase of labor productivity and an increase of the average monthly wage of enterprise workers. If the growth rate of wages at the enterprise exceeds the growth rate of labor productivity with regard to payments from the material incentives fund, then part of this fund is reserved or transferred to the fund for social-cultural measures and housing construction.

Monies included in the material incentives fund from the wage fund are used only to award bonuses to enterprise workers. Deductions to this fund, made from profits, are used:

to award bonuses to workers (in addition to bonuses from the wage fund);

to award bonuses to managers, engineering and technical personnel and salaried employees;

for one-time incentives to workers distinguished upon fulfillment of especially important tasks;

to pay for awards from the annual results;

to award bonuses from the results of the socialist competition within the enterprise;

to render one-time assistance to railroad workers;

to award bonuses to junior maintenance personnel and workers of other enterprises who contribute to improving the utilization of rolling stock.

The material incentives fund is distributed by individual directions of use in the estimate of fund disbursement which is confirmed by the enterprise management jointly with the trade-union committee.

The material interests of enterprise collectives to increase production efficiency is created not only by awarding bonuses but also by more complete satisfaction of the spiritual needs and improvement of the housing conditions of the workers. The fund for social-cultural measures and housing construction has been created for this purpose at rail transport enterprises. It is also formed from profits of the enterprise.

The amount of the profit deducted to this fund is determined by the norm expressed in percent of the material incentives fund. Let us assume that the material incentives fund of the railroad is equal to 19,358,700 rubles. The norm for deductions to the fund for social-cultural measures and housing construction is 30 percent. Deductions to this fund will then comprise $(19,358,700 \cdot 30) \div 100 =$
$= 5,807,600$ rubles.

Monies of the fund for social-cultural measures and housing construction are directed for construction of apartment buildings, cultural-educational and children's preschool institutions and also enterprises of communal-service designation (up to 60 percent of the fund is expended for these purposes). Enterprises can accomplish cultural-service and medical service of workers, can carry out rehabilitation and sports measures, can improve the feeding of children in kindergartens, day-care centers and Pioneer camps and can reduce the cost of feeding in dining halls, snack bars and so on from the monies of this fund. The railroads utilized 150 million rubles for these purposes in 1976.

An important condition for increasing production efficiency is introduction of new equipment and advanced technology at enterprises. Consequently, the enterprises should have at their disposal financial resources which permit them to solve independently problems of production development and introduction of new equipment. These resources are created by formation of the production development fund. Part of the enterprise profits, part of the depreciation deductions to restore basic stock and the income from sale of eliminated and surplus property are calculated to this fund.

The total profit and depreciation deductions directed to the production development fund is determined by the norms established by the superior organization.

Monies of the production development fund are used to finance capital investments for introduction of new equipment, mechanization and automation of production processes, modernization and renovation of equipment and improvement of production.

33.6. Financing of Capital Construction and Major Overhaul of Basic Stock

Expenditures to restore (replace) basic stock are capital investments.

To construct or reconstruct a railroad line, station, depot or other structure, one must first carry out technical and economic calculations for each of them. These calculations are formulated in the draft and estimates of construction.

Expenditures of labor, material and monetary resources required to carry out the work provided by the draft are determined in the estimate. The cost of construction calculated in the estimate is called the estimated cost. It is the price of the object of capital construction.

Sources of financing the state plan of capital investments include the railroads' own resources and the centralized resources of the state. Depreciation deductions intended for renovation, part of the profit from shipments, monies of the production development fund, the fund for social-cultural measures and housing construction and so on are related to one's own resources.

The size of the profit directed to finance capital investments is determined by comparing the financial plan of the railroad. Approximately 18-20 percent of railroad profits are used for this purpose. More than 60 percent of all capital investments are accomplished on railroads due to depreciation deductions and profits.

State budget funds and long-term bank credit are related to centralized resources of the state.

The effectiveness of capital investments, the period of their return and period of cancellation of credit are determined to justify the total credit.

Crediting capital investments is an important economic stimulus for increasing the effectiveness of capital expenditures, acceleration of construction and adhering to the normative deadlines for assimilation of the design capacity of new construction projects.

All funds intended for capital investments are kept in a special account at institutions of Stroybank of the USSR, which monitor the purposeful use of these funds.

Work on construction of objects and structures can be accomplished either through the efforts of those enterprises for which the new construction is intended (the cost-accounting method of construction) or by special construction and installation organizations through agreements with the customer (the contract method of construction). The main part (more than 90 percent) of work on capital construction on railroads is accomplished by the contract method.

Calculations between the contractor and customer for construction-installation work completed prior to 1969 were usually made for the completed structural elements and types of work rather than for the finished object. This procedure of calculations did not create incentives for the contractors to reduce the construction deadlines.

Calculations between the contractors and customers are now mainly carried out for objects completely constructed or for completed stages of work. This procedure of calculations contributes to concentration of material, labor and financial resources on starting objects, which reduces the construction deadlines and accelerates introduction of production capacities into operation.

Basic stock must be permanently maintained in an operating state. This is achieved by routine inspection and repair of them. The frequency of performing individual types of repair has been established by MPS for each type of basic stock. Routine maintenance and major overhaul are distinguished by financing sources. Expenses on routine maintenance of basic stock are included in the expenditures on shipments and are covered from enterprise income.

Major overhaul is financed from depreciation deductions intended for these purposes. The railroads annually expend more than two billion rubles of basic funds for major overhaul.

It is more efficient to carry out major overhaul of all objects located at a single rail line rather than of individual stations, junctions and sections. Therefore, MPS has granted the right to redistribute the depreciation deductions for major overhaul of rolling stock, roadbed, track superstructure and artificial structures among the railroads.

33.7. The Financial Plan of the Railroad

The presence of financial resources is compared in the financial plan to the need for them during the planning period. This comparison makes it possible to check whether the tasks provided by the production plans, capital investments and major overhaul and also the pledges before the budget, superior organization and banks have been totally provided with financial resources.

The financial plan is compiled in the form of the balance-sheet of income and expenses and has four sections.

Table 33.2. Financial Plan of Railroad (Balance-Sheet of Income and Expenses)

Indicator	Total, thousand rubles	Indicator	Total, thousand rubles
1. Income and Receipt of Funds		2. Expenses and Deduction of Funds	
Balance-sheet profit	252,000	Losses of housing-communal facilities	3,400
Reduction of norm of own circulating funds	---	Increase of norm of own circulating funds	200
Increase of stable liabilities	120	Reduction of stable liabilities	--
Income from sale of property written off	2,150	Expenses on economic maintenance of buildings and structures transferred to trade-union organizations	550
	2,030		
Depreciation deductions	136,400	Capital investments	94,335
Local income of stations	1,480	Expenditures for major overhaul	89,450
		Expenses for local income of stations	1,250
		Deductions to funds:	
		material incentives	15,960
		social-cultural measures and housing construction	4,788
		production development	7,120
Total income	394,180	Total expenses	217,053
3. Credit Ratios			
Receipt of Credits		Cancellation of Credits	
Long-term credit for capital investments	4,800	Cancellation of long-term credits for capital investments	1,200
		Cancellation of credit for introduction of new equipment	410
		Payment for long-term credit	825
Total receipt of credits	4,800	Total cancellation of credits	2,435

[Table continued on following page]

Table 33.2 [Continued from preceding page].

Indicator	Total, thousand rubles	Indicator	Total, thousand rubles
		4. Ratios to MPS	
Receipt of Funds		Payments of Funds	
For capital investments	--	Deductions from profits:	
		payment for production funds	124,196
For major overhaul	--	free balance of profit	55,066
		Depreciation deductions	--
		Funds from income of chiefs of stations directed to redistribution	230
		Removal of surplus circulating funds	--
Total receipt of funds	--	Total payments of funds	179,492
Balance	398,980	Balance	398,980

The profit, depreciation deductions, income from sale of property written off, local income of stations, reduction of the norm of own circulating funds, saving on major overhaul and so on are indicated in the first section--income and receipt of funds. The income and receipts are divided in this case by types of activity (shipments, capital construction and auxiliary production).

Capital investments, expenditures for increase of the norm of one's own circulating funds, for major overhaul, for formation of enterprise funds and so on are presented in the second section--expenses and deductions of funds.

Credit ratios are reflected in the third section and relations with the superior organization are reflected in the fourth section. The balance of railroads' income and expenses is presented in reduced form in Table 33.2.

As can be seen from Table 33.2, income and receipts of funds comprised 394,180,000 rubles and expenses and deductions comprised 217,053,000 rubles, i.e., 177,127,000 rubles less.

The receipt of credits exceeds the sum cancelled by the railroad during the planning year by 2,365,000 rubles. As a result the income part of the balance sheet is greater than the expense part by 179,492,000 rubles, which are transferred to MPS for centralized payments and expenses.

The railroads should totally cover expenses and deductions from their own income and should also provide transfer at the established rate of funds to MPS for centralized payments and expenses. Receipt of funds from MPS may occur only if there is a shortage of financing sources in the railroad to fulfill the major overhaul and capital investments plan.

6521
CSO: 8144/0359 END