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No 3

ECONOMIC INTELLIGENCE REPORT

RAILROAD CONSTRUCTION IN THE USSR, 1946-60, AND PROSPECTS THROUGH 1970

CIA/RR 98
18 September 1957

CENTRAL INTELLIGENCE AGENCY
OFFICE OF RESEARCH AND REPORTS

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(ORR Project 47.1068)

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RAILROAD CONSTRUCTION IN THE USSR, 1946-60, AND PROSPECTS THROUGH 1970*

Summary and Conclusions

The USSR has initiated a program of long-range development of its railroad network with major emphasis in the eastern areas** of the country. During the period of the Fourth and Fifth Five Year Plans (1946-50 and 1951-55, respectively) the USSR was unwilling to devote sufficient resources to new railroad construction to insure Plan fulfillment. Since the start of the Sixth Five Year Plan (1956-60), this policy has been changed, and the tempo of railroad construction has significantly increased.

The development of railroads in the eastern areas of the USSR, which started during World War II, has continued in the Fourth Five Year Plan. This Plan called for a 4,000-kilometer (km) South Siberian Main Line, new connections to Central Asia, and numerous shorter lines. Schedules were not met, however, and the completion of these lines became one of the primary goals of the Fifth and Sixth Five Year Plans. About 75 percent of these lines have now been completed, and most of the remainder are under construction. During the period from 1946 through 1956, 84 percent of all lines completed and put into operation in the USSR were located in the eastern areas. Present plans and surveys for future lines indicate that the emphasis on railroad construction in the east will continue at least through 1970.

The quality of construction on new main lines in the USSR at the present time approaches the standards for similar lines in the US. Railroads built by the USSR in the early postwar years were often poorly constructed, even by Soviet standards of that time. During 1946-56, various measures were taken which improved the quality of construction -- forced labor was gradually replaced by free labor, modern machines and equipment were introduced, and the quality of construction materials was ordered to be improved.

* The estimates and conclusions contained in this report represent the best judgment of ORR as of 1 June 1957.

** Including the Urals, Central Asia, Siberia, and the Far East.

The absolute length of new railroads completed and put into operation during the Fourth Five Year Plan averaged 440 km per year. This amount has increased gradually, and during the Sixth Five Year Plan it should reach an annual average of 1,300 km.* It is estimated that new railroad construction will continue at about this rate during 1961-70.

I. Introduction.

This report covers the construction and planned construction of new railroads in the USSR from 1946 through 1960** and prospective plans for construction through 1970. All broad-gauge main lines more than 50 km in length are included,*** but reconstruction, repair and maintenance, double tracking, electrification, station tracking, sidings, and narrow-gauge lines are excluded.****

Soviet statistics on railroad construction deal with two general stages of construction: first-stage construction and second-stage construction. First-stage construction requires about 53 percent of the total capital investment in railroad construction 2/ and includes all work from basic planning and survey through the laying of track. A new line is usually opened for "temporary" operation at the conclusion of this stage. Many lines, particularly those built by forced labor, have been carried through this stage of construction and have

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* For length of lines completed and put into operation or planned, see Table 1, p. 3 , below.

** The railroad system of the USSR contained 112,868 route-kilometers of main-line railroad on 31 December 1945. [redacted] 50X1
[redacted] Route-kilometers measure 50X1
the length of main-line railroad, either single or double track. The 112,868 km include about 4,260 km of narrow-gauge lines, most of which were added to the Soviet network when the USSR seized eastern Poland, the Baltic republics, and South Sakhalin. Some of these lines have now been converted to Soviet standard gauge.

*** The Salekhard-Igarka-Dudinka and the Pobedino-Okha broad-gauge lines are not included in the body of this report, but are discussed in Appendix B, p. 27, below.

**** See Appendix B for a brief description of the narrow-gauge lines in the "new lands."

been operated on a temporary basis since then. These lines have never been fully completed and are not considered part of the railroad system by Soviet authorities, although many carry regular traffic. Second-stage construction consumes the remaining 47 percent of the capital investment in railroad construction and includes the construction of communications lines, service buildings, water supply, energy supply, housing, cultural and communal building, and other ancillary work. Under normal conditions, this stage in construction of Soviet railroads follows immediately after the first stage and takes an average of 15 months to complete.* "Completion and putting into operation"** occurs only after the end of both stages of construction.

Plan directives, Plan fulfillment reports, and announcements of the acceptance of new lines into the railroad network are all concerned with railroads which have been officially completed. The total length of new railroad lines officially completed and accepted by the railroad systems during the Fourth and Fifth Five Year Plans and estimates of future completions through the Eighth Five Year Plan in the USSR, 1946-70, are shown in Table 1.

Table 1

Length of Railroad Lines Completed and Planned for Completion During the Fourth Through the Eighth Five Year Plans in the USSR 1946-70

Kilometers

Five Year Plan	Length a/
Fourth (1946-50) (completed)	2,200 b/
Fifth (1951-55) (completed)	3,100 c/
Sixth (1956-60) (planned)	6,500 d/
Seventh and Eighth (1961-70) (prospective)	10,200 e/

a. Figures rounded to nearest hundred kilometers.
b. See Table 4, p. 8, below.
c. 3/
d. 4/
e. A minimum. See Table 9, p. 24, below.

* See Appendix C, Table 11, p. 31, below.
** Hereafter referred to as official completion.

Estimates of the length of track laid (volume of construction) and planned in each year, 1946-60, for the two stages of railroad construction work are shown in the chart, Figure 1.* The volume of first-stage construction work (shown in Figure 1 as Track Laid) on individual railroad lines in each year, 1946-60, is shown in the chart, Figure 2.** The annual increments of second-stage construction (shown in Figure 1 as Lines Completed) have been derived from analysis of Five Year Plan official completion figures*** and from evaluation of the general trend of railroad construction. Although the estimated length of lines accepted in any 1 year may be inaccurate, the 5-year totals for the periods 1946-50, 1951-55, and 1956-60 are considered to be accurate to the nearest hundred kilometers.

During World War II and throughout the Fourth Five Year Plan, large numbers of prisoners of war, Russian political prisoners, and Soviet troops**** were employed in railroad construction in the USSR. These lines usually were built to a stage where temporary operation was possible and then were maintained and operated in that condition -- that is, no more than the first stage of construction was completed.

During the Fifth Five Year Plan the use of forced labor gradually diminished and its composition changed, so that by the end of the Plan Soviet troops constituted the vast majority of forced labor. These troops were nearly all working on the 710-km section of the Trans-Mongolian Railroad between Ulan Bator and Erh-lien, which was rushed to completion in 2 years./ 5/ Work on this line (completed on 2 January 1956) accounted for about three-fourths of all work done by forced labor during the Plan.

Forced labor is expected to play little part in railroad construction during the Sixth Five Year Plan. All known new lines are being

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* Following p. 4.

** Following p. 26.

*** See Tables 4, 5, and 6, pp. 8, 11, and 14, respectively, below.

**** Soviet Army troops used in new railroad construction are considered to be forced labor throughout this report.

/ See the map, Figure 3, inside back cover. The use of troop labor to expedite construction of this line may indicate that Soviet military authorities were interested in the project.

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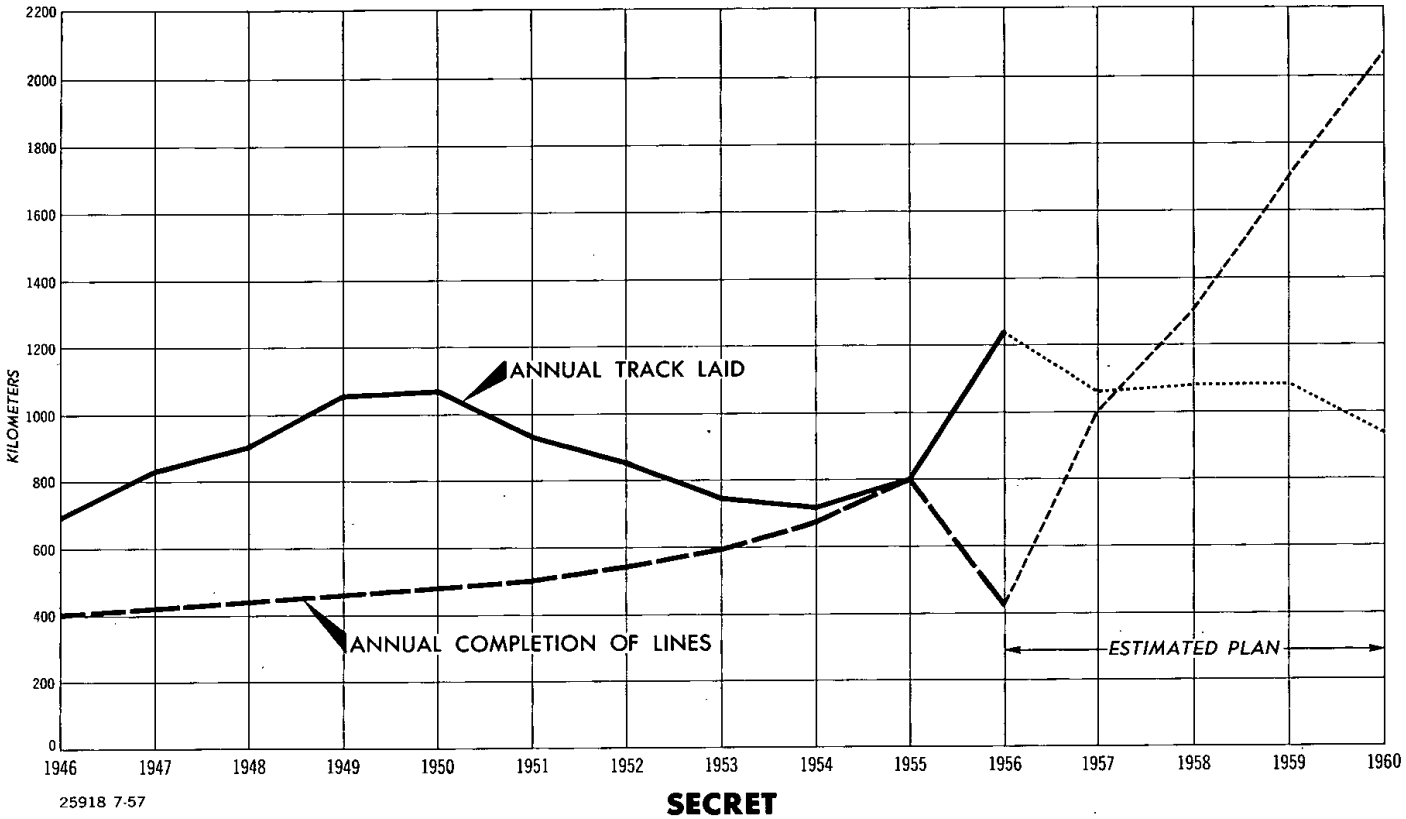
Figure 1

USSR

ANNUAL RAILROAD TRACK LAID AND LINES COMPLETED
1946-60



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built by civilian construction organizations of the Ministry of Transport Construction. The share of railroad track laid by forced and free labor during the Fourth, Fifth, and Sixth Five Year Plans in the USSR, 1946-60, is shown in Table 2.

Table 2

Share of Railroad Track Laid by Forced and Free Labor
During the Fourth, Fifth, and Sixth Five Year Plans in the USSR
1946-60

Five Year Plan	Total Track Laid (Kilometers)	Forced Labor [a]		Free Labor	
		Kilometers [b]	Percent of Total	Kilometers [c]	Percent of Total
Fourth (1946-60)	4,539 [d]	2,211	49	2,328	51
Fifth (1951-55)	4,041 [e]	1,157	29	2,884	71
Sixth (1956-60)	5,403 [f]	Negligible		5,403	100

a. Including Soviet Army labor.
b. See Appendix C, Table 10, p. 30, below.
c. Residual.
d. See Table 4, p. 8, below.
e. See Table 5, p. 11, below.
f. See Table 6, p. 14, below.

Some uncompleted work, or carryover,* must be brought over from Plan to Plan in any continuing construction program, and railroad construction practice in the USSR requires about 15 months (see Appendix C, Table 11**) to complete second-stage construction after the track has

* Carryover is the term given to all work on a construction project which remains to be done at the end of a Five Year Plan (or any selected period) and must be carried over into the next. For the purposes of this report, carryover is defined as the requirements of second-stage construction. First-stage construction which was left uncompleted at the end of a Plan (that is, some work done but track not yet laid) has not been included in carryover but has been entirely charged to the following Plan.
** P. 31, below.

been laid. Thus if construction continues uninterruptedly to completion, uncompleted work should roughly equal the value or volume of work necessary to carry out second-stage construction on that length of track laid during the last 15 months of a Plan.

As shown above, much of the new railroad construction in the USSR during World War II was done by forced labor. As a result, on 1 January 1946, 1,796 km of lines were in temporary operation, and thus the Fourth Five Year Plan started with a large carryover. Both the cumulative and newly added carryover of new railroad construction during the Fourth through the Seventh Five Year Plans in the USSR, 1946-65, are shown in Table 3.

Table 3

Cumulative and Added Carryover of New Railroad Construction During the Fourth Through the Seventh Five Year Plans in the USSR 1946-65

Kilometers

	Five Year Plans			
	Fourth (1946-50)	Fifth (1951-55)	Sixth (1956-60)	Seventh (1961-65)
Cumulative carryover at the beginning of Plan	1,796 a/	4,094 b/	5,075 b/	3,998 b/
First-stage construction	4,539 c/	4,041 d/	5,403 e/	N.A.
Second-stage construction	2,241 c/	3,060 d/	6,480 e/	N.A.
Carryover added f/	2,298	981	-1,077	N.A.

a. Track laid during World War II.
b. Algebraic sum of "Cumulative carryover" at beginning of previous Plan and "Carryover added" during previous Plan.
c. See Table 4, p. 8, below.
d. See Table 5, p. 11, below.
e. See Table 6, p. 14, below.
f. Difference between "First-stage construction" and "Second-stage construction" -- positive when "First-stage construction" is greater, negative when "Second-stage construction is greater.

During the Fourth Five Year Plan, because of the availability of large numbers of forced laborers, the USSR laid hundreds of kilometers of new track into remote areas in apparent anticipation of future development. Most of these lines were completed only to the stage of temporary operation and have been operated on that basis since. Without forced labor it is probable that many of these lines would not have been built.

As the number of forced laborers diminished, the volume of work performed by them decreased during the Fifth Five Year Plan. As a result, only a "normal" carryover of 981 km developed during this Plan.

The directives of the Sixth Five Year Plan announced that about 6,500 km of new railroad lines are to be completed in 1956-60. 6/ The actual construction of new track will be only 5,403 km (see Table 6*), and the balance of planned completions will be from the carryover of lines now in temporary operation. It is significant that, even with a substantial reduction during the Sixth Five Year Plan, the cumulative carryover at the beginning of the Seventh Five Year Plan will be about 4,000 km.

II. Volume of New Construction, 1946-60.

A. Fourth Five Year Plan (1946-50).

The USSR planned to construct and put into operation 7,230 km of new railroad during the Fourth Five Year Plan. 7/ The amount of track laid and sectors completed on individual railroad lines during this Plan in the USSR, 1946-50, is shown in Table 4.** The Fourth Five Year Plan was fulfilled by only 31 percent with the official completion of only 2,241 km. The failure to meet the planned goals is pointed up even more by the fact that only 445 km of this amount were made up of lines started during the Fourth Five Year Plan. The remaining 1,796 km officially completed were made up of second-stage construction work on lines carried over from World War II. 8/

During the Fourth Five Year Plan, new tracklaying was carried out on 4,539 km of new railroads. As shown in Table 2,*** forced labor was relied upon for the completion of almost half of this work.

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* P. 14, below.
** Table 4 follows on p. 8.
*** P. 5, above.

Table 4

Track Laid and Sectors Completed on Individual Railroad Lines
During the Fourth Five Year Plan in the USSR
1946-50

Kilometers

Line	Track Laid a/*	Official Completions
Akmolinsk-Pavlodar	350	
Artyshta-Chesnokovka	195	
Barnaul-Kulunda b/		
Bystrovka-Rybach'ye c/	65	78 d/
Chardzhou-Kungrad	370	212 e/
Dudinka-Noril'sk	40	
Dzhambul - Chulak-Tau c/	70	98 f/
Fedorovka - Kakhovka - Snigirevka g/	31	
Irkutsk-Slyudyanka	130	
Ishimbay-Yermolayevo	98	98 h/
Izvestkovyy-Urgal i/		350 j/
Kizel'-Molotov	126	
Komsomol'sk - Sovetskaya Gavan' i/		454 j/
Komsomol'sk-Nikolayevsk	130	
Kostroma-Galich	125	
Kozhva-Vorkuta i/		458 j/
Lokot'-Leninogorsk i/		336 j/
Magnitogorsk-Kuybyshev region b/		
Magnitogorsk-Sibay-Baymak b/		
Miass-Kyshtym	85	
Mikhaylovskiy-Semipalatinsk b/		
Mointy-Chu	387	
Morozovskiy-Kuberle	150	
Murmansk-Pechenga-Nikel' g/	30	
Naushki - Ulan Bator	350	
Reshety-Boguchany	80	
Seyda-Labytnangi	175	
Shuya-Il'ino b/		
Sos'va-Alapayevsk c/	60	157 j/
Stalinsk-Abakan	80	

* Footnotes for Table 4 follow on p. 9.

Table 4

Track Laid and Sectors Completed on Individual Railroad Lines
During the Fourth Five Year Plan in the USSR
1946-50
(Continued)

Kilometers

Line	Track Laid a/	Official Completions
Syzran'-Kuybyshev i/	40	
Tayshet-Osetrovo c/	600	
Urgal-Komsomol'sk	470	
Ust'-Kamenogorsk - Zyryanovsk	87	
Shaygino-Vakhtan-Shar'ya	25	
Vorkuta-Kara	150	
Suoyarvi-Yushkozero g/	15	
Yerevan-Sevan	25	
Total	4,539	2,241

a. See Appendix A, Figure 2, following p. 26.
b. Planned, but not started, during the Fourth Five Year Plan (1946-50).
c. Some track laid before 1 January 1946.
d. 9/
e. Estimated.
f. 10/
g. Probably not in original Plan directives; added later.
h. 11/
i. In temporary operation before 1 January 1946.
j. 12/

The track laid by free labor was mainly concentrated on segments of the South Siberian Main Line between Akmolinsk and Abakan, on the lines Mointy-Chu and Chardzhou-Kungrad in Central Asia and Kazakhstan, and on scattered shorter lines throughout the country. Progress on these lines was very slow, and of these lines only a 212-km sector of the Chardzhou-Kungrad line was completed. None of the lines, including Chardzhou-Kungrad, were opened for through traffic, even on a temporary basis during the Plan.

Some of the factors leading to the failure to complete new lines were as follows: (1) much of the available free labor was used in carrying out second-stage construction on the 1,796 km of lines laid during World War II; (2) reconstruction of war-damaged lines in the western USSR received first call on men and material; and (3) the Plan seems to have been a statement of maximum aims rather than of expectations.

Most of the track laid by forced labor during the Fourth Five Year Plan was located in the eastern areas. These lines, not urgently needed, were built slowly, and construction was of low quality. Roadbeds, bridges, and tracks were built to minimum specifications, and lines were only put into temporary operation. These lines generally had not been completed at the end of 1956 and are still operating on temporary status.*

B. Fifth Five Year Plan (1951-55).

The goal of the Fifth Five Year Plan in the USSR was considerably scaled down from that of the Fourth Five Year Plan and had as its main objective the completion of the major lines started during the Fourth Five Year Plan. The goal for completions was not given, but the statement was made that approximately 2.5 times more lines would be completed during 1951-55 than during 1946-50 13/ -- that is, about 5,600 km.**

Official completions again fell short of the estimated Plan of 5,600 km, in spite of the fact that many of the lines scheduled for completion were in the final stages of construction when the Plan started. The amount of track laid and sectors completed on individual railroad lines during the Fifth Five Year Plan in the USSR, 1951-55, is shown in Table 5.*** Official completions reached about 3,100 km, 15/ or 55 percent**** of the estimated Plan. Tracklaying

* The exception to this statement is the Trans-Mongolian Railroad. The first sector, Naushki - Ulan Bator, was built during the Fourth Five Year Plan and completed early in the Fifth. The second sector, Ulan Bator - Erh-lien, was built and completed during the Fifth Five Year Plan. Both sectors were built mainly by forced labor.

** Computed by multiplying 2,241 km by 2.5. [redacted] 50X1

[redacted] 50X1

*** Table 5 follows on p. 11.

**** Computed.

Table 5

Track Laid and Sectors Completed on Individual Railroad Lines
During the Fifth Five Year Plan in the USSR
1951-55

Kilometers

Line	Track Laid a/*	Official Completions
Agryz-Bulgul'ma-Pronino-Surgut	255	
Akmolinsk-Pavlodar b/	88	438 c/
Artyshta-Chesnokovka b/	5	200 d/
Alasuskiy-Karazhal	60	
Barnaul-Kulunda	343	343 e/
Bratsk GES (bypass)	30	
Chardzhou-Kungrad b/	257	309 f/
Dudinka-Noril'sk b/	60	
Fedorovka-Kakhovka-Snigirevka b/	193	154 g/
Kherson-Nikolayev	35	
Khodorov-Stanislav	77	
Kizel'-Molotov b/	32	
Kokchetav-Kaymanachikha	80	
Kurgan-Peski	200	
Kustanay-Dzhetygara	47	
L'vov-Uzhgorod	138	
Magnitogorsk-Sibay-Baymak	150	109 h/
Mointy-Chu b/	60	447 c/
Morozovsk-Kuberle b/	25	175 i/
Murmansk-Pechenga-Nikel' b/	190	
Omsk-Karasuk-Barnaul	20	
Reshety-Boguchany b/	105	
Stalinsk-Abakan b/	260	
Syktyvkar-Mikun'	100	
Syzran'-Kuybyshev b/	138	
Ulan Bator - Chinese Border (Erh-lien) j/	710	710 k/
Uritskoye-Peski-Volodarskoye	50	
Ust'-Kamenogorsk - Zyryanovsk	88	175 f/
Vorkuta-Kara b/	60	
Suoyarvi-Yushkozero b/	125	

* Footnotes for Table 5 follow on p. 12.

Table 5

Track Laid and Sectors Completed on Individual Railroad Lines
During the Fifth Five Year Plan in the USSR
1951-55
(Continued)

Kilometers

Line	Track Laid a/	Official Completions
Yerevan-Sevan b/	15	
Yermolayevo-Chkalov b/	35	
Yesil'-Turgay	10	
Total	4,041	3,060

a. See Appendix A, Figure 2, following p. 26.
b. Construction started during Fourth Five Year Plan (1946-50).
c. 16/
d. 17/
e. 18/
f. 19/
g. 20/
h. 21/
i. 22/
j. Outside Soviet borders.
k. 23/

on new lines reached 4,041 km during the Fifth Five Year Plan, slightly less than the length of track laid during the Fourth Five Year Plan. In spite of this drop in track laid, the actual capability of free labor increased. The length of track laid by forced labor dropped to 1,157 km, but free labor laid 2,884 km (see Table 2*). In addition, second-stage construction, which was mainly done by free labor, increased from 2,241 km to 3,060 km.

* P. 5, above.

C. Sixth Five Year Plan (1956-60).

The directives of the Sixth Five Year Plan in the USSR call for the construction and placing in operation of about 6,500 km of new railroad, 24/ the first time since World War II that the length of lines planned to be completed will exceed the length of new track planned to be laid. The estimated length of track laid and sectors completed on individual railroad lines during the Sixth Five Year Plan in the USSR, 1956-60, is shown in Table 6.* During this Plan, 4,288 km of new lines will be built,** and 981 km of carryover, continuing from the Fifth Five Year Plan, will increase the total amount completed to 5,269 km. The 1,211 km*** necessary to meet the Plan goal of about 6,500 km will be made up by completing some of the cumulative carryover accrued since 1946 (see Table 3****).

The completion of lines from the cumulative carryover, some of which have been on temporary operation status since 1950, is to take place at a time when great economic development is going on in areas served by these lines. Some of the lines now are carrying heavy loads and merit the additional work needed to make them fully operational. An additional benefit to the Soviet economy is found in the fact that these lines can be officially completed at less than half the capital investment of totally new lines./ The USSR is thus able to set large new goals for railroad completions during the Sixth Five Year Plan with only a moderate expansion of the railroad construction force.

For the first time since World War II, prospects for fulfillment of the new railroad construction goals are good. During the first year of the Sixth Five Year Plan, 1956, about 1,200 km of track were laid on new railroads (see Appendix A, Figure 27//). The good showing in tracklaying was somewhat offset by failure to complete second-stage construction. Only 416 km of lines were completed because of failure to construct housing and cultural facilities for workers and other subsidiary installations. 33/

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* Table 6 follows on p. 14.

** New track amounting to 5,403 km will be laid, but 1,115 km will be carried over into the Seventh Five Year Plan (1961-65).

*** The estimated length of lines to be completed, 6,480 km less 5,269 km, gives 1,211 km. See Table 6.

**** P. 6, above.

/ The initial investment in the first stage of construction on many of these lines, generally built by forced labor, was possibly hidden in the MVD budget.

// Following p. 26.

Table 6

Estimated Length of Track Laid and Sectors Completed on Individual Railroad Lines During the Sixth Five Year Plan in the USSR 1956-60

Kilometers

Line	Estimated Track Laid a/*	Completions b/
Achinsk-Abalakovo	258	
Agryz - Bulgul'ma-Pronino - Surgut c/	80	335
Aktogay-Gosgranitsa (Dzhungarskiye Vorota)	308	308
Atasuskiy-Karazhal c/	14	74 d/
Chardzhou-Kungrad e/		107 f/
Dzhizak - Syr-Dar'inskiy	120	60 g/
Fedorovka-Kakhovka-Snigirevka e/		70
Gur'yev-Astrakhan'	330	
Irkutsk-Slyudyanka h/		130 i/
Kamensk-Ural'skiy - Krasnoufimsk	165	
Kentau-Turkestan	70	
Kherson-Nikolayev c/		35 j/
Khodorov-Stanislav c/		77 k/
Kizel'-Molotov e/		158 l/
Kokchetav-Kaymanachikha	330	410
Krasnaya-Sopka - Goryachaya	55	55
Krasnoyarsk - Krasnoyarsk GES	150	
Kurgan-Peski c/	75	275
Kustanay-Dzhetygara c/	171	218
L'vov-Uzhgorod c/	17	155 m/
Magnitogorsk-Abdulino	500	500
Miass-Uchaly	98	98
Mikun'-Mezen'	400	150
Murmansk-Pechenga-Nikel' e/	20	
Novgorod-Kresttsy; Michurinsk-Sosnovo	100	100
Omsk-Karasuk-Barnaul c/	730	750
Omsk-Ekibastuzugol'	400	
Pugachevsk-Balakovo	100	100
Seyda-Labytnangi h/		175

* Footnotes for Table 6 follow on p. 15.

Table 6

Estimated Length of Track Laid and Sectors Completed
on Individual Railroad Lines
During the Sixth Five Year Plan in the USSR
1956-60
(Continued)

Kilometers

Line	Estimated Track Laid a/	Completions b/
Stalinsk-Abakan e/	100	440
Syktyvkar-Mikun' c/		100
Tayshet-Osetrovo h/ (including new Bratsk GES bypass c/)	187	700
Uritskoye-Peski-Volodarskoye c/	120	170
Suoyarvi-Yushkozero	200	340
Yerevan-Sevan e/	30	70
Yermolayevo-Chkalov e/	60	95
Yesil'-Turgay c/	215	225
Total	5,403	6,480

a. See Appendix A, Figure 2, following p. 26.
b. The estimates of completion are based on the status of construction, Plan goals, and the relative importance of the line to the economy, unless otherwise noted.
c. Construction was started during the Fifth Five Year Plan (1951-55).
d. 25/
e. Construction was started during the Fourth Five Year Plan (1946-50).
f. 26/
g. 27/
h. Tracklaying was completed during the Fourth Five Year Plan (1946-50).
i. 28/
j. 29/
k. 30/
l. 31/
m. 32/

During 1956 first-stage construction was rushed on many new lines in order to provide access to new industrial sites. The construction force was scattered and therefore could not be used most efficiently, which undoubtedly contributed to the poor completion figure. Despite some difficulties in 1956, the goal for completion of about 6,500 km of new railroads in 1956-60 should be attained. If additional difficulties arise, or if a cutback occurs in capital investment for new railroad construction, the official completion goal could still be attained. There are included within the Sixth Five Year Plan about 900 km of lines which could be postponed until the Seventh Five Year Plan with little harm to the development program for the eastern areas.* The construction of these lines could be replaced by the official completion of additional lines from the still large cumulative carryover.** These lines would have the advantage previously mentioned of requiring less than half of the construction resources demanded by the construction of the new lines which they would replace.

III. Capital Investment in New Construction, 1946-60.

The capital investment in new railroad construction for the period 1946-60 in the USSR has been calculated by applying the average cost of construction per kilometer, in 1 July 1955 rubles, to the annual length of new railroad construction for the same period. Terrain conditions, the chief cause of variation in the cost of railroad construction, have been used as the weight for derivation of average cost.***

The capital investment allocated for new railroad construction is only a small part of the total volume of construction and installation work carried out in the national economy, varying between 1.3 and 2.3 percent of the total. The estimated capital investment in new line construction compared with the total volume of construction and installation work on railroads during the Fourth, Fifth, and Sixth Five Year Plans in the USSR, 1946-60, is shown in Table 7.**** The importance of new railroad construction, especially to the development of the eastern areas of the USSR, is not indicated by the volume of capital investment.

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* Among these lines are Gur'yev-Astrakhan' (330 km); Achinsk-Abalakovo (258 km); and Mikun'-Mezen' (400 km). Little or no work was done on these lines in 1956. See Appendix A, Figure 2, following p. 26.

** Lines estimated to be most likely to be put into operation if needed are the following: Komsomol'sk-Urgal (470 km); Murmansk-Pechenga-Nikel' (240 km); and Vorkuta-Kara (210 km).

*** For detailed methodology, see Appendix C, p. 29, below.

**** Table 7 follows on p. 17.

Table 7

Estimated Capital Investment in New Railroad Line Construction Compared with Total Volume of Construction and Installation Work During the Fourth, Fifth, and Sixth Five Year Plans in the USSR 1946-60

Five Year Plan	Total Volume of Construction and Installation Work (Billion Rubles) [a]	New Railroad Construction	
		Capital Investment (Billion Rubles) [a]	Percent of Total
Fourth (1946-50) (completed)	208.2 [b]	4.9	2.3
Fifth (1951-55) (completed)	394.8 [b]	5.0	1.3
Sixth (1956-60) (planned)	600.0 [c]	8.3	1.4

a. 1 July 1955 rubles. For derivation, see Appendix C, Table 16, p. 38, below.
b. 34/
c. 35/

Fulfillment of the goals of the Sixth Five Year Plan for expansion in the eastern areas largely depends upon the construction of the new lines discussed in this report and the improvement of existing lines (including double tracking, electrification, dieselization, and modernization of signaling). Freight traffic on railroads in the eastern areas of the USSR by 1950 had increased 91 percent above the level of 1940, but for the country as a whole it had increased only 45 percent. (The average freight density on these lines is about twice the national average, and on some lines it reaches eight times the national average.) The planned economic expansion in these areas will further increase the demands on railroads -- it is estimated that by 1960 the freight traffic will be at least 2.5 times the level of 1950.

The annual expenditure for new railroad construction remained relatively stable at about 1 billion rubles from 1946 through 1955. It is planned during the Sixth Five Year Plan to increase this expenditure to a maximum of 2.1 billion rubles in 1959 and 1960. The annual capital investment in new line construction as a share of total capital investment for railroads during the Fourth, Fifth, and Sixth Five Year Plans in the USSR, 1946-60, is shown in Table 8.*

It is probable that new railroad construction is done on orders from Gosplan in accordance with plans for long-range development and not for particular railroad systems. New lines are separate from the existing railroads (except for physical links) until the time when they are formally accepted into the railroad system. This is true even for those lines carried for prolonged periods on a temporary operation status.

IV. Postwar Construction Practices, 1946-60.

Railroad construction practices in the USSR have been undergoing changes since 1946 which will probably continue through 1960. These changes have occurred and are continuing to occur in the composition of the railroad construction labor force, the degree of mechanization, and the availability and quality of construction materials.

* Table 8 follows on p. 19.

Table 8

Estimated Annual Capital Investment in New Line Construction as a Share of Total Capital Investment for Railroads During the Fourth, Fifth, and Sixth Five Year Plans in the USSR 1946-60

Plan and Year	Total Capital Investment in Railroads (Billion Rubles) a/*	Capital Investment in New Railroad Construction (Billion Rubles) b/	New Construction as a Percent of Total
Fourth Five Year Plan (1946-50) c/			
1946	4.2	0.8	19
1947	4.8	0.9	19
1948	5.9	1.0	17
1949	9.9	1.1	11
1950	9.8	1.1	11
Total	34.6	4.9	14.2
Fifth Five Year Plan (1951-55) d/			
1951	9.0	1.0	11
1952	7.9	1.0	13
1953	9.0	0.9	10
1954	9.4	0.9	10
1955	9.7	1.1	11
Total	45.0	4.9 e/	10.9

* Footnotes for Table 8 follow on p. 20.

Table 8

Estimated Annual Capital Investment in New Line Construction as a Share of Total Capital Investment for Railroads During the Fourth, Fifth, and Sixth Five Year Plans in the USSR
1946-60
(Continued)

Plan and Year	Total Capital Investment in Railroads (Billion Rubles) a/	Capital Investment in New Railroad Construction (Billion Rubles) b/	New Construction as a Percent of Total
Sixth Five Year Plan (1956-60)			
1956	12.6 f/	1.2	10
1957	N.A.	1.5	N.A.
1958	N.A.	1.6	N.A.
1959	N.A.	1.9	N.A.
1960	N.A.	2.1	N.A.
Total	70.0 g/	8.3	12.0
Grand total	149.6	18.1	12.1

a. 1 July 1955 rubles.
b. 1 July 1955 rubles. See Appendix C, Table 17, p. 39, below.

[redacted] 50X1

e. Differs from Tables 7 and 16 because of rounding.

[redacted] 50X1

g. 39/

A. Fourth Five Year Plan (1946-50).

During the Fourth Five Year Plan in the USSR, ambitious plans were announced for the completion of 7,230 km* of new railroad construction, but the resources for this program were not provided. Because primary emphasis during this period was on the reconstruction of destroyed and damaged lines and facilities in the western USSR, new construction moved at a slow pace. The vast bulk of the work was done by hand labor.** Even on the lines built entirely by free labor, the heavy work of excavation, filling, and other roadbed construction was carried out by the mass use of common labor. The more experienced cadres and the available machinery were concentrated on the construction of bridges, culverts, tunnels, and other work requiring technical skills. It was stated that on the Chardzhou-Kungrad line, "tens of thousands of kolkhozniks from the Chardzhouskaya, Khorezmskaya, and Tashauzskaya Oblasts and the Kara-Kalpakskaya ASSR participated in the construction of the roadbed ... . Work was conducted by the tested method of people's construction." 41/

Materials in use were based on prewar Soviet standards (unacceptable for main-line use in the US). The heaviest rail available in the USSR was type R-43,*** 42/ but this type was used mainly on existing lines, and new construction received even lighter types. Many untreated ties were used, and even those treated were often of inferior quality. Many new lines were laid with minimal ballast and some with no ballast whatever, although gravel ballast was mandatory for official completion. 43/ On lines laid by forced labor, even poorer materials were used, such as even lighter or used rails, low-quality ballast (or no ballast at all), and untreated ties. 44/

The speed of construction generally was slow and the quality of the completed work poor. [redacted] "the entire system of railroad line construction in the USSR seems like an improvisation." 45/ 50X1

B. Fifth Five Year Plan (1951-55).

During the Fifth Five Year Plan in the USSR a transition began. Heavy rail types R-50 and R-65**** were developed 46/ and

* By comparison, the Sixth Five Year Plan calls for completion of only about 6,500 km 40/ (see Table 1, p. 3, above).
** See I, p. 2, above.
*** R-43 rail weighs 43 kilograms per meter (86 pounds per yard).
**** R-50 rail weighs 50 kilograms per meter (101 pounds per yard), and R-65 rail weighs 65 kilograms per meter (130 pounds per yard).

gradually put into use, although type R-43 remained the most common throughout the period. A similar improvement took place in other materials late in the period of the Plan.

The composition of the labor force also changed greatly during this period. Forced labor was gradually reduced, and modern machinery was introduced on an increased scale. As a result, the speed of construction increased, and the general quality of construction improved. In spite of these improvements, however, serious shortcomings continued to exist. In mid-1954, Kaganovich emphasized the problems still facing railroad builders when he pointed out that the acceptance of the Akmolinsk-Pavlodar Railroad into full operation was a "gross error" because of its low operational capacity. He also gave numerous examples of lagging construction and stressed the need for increasing the rate of construction. 47/

C. Sixth Five Year Plan (1956-60).

During the Sixth Five Year Plan in the USSR the transition to the use of materials comparable to those of US standards should be completed. Statements on the construction of new railroads during this period emphasize the use of heavy rails (probably R-50) laid on gravel ballast.* 48/ The use of precast reinforced concrete for culverts, small bridges, track buildings, communications poles, and track signals is becoming widespread. In addition, considerable work has been done toward the development of practical prestressed concrete ties. Although some difficulties have been encountered, experimental sections of track are already testing such ties. 49/ It was originally planned to produce and lay some 10 million of these ties** during 1956-60. 50/ Although this figure will probably not be reached, a large number of them should come into use during the later years of the Plan.

R-50 rail came into use late in the period of the Fifth Five Year Plan, on a limited basis, and R-65 has not as yet been widely used. Both types approximate US weight standards, although the quality of steel may be inferior.

* The use of heavy rails would be limited to new lines planned for heavy traffic. Railroads of lesser capacity would receive lighter rails.

** Sufficient for about 6,200 km of track.

Mechanization is now common in the construction of the new railroads, and the mass use of hand labor in clearing and grading is being decreased.* As in other fields, mechanization and increase in productivity of labor are being stressed. On the Magnitogorsk - Beloretsk-Abdulino line all earth moving is to be done by mechanized processes, and the large embankments at the approaches to the Belaya and Dema Rivers will be done by suction dredges. 51/ Among the types of equipment arriving at new construction sites are the following: bulldozers, levelers, graders, tracklayers, excavators, mobile electric power stations, and concrete drying installations (for the preparation of precast reinforced units). 52/

Emphasis on the use of precast reinforced concrete, the increased use of modern machinery and equipment, the introduction of new equipment, and the improvement in the qualifications of the workers should continue through 1960.

V. Prospects for Future Construction, 1961-70.

Although only general indications have been given of plans for railroad construction in the USSR beyond 1960, continued emphasis on construction in the eastern areas seems certain. Many lines have been mentioned as desirable, and two lines in particular are repeatedly named, the Amur-Yakutsk Railroad 53/ and the Polunochnoye-Labytnangi Railroad.** 54/ A recent article in the Soviet press 55/ on economic development in the eastern areas included a small-scale map and several pages of text on the prospects for new railroad construction in 1961-70. The completion of these lines, some of which reach far into the areas of permafrost and swamp land, seems at first glance to be overambitious. They could be completed, however, by continuing the annual rate of construction attained in 1956. The technical problems of railroad construction over permafrost have already been solved by the USSR. The cost of such a construction program would be high, but would not constitute an excessive burden on the Soviet economy. Even under the assumption that the average cost would equal 2.2 million rubles per kilometer 56/ -- an extremely high estimate -- the capital investment required over a 10-year period would be only about 22 billion rubles.

Prospective new railroad lines to be constructed during the Seventh and Eighth Five Year Plans in the USSR, 1961-70, are shown in Table 9.***

* This process is not completed as yet, but has made considerable headway.

** Also called the Ural-Pechora Railroad.

*** Table 9 follows on p. 24.

Table 9

Prospective New Railroad Lines To Be Constructed
During the Seventh and Eighth Five Year Plans in the USSR a/
1961-70

Kilometers

Line b/	Approximate Length c/
Abalakova - Podkamennaya Tunguska - Yermakovo	1,180
Aleksandrov-Gay - Makat - Kungrad	1,100
Aral'sk-Dzhezkazgan	450
Balkhash-Aktogay	380
Bol'shoy Never - Yakutsk - Magadan	2,590
Kara-Amderma	160
Karaganda-Aktogay	620
Kaymanachikha-Karasuk	180
Lodeynoye Pole - Vytegra - Cherepovets	530
Mezen'-Arkhangel'sk	240
Polunochnoye-Labytnangi	920
Sevan-Kirovakan	60
Solikamsk-Ukhta	500
Syktyvkar - Verkhne-Kamskaya	280
Tayshet-Abakan	520
Uchaly-Magnitogorsk; Baymak-Sara	240
Yushkozero - Alakurtti (West Karelian Railroad)	220
Total	10,170

a. A limited amount of work already may have been carried out on some of these lines.
b. 57/
c. Distances derived from 1:4,000,000 scale map. 58/

APPENDIX A

PROGRESS CHART

The following progress chart (see Figure 2*) shows the annual progress of tracklaying on all major railroad construction projects in the USSR in 1946-56 and gives estimates of planned annual tracklaying in 1957-60.

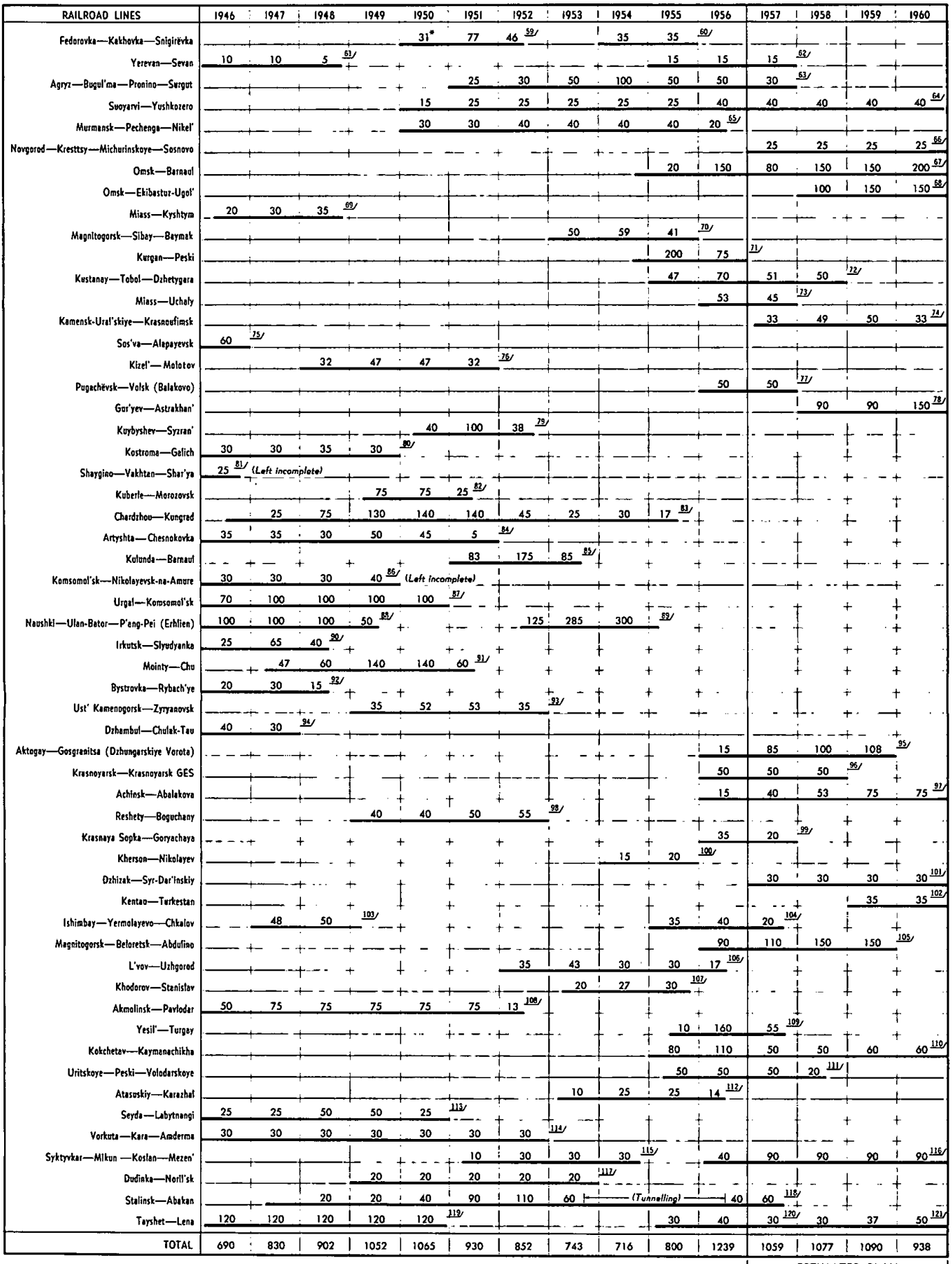
50X1

* Following p. 26.

Figure 2

50X1

USSR: PROGRESS OF CONSTRUCTION ON INDIVIDUAL RAILROAD LINES, 1946-60



* Kilometers of track laid per year.

25917 7-57

50X1

APPENDIX B

UNUSUAL CONSTRUCTION PROJECTS

This appendix discusses briefly three railroad construction projects in the USSR which were not considered in the body of the report but are nevertheless worthy of attention. Two of these projects are broad-gauge lines on which reports are inconclusive, and the third is a major narrow-gauge network in northern Kazakhstan.

1. Pobedino-Okha.

A broad-gauge railroad has been reported under construction on Sakhalin Island between Pobedino or Keton (northern terminal of the South Sakhalin narrow-gauge network) and Okha. It is reported that some construction has been carried out and that a broad-gauge line runs northward from Pobedino, but the extent of the construction is unknown. When completed the total length of the line will be from 450 to 500 km, depending on the route chosen. Economic considerations do not appear to justify such a project unless the sector of narrow-gauge line from Pobedino south to the port of Poronaysk is to be converted to broad gauge. 122/

2. Salekhard-Igarka-Dudinka.

A 1,050-km railroad between Salekhard and Igarka in the USSR, with a 250-km connection to Dudinka, has been reported under construction since 1945. At present the status of this line is indefinite. Track has probably been laid at least 250 to 400 km eastward from Salekhard (on the Ob' River), and train movement at very low speed has been reported on this section. Although the terrain is flat, the route was reported to have many curves in order to avoid the worst of the swampy areas. The roadbed was reported to be poorly built and the quality of the completed construction poor. 123/

Little is known about the eastern end of this line. In 1953-54, construction materials were reported to be stockpiled between Dudinka and Igarka (along the Yenisey River), and rumors were prevalent that construction to the west or southwest was under way. 124/ It is possible that the line was open along its whole length in 1954 for limited construction traffic. 125/ It is believed that since then much of the line has been allowed to deteriorate and that through traffic is not possible at present.

Neither economic nor military considerations appear to justify the construction of this line. Work on it probably was abandoned at the time of Stalin's death along with a number of other grandiose projects.

3. The "New Lands" Narrow-Gauge Railroads.

In late 1954, in connection with the "new lands" program, the planned construction of an 1,850-km narrow-gauge railroad network was announced. 126/ Plans were changed shortly afterward, and by mid-1955 it was clear that many of the planned narrow-gauge railroads were actually being built as broad-gauge railroads. 127/

The change in plans was confirmed early in 1956 by the directives of the Sixth Five Year Plan, which called for the completion of only 935 km of narrow-gauge railroads in the "new lands."* 128/ Recent statements in the Soviet press indicate that even some of these remaining lines may be converted to broad gauge because of their present low traffic capacity and the high cost of transshipment. 129/

* The remainder of the lines, originally planned to be narrow gauge, have been built (or are under construction) as broad-gauge lines. These are included in the body of the report.

APPENDIX C

METHODOLOGY

1. First-Stage Construction.

During the Fourth and Fifth Five Year Plans, forced labor was used to carry out first-stage construction on about half of the new railroads in the USSR. Such first-stage construction work done by forced labor on individual railroad lines during the Fourth and Fifth Five Year Plans in the USSR, 1946-55, is shown in Table 10.* It may be noted that all of the lines under construction during the Fifth Five Year Plan had been started during the Fourth, except for the Ulan Bator - Erh-lien sector of the Trans-Mongolian Railroad.

2. Second-Stage Construction.

The second stage of construction on a new Soviet railroad occurs between the completion of the first stage of construction (which is marked by the first through passage of a train) and the official completion of the railroad. On railroads built under normal conditions, this second stage may begin before the first stage is completed.

The time interval between passage of the first train and official completion of new railroads on selected lines in the USSR is shown in Table 11.** In this table, selected railroads have been chosen and the lengths of time necessary for their second-stage construction have been averaged to get an approximate average length of time for second-stage construction.

3. Cost of Construction.

An average cost per kilometer for railroad construction, in 1 July 1955 rubles, is needed in order to estimate capital investment in new railroads. This cost, based on average terrain conditions, has been estimated as follows: the ranges of volume of earthwork and total cost of construction per kilometer of new line under varying terrain conditions [redacted] It is found that for every 1,000 cubic meters of earthwork per kilometer in excess of 15,000 cubic meters per kilometer the total cost of construction is increased 30,000 rubles. The relationship between the volume of earthwork and the total cost of construction in railroad construction in the USSR is shown in Table 12.*** Increase in volume of earthwork covers only a part of

50X1

* Table 10 follows on p. 30.
** Table 11 follows on p. 31.
*** Table 12 follows on p. 32.

the additional cost. Other factors which increase the cost of construction are the following: additional bridging; strengthening of slopes; rock excavation (which is 2 to 3 times more costly than normal earthwork); and tunneling.

Table 10

First-Stage a/ Construction by Forced Labor on Railroad Lines During the Fourth and Fifth Five Year Plans in the USSR 1946-55

Kilometers

Line	Fourth Five Year Plan (1946-50)	Fifth Five Year Plan (1951-55)
Dudinka-Noril'sk b/	40	60
Kizel'-Molotov c/	126	32
Komsomol'sk-Nikolayevsk d/	130	
Murmansk-Pechenga-Nikel'	30 e/	190 f/
Naushki - Ulan Bator g/	350 h/	
Reshety-Boguchany i/	80	105
Seyda-Labytnangi j/	175	
Sos'va-Alapayevsk k/	60	
Tayshet-Osetrovo l/	600	
Ulan Bator - Erh-lien g/		710 m/
Urgal-Komsomol'sk n/	470	
Vorkuta-Kara o/	150	60
Total	2,211	1,157

a. See p. 2, above.
b. 130/
c. 131/
d. 132/
e. 133/
f. 134/
g. Part of the Trans-Mongolian Railroad outside Soviet borders.
h. 135/
i. 136/
j. 137/
k. 138/
l. 139/
m. 140/
n. 141/
o. 142/

Table 11

Time Interval Between Passage of the First Train and Official Completion of New Railroads on Selected Lines in the USSR

Line	Date of First Through Train	Date of Official Completion	Time Interval (Months)
Akmolinsk-Pavlodar	16 February 1952 a/	27 December 1953 b/	21.5
Artyshta-Chesnokovka	19 February 1952 c/	18 March 1953 d/	13.0
Kulunda-Barnaul	May 1953 e/	26 December 1953 f/	7.5
Mointy-Chu	August 1951 g/	27 October 1953 h/	26.0
Ulan Bator - Erh-lien	18 April 1955 i/	1 January 1956 j/	8.5
Average time interval			15.3 k/

a. 143/
b. 144/
c. 145/
d. 146/
e. 147/
f. 148/
g. 149/
h. 150/
i. 151/
j. 152/
k. There is no apparent correlation between the length of the line and the time needed to complete the additional work done in the second stage (see p. 2, above).

Because average terrain conditions are the critical factor in the determination of total construction costs of railroads, estimates were made by three methods and an average cost found for each. These three average costs were then weighted and a final average cost derived. The three methods of cost estimation and final derivation of average cost follow.

Table 12

Relationship Between Volume of Earthwork and Total Cost of Construction in Railroad Construction in the USSR a/

Condition of Terrain b/	Volume of Earthwork per Kilometer (Thousand Cubic Meters)	Range of Total Cost of Construction per Kilometer (Million Rubles) c/
Level	12 to 15	0.9 to 1.0
Slightly hilly	15 to 25	1.0 to 1.3
Hilly	25 to 35	1.3 to 1.6
Mountainous	35 and over	1.6 to 2.2

a. 153/
b. Terrain conditions are translated directly from Russian.
c. 1 July 1955 rubles, rounded to two significant figures (converted from 1 July 1950 rubles [redacted] 50X1

Method 1. The average volumes of excavation per kilometer of line were announced for the most important lines planned for construction during the Fourth Five Year Plan. 155/ The total volume of earthwork was computed and divided by the total kilometers to obtain an average volume of earthwork per kilometer, 29,000 cubic meters per kilometer. The derivation of the average volume of earthwork per kilometer of railroad construction on major new railroads planned for construction during the Fourth Five Year Plan in the USSR, 1946-50, is shown in Table 13.* The cost for this average volume was determined from Table 12 to be 1,420,000 rubles per kilometer (Estimate 1).

The average cost obtained by this method is given double weight in the final average for the following reasons: specific average volumes are given for specific lines, the over-all length of the lines involved is great, and the lines were actually under construction during the Fourth and Fifth Five Year Plans.

Method 2. The routes of all major lines under construction or planned for construction during the Sixth Five Year Plan were laid out on large-

* Table 13 follows on p. 33.

Table 13

Derivation of Average Volume of Earthwork per Kilometer of Railroad Construction on Major New Railroads Planned for Construction During the Fourth Five Year Plan in the USSR a/
1946-50

Line	Planned Length (Kilometers)	Planned Average Volume of Earthwork (Thousand Cubic Meters per Kilometer)	Planned Total Volume of Earthwork (Thousand Cubic Meters)
Bystrovka-Rybach'ye	78	39	3,042
Chardzhou-Kungrad	615	14	8,610
Ishimbay-Yermolayevo	95	30	2,850
Mointy-Chu	418	15	6,270
South Siberian Main Line b/	2,884	34	98,056
Total	4,090		118,828
Average volume of earthwork, 29,000 cubic meters per kilometer c/			

50X1

b. Including the following (from west to east): Abdulino-Magnitogorsk (now under construction); Akmolinsk-Pavlodar; Kulunda-Barnaul; Artyshta-Chesnokovka; Stalinsk-Abakan (now nearing completion); and Abakan-Tayshet (not yet started).
c. Computed by dividing 118,828,000 by 4,090. Result rounded to two significant figures.

scale terrain maps, 157/ and estimates were made of terrain conditions.* The total length of these lines was apportioned among the four terrain categories and equated to the cost for the midpoint of the appropriate category. The derivation of the average cost of new railroad construction during the Sixth Five Year Plan in the USSR, by map study of terrain conditions, 1956-60, is shown in Table 14. The average cost, weighted by the percent of total lines in each category, was then computed to be 1,159,000 rubles per kilometer (Estimate 2).

This method is considered less accurate than Method 1 because of the subjective nature of the terrain evaluation process.

Table 14

Derivation of Average Cost of New Railroad Construction
During the Sixth Five Year Plan in the USSR
by Map Study of Terrain Conditions
1956-60

	(A)	(B)	(C)
Condition of Terrain a/ b/	Percent of Total	Midpoint of Cost Range per Kilometer (Million Rubles) a/	Weighted Factor c/
Level	50	0.95	0.475
Slightly hilly	29	1.15	0.334
Hilly	11	1.45	0.160
Mountainous	10	1.90	0.190
Total	100		1.159 d/

a. 158/
b. Terrain conditions are translated directly from Russian.
c. "Weighted Factor" is computed by multiplying "Percent of Total" times "Midpoint of Cost Range" (C = B x A). The sum of the four weighted factors equals the average cost of construction per kilometer in million rubles.
d. Average cost per kilometer.

* Numerous references in Gudok and Stroitel'naya gazeta were also used as aids in arriving at these estimates.

Method 3. The volume of earthwork for double tracking is stated to be 150 million cubic meters for every 10,000 km of track, or 15,000 cubic meters per kilometer (average). 159/ The cost of earthwork for double tracking is stated to be 35 to 40 percent above the cost of earthwork for single tracking. 160/ Because the cost of earthwork and volume of earthwork under similar conditions are directly related, the additional volume needed for double tracking is 35 to 40 percent greater than that required for single tracking. As a result the following computations were made:

	Volume (Cubic Meters per Kilometer)	Index
Volume of earthwork, single track	X	100
Additional volume of earthwork to construct double track	15,000	37.5

$$\text{Thus:} \quad \frac{X}{15{,}000} = \frac{100}{37.5}$$

$$X = \frac{1{,}500{,}000}{37.5}$$

$$X = 40{,}000$$

Therefore the average volume of earthwork needed for single tracking is 40,000 cubic meters per kilometer.

The average cost of construction for lines having an average volume of earthwork of 40,000 cubic meters per kilometer was determined from Table 12* (by interpolation) to be 1,750,000 rubles per kilometer (Estimate 3).

This method is considered less accurate than Method 1 because the basic data given do not apply directly to single-track earthwork.

Derivation of Final Average Cost of Construction. In calculation of the final average cost, Estimate 1 (derived by Method 1) was given a weight of 2, and Estimates 2 and 3 (derived by Methods 2 and 3) were each given a weight of 1. The computation of the final average cost of new railroad construction during the Sixth Five Year Plan in the USSR, 1956-60, is shown in Table 15.**

* P. 32, above.

** Table 15 follows on p. 36.

Table 15

Computation of Final Average Cost of New Railroad Construction During the Sixth Five Year Plan in the USSR 1956-60

		Thousand Rubles [a]	
Estimate	Weight	Cost per Kilometer	Weighted Cost per Kilometer
1	2	1,420	2,840
2	1	1,159	1,159
3	1	1,750	1,750
Total	4		5,749

Final average cost per kilometer: $\frac{5,749,000}{4}$ = 1,437,250 rubles

Rounded to two significant figures: 1,400,000 rubles

a. 1 July 1955 rubles.

The average cost per kilometer from Table 15, 1.4 million rubles (rounded to two significant figures), was used for the calculation of all capital investment figures for new railroad construction.

4. Capital Investment.

The capital investment in new railroad construction was estimated by applying the average cost (per kilometer) for railroad construction to the total volume of work done (in kilometers) in each of the Five Year Plan periods, as follows: the average cost for the construction of 1 km of railroad in the period 1946-60, estimated to be 1.4 million rubles,* has been broken into two parts in accordance with Soviet railroad construction practice. The first part covers the cost of first-stage construction** and takes about 53 percent of the total capital investment per kilometer 161/ -- that is, 740,000 rubles per kilometer. The second part covers the cost of second-stage construction** and takes the remaining 47 percent of the total capital investment per kilometer 162/ -- that is, 660,000 rubles per kilometer.

* See 3, p. 29, above.
** See I, p. 2, above.

The cost for first-stage construction was applied to the total length of track laid during each of the Five Year Plan periods because tracklaying is a rough indicator of completion of first-stage construction work. The cost for second-stage construction was applied to the total length of lines completed during each of the Five Year Plan periods, because official completion marks the end of second-stage construction. The capital investment in new railroad construction and the volume of uncompleted work during the Fourth, Fifth, and Sixth Five Year Plans in the USSR, 1946-60, are shown in Table 16.*

The annual capital investment in new construction has been estimated by the methodology used in estimating capital investment for Five Year Plans,** except that annual periods replace the Plan periods.

The derivation of annual investment in new railroad construction during the Fourth, Fifth, and Sixth Five Year Plans in the USSR, 1946-60, is shown in Table 17.*** The annual capital investment figures are considered less accurate than Plan figures because the annual official completions are estimated from Plan total completions and are based on general trends. It is estimated that the least accurate of the annual capital investment figures is within 20 percent of the actual figure.

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* Table 16 follows on p. 38.
** See p. 36, above.
*** Table 17 follows on p. 39.

Table 16

Capital Investment in New Railroad Construction and Volume of Uncompleted Work During the Fourth, Fifth, and Sixth Five Year Plans in the USSR
1946-60

Time Period and Stage of Work	(A) Volume of Construction a/ (Kilometers)	(B) Average Cost per Kilometer b/ (Thousand Rubles)	(C) Derived Capital Investment c/ (Billion Rubles)
World War II (1939-45)			
Carryover, d/ 31 December 1945	1,796	660	1.2
Fourth Five Year Plan (1946-50)			
First-stage construction e/	4,539	740	3.4
Second-stage construction f/	2,241	660	1.5
Total			4.9
Carryover, d/ 31 December 1950	4,094	660	2.7
Fifth Five Year Plan (1951-55)			
First-stage construction e/	4,041	740	3.0
Second-stage construction f/	3,060	660	2.0
Total			5.0
Carryover, d/ 31 December 1955	5,075	660	3.3
Sixth Five Year Plan (1956-60)			
First-stage construction e/	5,403	740	4.0
Second-stage construction f/	6,480	660	4.3
Total			8.3
Carryover, d/ 31 December 1960	3,998	660	2.6

a. See Table 3, p. 6, above.
b. 1 July 1955 rubles. For derivation of figures, see 4, p. 36, above.
c. 1 July 1955 rubles, rounded to two significant figures. Computed by multiplying "Volume of Construction" times "Average Cost per Kilometer" (C = A x B).
d. See I, p. 5, above.
e. See I, p. 2, above.
f. See I, p. 3, above.

Table 17

Derivation of Annual Investment in New Railroad Construction During the Fourth, Fifth, and Sixth Five Year Plans in the USSR 1946-60

Plan and Year	Track Laid		Additional Work Carried Out to Complete Lines		Total Capital Investment (Billion Rubles) b/
	Length (Kilometers) a/	Investment (Billion Rubles) b/ c/	Length (Kilometers) a/	Investment (Billion Rubles) b/ d/	
Fourth Five Year Plan					
1946	690	0.5	400	0.3	0.8
1947	830	0.6	420	0.3	0.9
1948	902	0.7	440	0.3	1.0
1949	1,052	0.8	460	0.3	1.1
1950	1,065	0.8	480	0.3	1.1
Fifth Five Year Plan					
1951	930	0.7	500	0.3	1.0
1952	852	0.6	540	0.4	1.0
1953	743	0.5	590	0.4	0.9
1954	716	0.5	670	0.4	0.9
1955	800	0.6	800	0.5	1.1
Sixth Five Year Plan					
1956	1,239	0.9	416 e/	0.3	1.2
1957	1,059	0.8	1,000	0.7	1.5
1958	1,077	0.8	1,300	0.8	1.6
1959	1,090	0.8	1,700	1.1	1.9
1960	938	0.7	2,084	1.4	2.1

a. See Figure 1, following p. 4.
b. 1 July 1955 rubles, rounded to two significant figures.
c. Computed by multiplying the cost per kilometer (740,000 rubles) by the length of track laid annually (see p. 36, above).
d. Computed by multiplying the cost per kilometer (660,000 rubles) by the length of lines completed annually (see p. 36, above).
e. 163/

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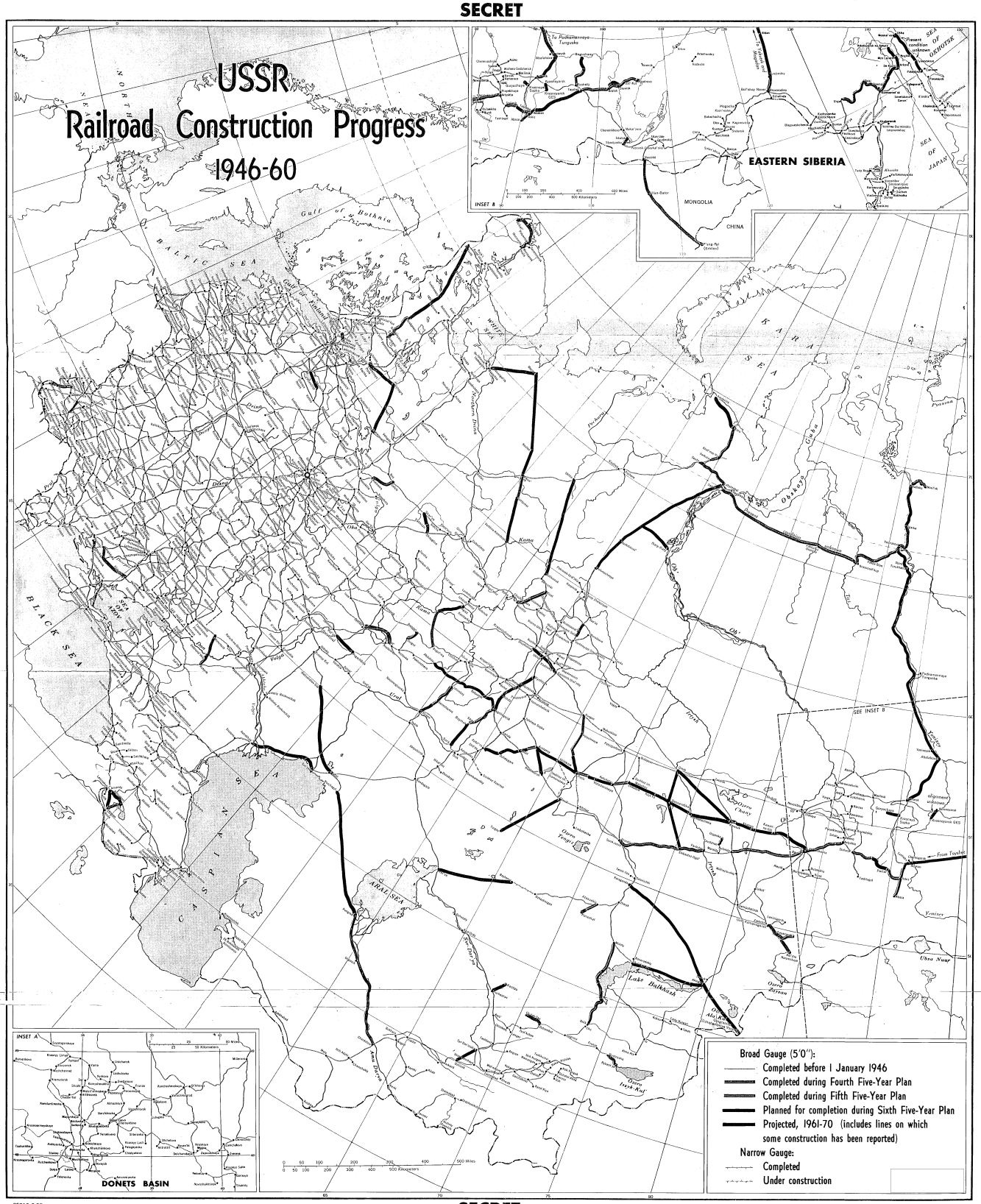

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