CHAPTER 17

ENVIRONMENTAL IMPACT ASSESSMENT

Chapter 17

Environmental Impact Assessment

17 - 1 Environmental Impact Assessment in Mongolia

The Environmental Impact Assessment (EIA) in Mongolia is described by the Government Regulation No.121 (Fig.17-1). The Project Proponent submits a project description to Ministry for Nature and Environment (MNE) and Local Government. The screening by the MNE and Local Government is done in order to determine what level of EIA will be required. Three potential decisions are ;

① Negative Declaration (no further study in reference to the Mongolian EIA Procedure required).

② Mitigation Negative Declaration (impacts are "insignificant " and can be reduced through mitigative measures. And not further study required).

③ Detailed Assessment (An EIA Study (focused EIA or Full EIA) will be required).

In the case of Detailed Assessment, one of Licensed Environmental Impact Assessment Companies conducts scoping, EIA Study and Report. After the public notice the final decision must be done on the base of the EIA Study and Report and the governmental body may authorize or deny the commencement of project operation.

Before each construction of this project, EIA should be conducted in accordance with the Mongolian EIA procedure.

17-2 Environment Around the Project Sites

Mongolian Environmental Action Plan (the Ministry for Nature and Environment (1995), Ulaan-baatar) described the Environmental Problems of Mongolia. Environment around this project sites are as follows:

① Because of harsh climatic factors, the rates of humus production, vegetative regeneration and growth, and livestock productivity are very low in comparison to other countries in the region.

② A significant portion of the land resources are currently degraded as a result of soil erosion (Appendix 17-1), overgrazing (Appendix 17-2), and deforestation (Appendix 17-3) (including loss of forests to fire and insect damage).

③ The great part of the grassland are considered as vulnerable to fires.

④ Grazing pressure is great near settlements.

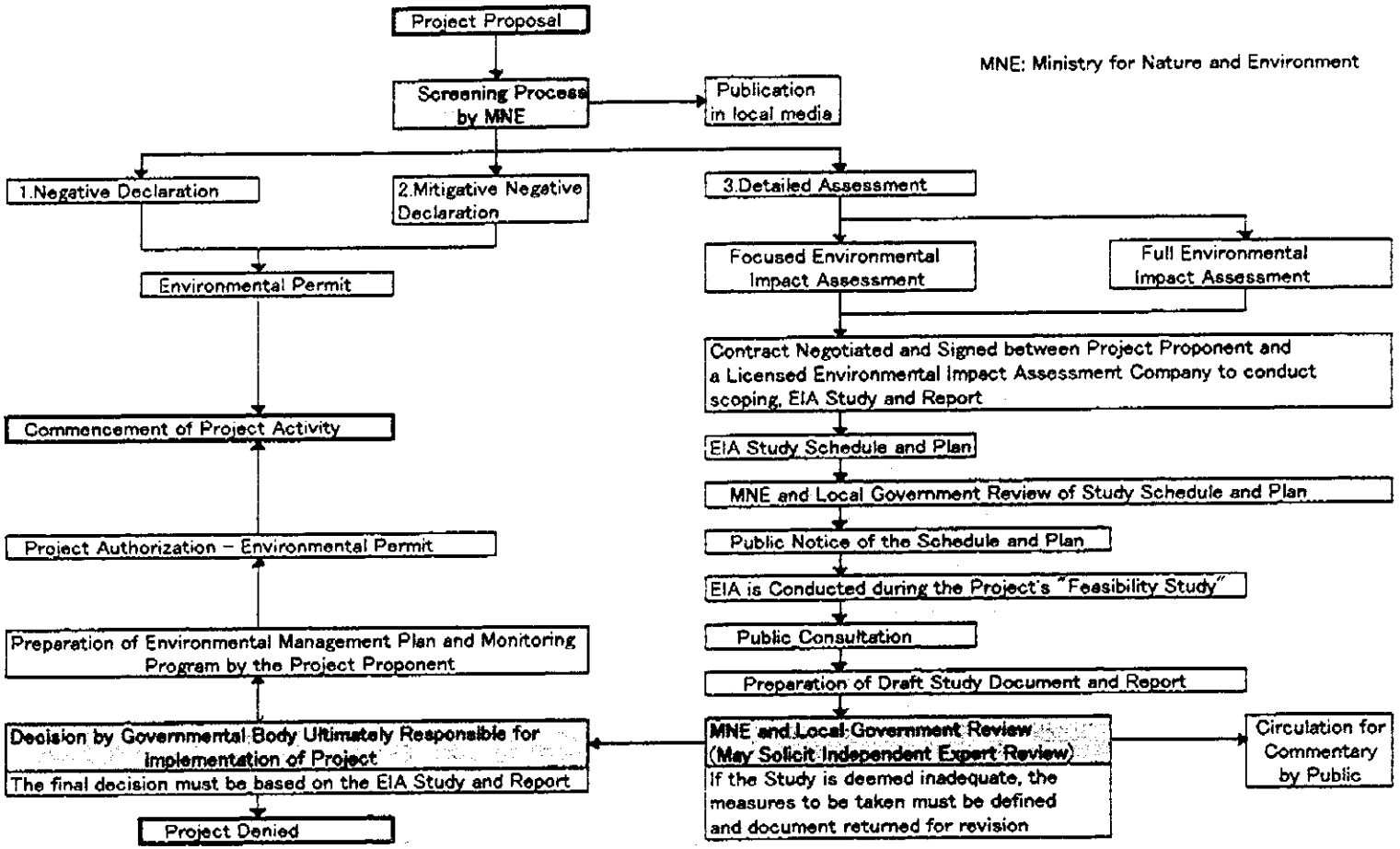


Fig. 17 – 1 Mongolian Environmental Impact Assessment Procedure

⑤ Crop cultivation (Appendix 17-4) is an important cause of soil erosion.

⑥ Poor irrigation practices reduce fertility of soils.

⑦ The declining wildlife population is due to hunting and wildlife trade, depleting water resources, deforestation, overgrazing and urbanization.

⑧ Vehicles' travel across the grasslands causes rangeland degradation.

⑨ There is a strong trend toward urbanization of the population. Use of renewable natural resources, including surface water, ground water, forest, soil and rangeland resources, have already exceeded the sustainable limit in some areas.

17-3 Environmental Impact Assessment for Project Sites of the Short-term Urgent Projects

17-3-1 Introduction

In the Environmental Impact Assessment, the following items will be specially discussed as components of EIA:

- Measure toward construction wastes (Appendix 17-5) which will be produced during constructions;
- Possibility for soil erosion which will be induced by construction such as a track transfer;
- Impacts of this project toward fauna (Appendix 17-6) and flora (Appendix 17-7); and
- Impacts toward aquatic biota (Appendix 17-8) in constructing revetment.

17-3-2 Biodiversity around the Project Sites

The majority of landuse along the Rehabilitation Project Sites of the Mongolian railway is rangeland. But climate, water environment, and population density influence on the distribution of wild life. The numbers of terrestrial wild vertebrate animal and plant species in the project sites is shown in Table 17-1. The border region with Russia (Sites 1 and 2), the region between 250 km and 290 km (Sites 14 to 17) and the region being contact with a special protected area (Bogt Khan Uul) (Sites 26 to 29 and Site 31) have a larger number of wild life than the other project sites. The reasons are:

- these project sites have relatively abundant of water;
- these project sites are in or near the area which is not easily accessible. The border region with Russia is prohibited to enter, the region between 250 km and 290 km is surrounded with low mountains and doesn't have a convenient road system. The region

between 420 km and 465 km is near the special protected area and doesn't have a convenient road system.

- these project sites have not only grassland but also mountains and rivers.

On the other hand, sites 3 to 5 near Sukhe-baatar, sites 8 and 9 near Darkhan, sites 11 to 13 near Baruunharaa and Zuunharaa, and sites 20, 21 and 23 near Ulaan-baatar are a region which has a smaller number of wild life. In these sites, the following vertebrate animals are seen:

- mammals (Appendix 17-7(d)): *Microtus* (Vole)
- birds (Appendix 17-7(c)): *Columba livia* (Rock Pigeon), *Milvus migrans* (Black Kite), *Alauda arvensis* (Northern Skylark), *Corvus corax* (Eurasian Crow), *Corvus monedula* (dauricus) (Jackdaw), *Pika pika* (Black-billed Magpie), *Passer montanus* (Tree Sparrow)

These animals are species which are seen near settlements, and characteristics of these species are shown in Appendix 17-7(c) and (d). Specially, in sites 20, 21 and 23 near Ulaan-baatar grassland is overgrazed and its soil is severely disturbed (Appendix 17-1).

The site 13pk4 where natural environment is relatively preserved, the intermediate site 66pk4-5, and the disturbed site 356pk1 near Ulaan-baatar are seen in Photo 17-1, 17-2 and 17-3, respectively.

Table 17-1 Numbers of terrestrial plant and vertebrate species

Site		number of plant species	number of vertebrate species
1	10pk6-10pk8	64	23
2	17pk9-19pk2	77	23
3	Sukhbaatar	40	9
4	30-32km	28	10
5	54-56km	30	9
6	65-69km	32	14
7	92-96km	35	10
8	110km	15	8
9	170km	16	9
10	208-209km	58	14
11	223km	26	7
12	235km	34	9
13	244-245km	28	7
14	255km	39	26
15	272km	54	36
16	285km	73	32
17	289km	63	19
18	315km	29	14
19	335km	19	19
20	358km	18	10
21	399km	10	11
23	Dunt river(park)	22	10
26	420-421km	49	34
27	429-443km	38	17
28	434-435km	37	21
29	442-443km	43	22
31	465km	48	31

From the local subcontractor's report on environmental study (1996) (Report A)

Photo 17-1 13pk4

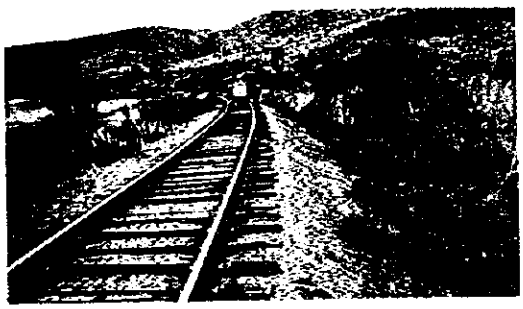


Photo 17-2 66pk4-5

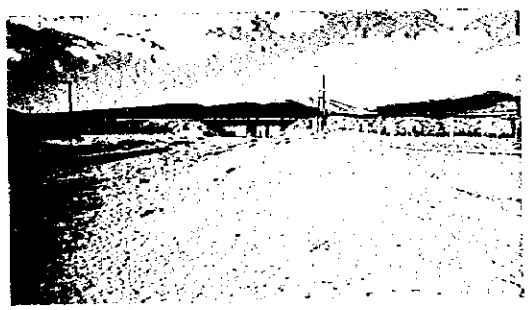


Photo 17-3 356pk1

17-3-3 Environmental Measures toward Construction Wastes

Construction wastes are produced in a truck transfer (31pk2-4), widening stream channel (399pk1), drain improvements and so on. Details on construction wastes are shown in Appendix 17-5. The composition of the construction wastes for this project is very simple: wasted sediment, soil, concrete and iron material. If the wasted soil and/or sediment has an offensive smell or a possibility of contamination, it is necessary to analyze it. The construction wastes should be reused as much as possible. Methods for disposal of construction wastes should be determined with a local government.

Site 399pk1, where a stream channel will be widen, is in an industrial zone and domestic wastewater flows in this channel. Sediments in this channel and soils near the site 399pk1 were chemically and microbiologically analyzed in the laboratory of the Nuclear Physics Research Center of the Mongolian State University. Cyanides in the water sample were analyzed. Analyses of heavy metals were done with the X-ray Fluorescence Technique. The results are shown in Table 17-2. Comparing them with the Dutch guidelines, cadmium concentration for every soil and sediment samples is between the reference (background) value and indicative value for further investigation. The comparison of sediment samples with soil ones shows that there is not significant difference between them, and indicates that the primary contamination of sediment is not from the water, but from air. Microbiological analyses show that fecal coliforms slightly contaminated the soil sample and slightly or moderately contaminated sediment samples. A pathogenic bacterium (*Clostridium perfringens*) was not detected in soil and sediment samples. Cyanides were not detected in the water sample. Local subcontractor's report (Report B) concluded that the sediment and soil can be transported and disposed at waste disposal place if proper permission will be given by the Ministry for Nature and Environment and the Sanitary Inspection body of the Ulaan-baatar city.

It is recommended that every domestic waste to be produced during constructions will be sent to the nearest station and appropriately disposed.

Table 17-2 Heavy Metal concentration in Sediment and Soil Samples at the Site 399pk1

	Mercury	Cadmium	Lead	Chromium	Arsenic	Copper	Zinc
Threshold concentration in soil (mg/kg dry weight)*							
Background value	0.5	1	50	100	20	50	200
Indicative value for	2	5	150	250	30	100	500
Further investigation							
Indicative value for	10	20	600	800	50	500	3,000
Cleaning up							
Sample** (mg/kg dry weight)							
Sediment No.1	<0.1	<3	0.1	0.1	ND	<0.05	<0.4
Sediment No.2	0.08	2	0.1	0.1	ND	0.03	0.4
Sediment No.3	0.2	3	0.4	0.4	ND	0.1	1
Sediment No.4	0.3	5	0.5	0.6	ND	0.2	2
Soil No.1	0.1	<3	0.4	ND	ND	0.3	2
Soil No.2	<0.5	<12	0.7	ND	ND	<0.2	1

* Dutch guidelines for several soil metal pollutants: I. Thornton, Soils in the Urban Environment (1991), Clarendon Press, Oxford

** the local subcontractor's report on environmental study (1997) (Report B)

17-3-4 Environmental Measures toward Slope Stability

Slope stability will be done at sites 8pk10, 13pk3, 17pk5-6, 18pk10-19pk1, 54pk2-3, 57pk9, 61pk10, 250pk6-8, 251pk2, 267pk2-3, 282pk9-283pk2. The natural environment at these sites is relatively conserved. It was studied if there were nests of the rare bird species near the project sites. In the birds which were observed as shown in the local subcontractor's report (Report A, 1996) we check the following bird species:

- Grey Heron (*Ardea cinerea*): It nests in pairs or colonies on river banks, lakes, and reservoirs. Its nest is loosely cone-shaped, made of branches and reed stalks, and built on high trees, in flooded osiers, or stands of reed. It nests from April (in the south) and later. Sites: 17pk9-19pk2, 65-69km, 285km, 442-443km.
- Golden Eagle (*Aquila chrysaetos*): It builds massive nests with thick boughs on inaccessible rocks or high trees; in desert, on ruins, or saxal trees. It lays one or two white eggs, usually (not always) mottled a bright reddish-brown in March or April. Sites: 272km, 420-421km, 465km.
- Black Kite (*Milvus migrans*): It nests in trees, more rarely in precipice niches. Its nest is lined with rags, wool, scraps of paper, and other rubbish. It lays two or three white eggs with brown or violet spots end of April to May. Sites: 10pk8-10pk6, 17pk9-19pk2, 65-

69km, 92-96km, 255km, 272km, 285km, 289km.

- Northern Goshawk (*Accipiter gentilis*): It is common, but very cautious and not often seen. It nests in trees (pines, spruces, birches, oaks, lindens), often using nests of other birds. Sites: 92-96km.
- Common Buzzard (*Buteo buteo*): Its nest is made of boughs situated in trees. It lays two to four white eggs spotted with rust in April and May. It is unwary near the nest. Sites: 235km, 255km, 272km, 420-421km, 429-430km, 434-435km, 442-443km, 465km.
- Eagle Owl (*Bubo bubo*): it inhabits all unpopulated, remote areas, and avoids contact with people. It nests in cliffs, in inaccessible parts of the forest, in ravines, in rock slides, under precipice. Its nest is on the ground, in hollows or rocky ledges, in hollow trees; it occasionally uses nest of a raptor. Sites: 17pk9-19pk2, 272km, 285km, 289km, 420-421km.

The majority of these bird species are internationally rare, but none of them are not protected by the Mongolian Law and appear in the Mongolian Red Data Book. Nests of these bird species were not found at the slope stability sites.

17-3-5 Environmental Measures toward River Bank Protection

The sites, where their river bank has been protected with rock blocks by now, are 11pk1-4 (250m), 31pk2-4 (300m), 51pk9-52pk1 (250m), 55pk9(100m), 67pk4-6 (300m), 208pk1-2. In this short term urgent project, river banks at the sites 10pk7-10, 51pk9-52pk1, 54pk4-5, 57pk8-10, 67pk6-7, 208pk1-3 will be protected. After this project, the proportion of protected river bank between 10 km and 70km is less than 2 per cent.

Environmental problems produced with the protection river bank are:

- Suspended sediment which may be produced during construction;
- Impacts toward aquatic biota with the river bank protection system; and
- Impacts toward plants along river side during construction..

Algae species are an ubiquitous group of photosynthetic organisms responsible for the majority of photosynthesis (the first stage of the food webs) in streams. Light attenuation by dissolved organic matter or suspended organic and inorganic particles can reduce light penetration in larger streams, particularly those that carry high suspended sediment loads. If the reduction of light penetration continues for a long period, aquatic ecosystem will be impaired. Therefore, it is necessary to choose the construction method with which suspended sediment occurs as little as possible. The spawning and hatching season for most fish species

are from April to June (Appendix 17-7(a)). It is recommended that the construction will be carried out excluding this season if possible.

Impacts toward original aquatic biota with the river bank protection system may be small, because the proportion of river bank protected in the river side is small. And then the river bank protection system will produce a variety of habitats which has a different condition (flow velocity and surface property of the river bank) from original one. In general, species richness increases as a function of habitat complexity. Periodic, recurrent disturbances such as flash floods or droughts can cause local, short-term changes in community structure. The severity of these disturbances can be ameliorated when the habitat is complex, because habitat complexity confers refuge.

Impacts toward plants along river side during construction should be recovered as soon as possible, because bared soil induces the soil erosion, which also affects the protected river bank (Appendix 17-1). A plant cover reduces soil erosion.

17-3-6 Environmental Measures toward Track Transfer

The river bank at section 31pk 2-4 is eroded at a rate of 5 to 6 meters a year. Therefore, the track will be translocated to be left from the Orkhon river in the short-term urgent project. The zone impacted by the translocation of track is 2 km long and has a wood land which consists of Siberian Elm (*Ulmus pumila*) (Appendix 17-6(a) and Report A). It is necessary to get a permission from the local government to clear trees. And this construction will impact the grassland, where rare plant species (Dichotomous Star (*Stellaria dichotoma*), Chickweed (*Stellaria media*) and Seabuckthorn (*Hippophae rhamnoides*)) were found (Appendix 17-6(b) and Report A). The first two species are frequently found at the project sites along the Mongolian railway (Appendix 17-6(b)). It is necessary to communicate with the local government on these plants. After the translocation of track the recovery of plant should be done as soon as possible in order to conserve the soil condition. Fences are generally made along the Mongolian railway in order to keep out cattle from tracks. Devastated vegetation should be protected with fences, and then the fences will be set to the normal position after the recovery of vegetation. Rare vertebrate species which made nests at this project site were not found (Appendix 17-7(b) to (d) and Report A).

17-3-7 Environmental Measures towards New Bridge Construction and Replacement with Beam

New bridges will be constructed at the sites 125pk8, 235pk3, 255pk3, 334pk3 and

352pk7 and a beam will be replaced for some bridges at the sites 285pk1, 289pk1, 326pk9, 334pk3, 338pk10, 344pk1 and 356pk1. It is necessary to reduce the occurrence of suspended sediment during the construction as little as possible at the site where the river always has a water flow. Since heavy machines will be used for this construction, the soil will be compacted with these machines near the construction site. In this respect, the disturbed area should be protected from grazing until the recovery of vegetation. It is recommended that heavy machines, equipment and materials should be transported by railway.

Construction wastes produced during construction, concrete and iron material, will be separated and should be appropriately treated including reusing them.

17-3-8 Environmental Measures toward Waterproof and Minor Methods

Bridges at the sites 235pk3, 245pk5, 255pk3, 342pk2 will be repaired with waterproof and minor methods. If chemicals will be used in repairing bridges, it is necessary to protect the environment from the contamination with chemicals. Used containers and residues of chemicals should be carried to Ulaan-baatar and properly treated.

17-3-9 Environmental Measures toward Drain Improvement

In the case of drain improvement for the Sukhe-baatar station, it is necessary to select the construction place, where a channel will lead flood water to the river, not to impact buildings. At other drain improvement sites, buildings and gers were not found. But it is necessary to check no impact against buildings and gers in introducing a new culvert.

There are disturbed grass lands near Sukhe-baatar, Darkhan, Baruunharaa, Zuunharaa and Ulaan-baatar (340 km to 390 km) due to over-grazing, intrusion of vehicles, soil erosion with flood and urbanization (Appendix 17-1 and 17-2). And the flood and the degradation of grassland form a vicious circle. This problem is not only for the Mongolian Railway but also for the Mongolian Government and Local Governments. From the long-term point of view, grasslands should be protected from over-grazing and stable soil system should be recovered, which will be effective measure against floods.

CHAPTER 18

IMPLEMENTATION PLAN

Chapter 1 8
Implementation Plan

18 - 1 Conditions

The implementation plan was formulated based on following conditions:

① Implementation Timing

The short term urgent project is programmed to be completed by the end of 2004.

② The implementation program of the urgent project is established considering the urgency of the countermeasures to be executed where necessary based on the site inspection and balance of the annual investment amount.

③ Prices

The investment costs are estimated based on the market prices in Mongolia as of August 1996, while currency exchange rates are as following :

US $ 1.00 = 550 Tugrik = J yen 110

④ Materials, equipment and others which are not available in the country are to be imported from other countries.

⑤ Unit Costs

Unit costs applied in the cost estimate are based on the market prices in the country, while materials and equipment to be imported from other countries due to unavailability in the country are estimated referring to that of other projects in the country or estimated using the prices/costs in Japan or other neighboring countries.

⑥ The Investment Cost

The total investment cost is classified under the direct cost, the indirect costs, and other items as following;

a. Direct Construction Cost (Materials, personnel expenses , machine and equipment, temporary work and mobilization/demobilization)
b. Overhead Cost (20 % of a.)
c. Contingency (10 % of a.)
d. Engineering (16 % of a.)
e. Taxes As following;

	Personnel Expenses	Materials and Equipment Costs
Local	20 %	10%
Foreign	0%	10%

18 - 2 Investment Cost

The total investment cost is US$ 12.3 million in 1996 prices which is composed of US$ 6.5 million for the river bank protection, US$ 0.7 million for the slope stability, US$ 0.5 million for the bridge rehabilitation, and US$ 4.5 million for the drain improvements. Tab. 18-2-1 shows a break down of the investment cost of the project.

Tab. 18-2-1 Investment Cost

Unit : 1,000U S $

Item	Bank protection			Slope protection			Bridge rehabilitation			Drain improvement			Total		
	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total
Direct Construction Cost	1,334	2,719	4,053	102	324	426	142	195	337	893	1,891	2,784	2,471	5,129	7,600
Overhead Cost	267	544	811	20	65	85	28	39	67	179	378	557	494	1,026	1,520
Contingency	134	271	405	11	32	43	15	19	34	89	189	278	247	513	760
Engineering	133	514	647	10	61	71	14	37	51	89	358	447	247	969	1,216
Sub-Total	534	1,329	1,863	41	158	199	57	95	152	357	925	1,282	988	2,508	3,496
Total	1,868	4,048	5,916	143	482	625	199	290	489	1,250	2,816	4,066	3,459	7,637	11,096
Taxes	618		618	66		66	53		53	427		427	1,164		1,164
Grand-Total	2,486	4,048	6,534	209	482	691	252	290	542	1,677	2,816	4,493	4,623	7,637	12,260

18 - 3 Implementation Program

(1) Implantation Program

The short term urgent project is to be completed by the end of year 2004, the years of 1999-2001 are for preparation. Execution of 9 locations out of 72 locations will be carried out during 1999 – 2001 while the remaining majority will be constructed during 2002 – 2004.

Preparatory work to be performed between 1999 and 2001 includes :

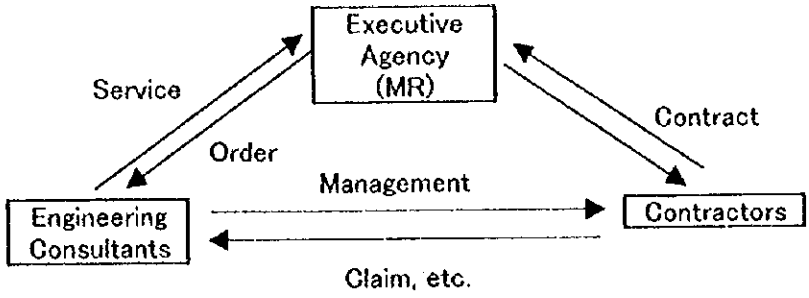
- Request and negotiation on funds with the donor countries.
- Exchange of Note on the funding agreement.
- Preparation of detailed design and bid documents.
- Drawing approval.

Tasks to be done between 2001 and 2004 are ;

- Mobilization.
- Execution of construction works.
- Demobilization.
- Supervising and management during the project implementation.

(2) Implementation system

The Mongolian Railway is the execution agency under the control of Ministry of Infrastructure Development for the entire project. The implementation of the project will managed under flowing tri-party system;



Tri-party Organization

18 - 4 Annual Expenditure Plan

The annual disbursement is grouped into following categories i.e.,

(1) Preparatory work

- Activities including basic and detailed design, and negotiation with funding resources.

(2) Implementation

- Bank protection

  Track transfer at 31 pk 2-4., revetment construction, and relocation of telecommunication lines/posts, etc.

- Slope stability

  Removal of over hanging rocks, weathered rocks and loose boulders. Excavation for rock pooling zone, construction of concrete lining walls and replacement of telecommunication posts/lines.

- Bridge rehabilitation

  Replacement of structurally damaged girders with new one, and repair of deteriorated concrete slabs and ballast walls.

- Drain Improvement

  Construction of new culverts and bridges where required to increase discharge capacity.

  Improvement of drainage system in Sukhe-baatar station yard is included in the study.

  Widening of channel at 399 pk 1 is also considered in the study.

Investment schedule and the breakdown of the project cost are given in Tab. 18-4-1 and Tab. 18-4-2.

The following 9 locations are programmed to be executed in the beginning years, 1999 – 2001.

Slope Protection		Drain Improvement	
1999	13pk3	399pk1	389pk1
2000	61pk10	391pk2	356pk1
2001	18pk1	340pk5	253pk3

Tab. 18-4-1 Annual Work Program by Major Clarification

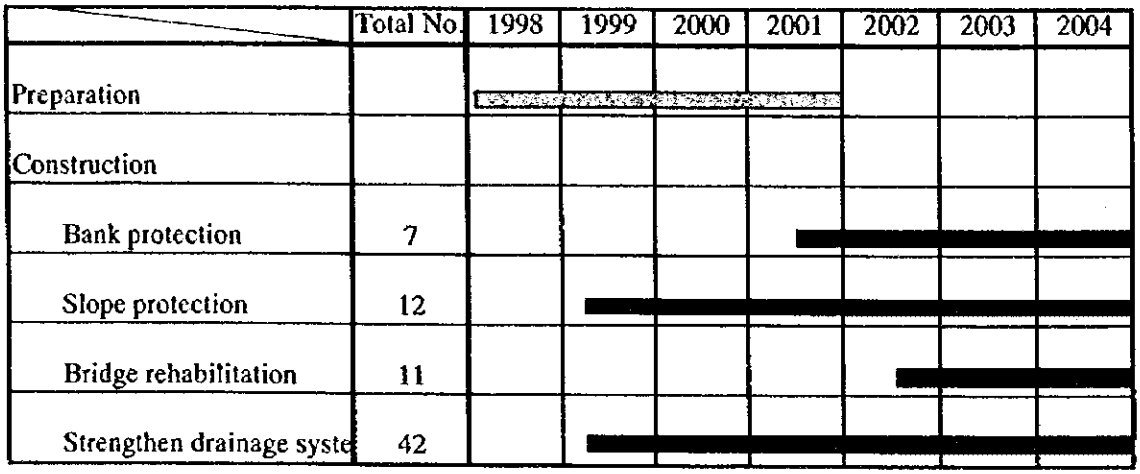


Table 18-4-2 Annual Expenditure Plan

Unit : 1,000 U S $

	1999			2000			2001			2002			2003			2004			Grand-Total		
	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total
A Bank protection	0	0	0	0	0	0	0	0	0	554	1,276	1,830	479	1,217	1,696	301	226	527	1,334	2,719	4,053
B Slope protection	5	19	24	5	27	32	41	52	93	23	96	119	15	73	88	13	57	70	102	324	426
C Bridge rehabilitation	0	0	0	0	0	0	0	0	0	0	0	0	66	86	152	76	109	185	142	195	337
D drain improvement	45	91	136	26	70	96	29	72	101	183	433	616	180	348	528	430	877	1307	893	1,891	2,784
E Direct Construction Cos	50	110	160	31	97	128	70	124	194	760	1,805	2,565	740	1,724	2,464	820	1,269	2,089	2,471	5,129	7,600
F Overhead Cost	10	22	32	6	19	25	14	25	39	152	361	513	148	345	493	164	254	418	494	1,026	1,520
G Contingency	5	11	16	3	10	13	7	12	19	76	181	257	74	172	246	82	127	209	247	513	760
H Engineering	5	239	244	3	239	242	7	12	19	76	180	256	74	172	246	82	127	209	247	969	1,216
I Sub-Total	20	272	292	12	268	280	28	49	77	304	722	1,026	296	689	985	328	508	836	988	2,508	3,496
J Total (E + I)	70	382	452	43	365	408	98	173	271	1,064	2,527	3,591	1,036	2,413	3,449	1,148	1,777	2,925	3,459	7,637	11,096
K Taxes	24		24	19		19	30		30	391		391	377		377	324		324	1,164		1,164
L Grand-Total	94	382	476	62	365	427	128	173	301	1,455	2,527	3,982	1,413	2,413	3,826	1,472	1,777	3,249	4,623	7,637	12,260
(%)			3.9			3.5			2.5			32.5			31.2			26.5			100.0

CHAPTER 19

OPERATING AND MANAGEMENT

Chapter 19
Operating and Management Plan

19 - 1 Base Units

Operating and management expenditures for the short-term urgent project are classified into labor cost and material cost. Material cost is divided into eight (8) expense items and the most appropriate base unit is set for each expense item. Base units are estimated from the financial statement of MR for 1995 (adjusted for price increase of 37.8% up to the time of investigation). In case any expense item on the financial statement of MR does not fall in one of the eight (8) categories, base unit is assessed referring to the data of the similar railway company in Japan. Base units estimated from the financial statement for 1996 show almost the same results.

Table 19-1 Base Unit

(Unit : Tugrik)

Expense Cost	Base Unit	
Labor cost	560,560/person	(number of employees)
Material Cost		
General Administrative Expense	11,457/person	(number of employees)
Maintenance Management Expense	0.27/km	(car km)
Transportation Management Expense	6.62/1,000prs.ton.km	(transportation volume)
Railway Maintenance Expense	15.33/km	(car km)
Communication Maintenance Expense	66.02/km	(train km)
Car Maintenance Expense	14.72/km	(car km)
Transportation Expense	732.50/1,000prs.ton.km	(transportation volume)
Operation Expense	53.07/km	(car km)

19-2 Calculation of Operating and Management Expenses

Operating and Management Expenses are caluculated for the years 2005, 2010 and 2020 from number of employees, transportation volume, car kilometers and train kilometers for the project section and base units.

Transportation volume, car kilometers and train kilometers are estimated for the project section from the OD table based on the demand forecast and train operation plan. As

transportation volume, car kilometers and train kilometers for the project section are about 44% of those for the whole MR lines, the number of the employees required for operating the project section is estimated as 44% of total staff of MR's railway divisions. Total staff of railway divisions for the years 2005, 2010 and 2020 are set as the actual number in 1996 plus the increase of the transportation personnel in Table 6-21 of Chapter 6 (Table 19-2). It can be presumed that the current number of railway maintenance personnel and signaling and communication personnel can respond to increased workload in the future. It is not necessary to take into account the rebound of the increase of transportation service personnel to the number of personnel of the administrative divisions of the headquarters.

Operating and Management Expenses are shown in Table 19-3.

Table 19-2 Number of Personnel for the Project Section

Item \ Year	1996	2005	2010	2020
Transportation Personnel	3,590	3,912	4,143	4,291
Ditto (Increase)		322	231	148
Railway Divisions Total	6,709	7,031	7,262	7,410
for the Project Section	2,952	3,094	3,196	3,261

Table 19-3 Operating and Management Expenses

(Unit: Million Tugrik)

Item \ Year	2005	2010	2020
Number of Employees (persons)	3,094	3,196	3,261
Transportation Volume (million passenger./ton-km)	1,930	2,240	2,543
Car Km (1,000 km)	69,132	81,610	102,787
Train Km (1,000 km)	2,718	3,036	3,301
Labor Cost	1,734	1,792	1,828
Material Cost			
General Administrative Expense	35	37	37
Maintenance Management Expense	19	22	28
Transportation Management Expense	13	15	17
Railway Maintenance Expense	1,060	1,251	1,576
Communication Maintenance Expense	179	200	218
Car Maintenance Expense	1,018	1,201	1,513
Transportation Expense	1,414	1,641	1,863
Operation Expense	3,669	4,331	5,455
Total Material Cost	7,406	8,699	10,707
Grand Total	9,141	10,490	12,535
US Dollar Equivalent (1,000 US$)	16,620	19,073	22,790

CHAPTER 20

ECONOMIC AND FINANCIAL EVALUATION

Chapter 20
Economic and Financial Evaluation

20 - 1 Economic Evaluation

20-1-1 Socio-Economic Conditions in 1996

Mongolian economy in the past years 1985-95 was discussed in the master plan study of Chapters 1 and 2 edited in Part 1. New statistical information such as the statistical yearbook for 1996 were available when the study entered in the Second Part (the feasibility study of the urgent projects in June, 1997). Discussion of the new statistical data are summarized in the following subsections[1] , while the data were incorporated in tables in Chapters 1 and 2 of Part 1. In summary the trend of economic development of the restructured economy continued in 1996, though growth ratios from the previous year were less than expected.

(1) Population

Statistical Yearbook for 1996 shows the entire population at 2.33 million with a rate of growth at 1.6 %. from the year 1995. Population growth rate continued to decrease as it was 1.8 % in the average of five years, 1991-95.

(2) GDP

The rate of increase of GDP in real terms was 2.6% from 1995. The rate was 6.3 % in 1994-95. Those figures would indicate the year to year development of the economy were not stable in recent years, of which major reasons were pointed as deficits in government budget, slow recovery in export which have been closely associated with stagnated Russian economy, increased domestic private demand which would consume foreign exchange reserves as well as domestic savings, etc.

(3) Prices

Price escalation continued in 1996. As discussed in Chapter 1 of Part 1, the annual rate of increase in general consumer index was +50 % in 1996 and increases are likely to continue in 1997. It should be calmed down as it will deprive potential power of development from the Mongolian economy.

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[1] Mongolian Economy and Society 1996 (State Statistcal Office of Mongolia, 1997)

(4) Employment

The total number of employees was 795,000 in 1995, which decreased slightly to 792,000 in 1996. Caused by slow development of the economy, unemployed persons increased, resulting the rate of unemployment from 5.4 in 1995 to 6.4 % in 1996

20-1-2 Transport Demand in 1996

(1) Transport Sector 1996[1]

Caused by slow development of the economy in 1996, the overall transport demand remained mostly at the same magnitude as in 1995. Passengers on the three modes were 109.1 million persons in total , which was mostly the same as in the previous year, but it is found railways and airlines had minor increases while the volume on roads remained unchanged. The total of cargo on three modes was 9.45 million tons, indicated a 5.6% increase from 1995. Cargo movement showed increases on railways and roads in 1996, but no change in airlines in that year.

(2) Railways in 1996[2]

Passengers movements were 3.01 million persons in total in 1996, which increased by 6.5 % from the previous year, where domestic movements showed an increase of a larger ratio of 8.0 % from 1995, while total international movements dropped by 18%. Cargoes showed a total of 7.46 million tons carried in that year, a modest increase by 0.13 million tons from 1995. The largest volume transported was coal at 4.3 million tons, which shared a 58% of the total tons of the year; i.e. 78% of the total domestic movements. Export in total increased by 17% from 1995.

20-1-3 Selection of the Short Term Urgent Projects

Of the projects categorized in 184 in total incorporated in the master plan over 2000-19, 72 projects are recommended for urgent implementation from engineering and safe operation viewpoints. When the Part II study commenced in June 1997, the group in total was taken as the subject of the feasibility analysis.

Project list: see Table 15-1 in Chapter 15.

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[1] Ibid.

[2] Mongolian Railway Statistics of 1996 (Mongolian Railway, 1997)

20-1-4 Economic Analysis

(1) Conditions

1) EIRR is calculated by the following formula

$$0 = \sum_{i=1}^{n} (Bi-Ci)/(1+eirr)^{i-1}$$

Bi : Benefits in year i

Ci : Cost in year i

i : the year in number starting 1999 as 1

n: the analysis period

2) Economic project cost was estimated by deleting transfer elements of tax and duties from the financial cost (see Table 20-1-2 afterward)

3) Project benefit streams were enumerated for 30 years beyond the year of completion of the project (years in 2005-34).

4) Completion of those projects will reduce the damage occurrence caused by natural disaster. (see below in Table 20-1-1 which is taken from the assumed damage occurrence of the whole master plan shown in Table 13-1-2).

5) Economic benefits (savings) are composed of three elements, being described in (3) of this Chapter afterward. i.e: 1) savings in damage repair cost, 2) savings in passenger time cost and 3) savings in road transport cost.

Table 20-1-1 Reduced Damage Occurrence
by Short Term Urgent Projects

Damage scale	Reduced Damages per Year by Short Term Projects
L	0.38
M	0.97
S	1.35
Total	2.70

(2) Economic Project Cost

See Table 20-1-2 in which the economic and financial costs of the short term urgent projects are summarized from Chapter 18. The project costs are shown in terms of $us in thousand in1996 prices.

Table 20-1-2 Project Costs: Economic and Financial

($'000 in 1996 prices)

Year	Works	Economic Cost	Financial Cost
1999	Implementation	452	476
2000	Implementation	408	427
2001	Implementation	271	301
2002	Implementation	3,591	3,982
2003	Implementation	3,449	3,826
2004	Implementation	2,925	3,249
Total		11,096	12,260

Source: Tables in Chapter 18 .

(3) Economic Benefits

The contents of economic benefits were classified in the master plan study of Chapter 13, where the total benefits/savings of the entire plan was compared with the investment cost, resulting in a value of 12.09% in EIRR. The economic evaluation of the urgent short term projects is conducted in the same manner as in the case of the master plan study. The result of EIRR in the feasibility analysis is shown afterward together with the description of qualitative benefits.

1) Damage occurrence and Temporary Repair Cost

Damage Occurrence

The averaged damage occurrence under the master plan setting is assumed at 6.8 per year if there is no preventive rehabilitation, and it is assumed the number will be reduced if preventive civil works are implemented by stage. Table 20-1-1 showed the expected reduction of damages with the implementation of the stage 1, i.e. the short term projects.

Urgent Repair Cost

Damages on railways are repaired by MR temporarily in urgent need to resume the train operation. The economic cost of the repair work for the entire master plan was estimated by determining the representative cost of each scale classified into three classes, being shown in Table 13-1-3. However, the selection of the short term urgent projects was much dependent on engineering viewpoints of immediate necessity to rehabilitate, which resulted in rather larger cost of rehabilitation for L class particularly when compared with the rehabilitation cost showing each stage. The repair cost for L in the first stage which became subjects of the short term

urgent projects was revised in Table 13-1-3, while cost for classes of M and S were considered no need to change. From that table, the estimated costs of repair for the short term projects are quoted in the following Table 20-1-3.

Table 20-1-3 Short Term Projects, Urgent Repair Cost

Damage		Repair Cost of the Damages in US$	
Scale	Occur.	Cost per project	Cost in 2005
L	0.38	1,738,300	660,554
M	0.97	123,100	119,407
S	1.35	82,080	110,808
Total	2.70	1,943,480	890,769

2) Time Value of Waiting Passengers

The time cost per hour per passenger was estimated at $us 0.266 /hr in 1996 prices, which was calculated by using GDP per capita of Mongolia and foreign countries (data of Russia and China were used) in 1996. (See (2) in 13-1-3 of Chapter 13) The value is assumed to increase with traffic volume and GDP per capita. The selected values of the time cost are in Table 20-1-4 and calculation process is in Ap Tables 20-1-1 and 20-1-2.

Table 20-1-4 Time Value, Passenger Time Cost
Short Term Urgent Project

Year	Unit Value US$	Railway Traffic Averaged Pass / day	Total Time Cost Wasted US$
2005	0.334	4,300	64,542
2010	0.374	4,800	80,654
2020	0.478	5,400	116,000

Travel time cost of cargoes are not measured in this economic evaluation.

3) Transport Cost of Road Vehicle Transport

Disruption of train operation will have various unfavorable impacts on the national economy, not only in the costs of damage repair and wasted passenger time. All those impacts cannot be shown quantitatively, but it is considered better to quantify part of the cost by assuming the diversion to road vehicle transport during the disrupted hours. The road cost would be involved in the disrupted activities in various aspects of the society not only in economic productions but in social, cultural and administrative functions.

-1 Conditions

a. Distances: road length of 450 km which is the distance of railways from the Russian border to Bayan via Ulaan-baatar.

b. Load capacity of vehicles: bus 30 persons
mini bus 10 persons
truck 8 tons

-2 Vehicle Operation Cost.

Components of vehicle operation cost (VOC) such as depreciation, fuel, maintenance, wages, are estimated at international border prices since the domestic market has not developed yet in the country. Makes and produced year were so different, but the most common makes could be determined by supplied data from Customs Office, being shown in Ap Table 20-1-3. As shown there, the results were compared with recent other studies in Mongolia and Pakistan and found the estimate was reasonable in cost per km. The VOCs in economic terms are shown below.

Bus $ 234.65 per 1000km
Minibus $ 181.71 per 1000km
Truck $241.63 per 1000km

-3 Diversion

The average transport volume per day was tabulated from figures in Table 5-4-4 in Chapter 5, damage occurrence per year was same as in Table 20-1-1, the disrupt hours are described in "remarks" of Ap Table 20-1-1 and the estimated cost of diversion to roads in 2005, 2010 and 2020 are in Ap Table 20-1-4. The diversion would not need the train operation if they use the road transport service, consequently the train operation net revenue (=revenue-cost) needs be deducted from the road costs. The cost was studied in financial analysis in 20-2 in Chapter 20 from which the amount to reduce could be calculated. They are shown in Appendix Table 20-1-5, from which the summary is shown in the following Table 20-1-5.

Table 20-1-5 Road Transport Cost

Year	a	b	C = a - b
	Road Transport	Train Operation	Net Road Transp. C.
2005	392,676	10,268	382,408
2010	470,792	12,990	458,802
2020	519,755	12,423	507,332

Damages in scale S are assumed not to divert to road transport and wait the re-opening in trains on the railways.

(4) Summary of Benefits

The classified benefits in 1) through 3) above for the short term projects were tabulated for the defined stream years of 30 years from 2005 to 2034. The total without discounting showed the figures in the following Table 20-1-6: where it is found the savings in damage repair cost would share 65%, savings in time cost at 6% and those in road transport cost would be at 29%.

Table 20-1-6 Summary of Benefits, 2005-2034

(US$ 1,000, not discounted)

Years	Savings			
	Railway Repair	Pass Time C.	Road Veh. Transp	Total
2005 – 2034	33,290	3,137	14,998	51,425
%	64.70	6.10	29.20	100.00

(5) EIRR and Sensitivity Test

The economic internal rate of return (EIRR) was calculated for the urgent short term project which resulted in the value of 13.05% (the base case in Table 20-1-7 and in Ap Table 20-1-6). The sensitivity test showed in the table 20-1-7 that EIRR was reduced to lower values when the benefits decreased within this extent than the cases of increased costs. However the difference is marginal and it is confirmed the lowest value of 8.82% shown in case VI remains close to the value of the standard case (see also Ap Table 20-1-7).

Table20-1-7 Urgent Short Term Projects: EIRR and Sensitivity Tests

Case	EIRR	Case	EIRR
Base Case	13.05%		
Case Ⅰ	11.92%	Case Ⅱ	10.97%
Case Ⅲ	11.81%	Case Ⅳ	10.54%
Case Ⅴ	10.77%	Case Ⅵ	8.82%

Case Ⅰ Increased cost by 10%
Case Ⅱ Increased cost by 20%
Case Ⅲ Reduced benefits by 10%
Case Ⅳ Reduced benefits by 20%
Case Ⅴ Combined Ⅰ and Ⅲ
Case Ⅵ Combined Ⅱ and Ⅳ

(6) Indirect Benefits

Indirect benefits of the railway rehabilitation can be emphasized in the following points;

1) Security of the Life Line

Mongolia has a vast land of 1.57 million km^2 under severe climate conditions, particularly in winter season. The population is 2.3 millions of which the majority has engaged in the primary live-stock raising using the vast steppe. The situation did not change when the economy under socialist system collapsed and restructured into the free market mechanism.

Most of cargoes are transported by land, where the road network has been made of earth/gravel roads in most areas under poor conditions. The network cannot provide safe and constant services because services to the vehicle travel are not sufficient as can be seen in few locations of petrol stand and repair shops along the road. On the other side, the railway system has developped to the life line of the people since it connects main urban centers along the central corridor and maintains linkages to Russia and China. Dependence on the rail system in import of critical cargoes and in transport of coal from mines to major urban centers particularly are in necessity to the daily life of the people since the coal has been the key energy source in power and heating. The current transport conditions places the railway service to be the most critical life-line of daily life of people. The major two aspects in energy source transport are discussed in the followings;

Energy source

The power system and heating depend on the coal energy produced in Baganuur and others. The largest mine is Baganuur from which train service of 2-4 round trips per day with a load of 2500 tons per train in average in 1995 are seen to Ulaan-baatar and others. In the future, round trips will be 5-6 per day with 3500 tons per train or more since the consumption in urban areas will grow. New mines will be developed to meet these demand. The road between Baganuur and Ulaan-baatar is under rehabilitation work with surfacing. But the road and vehicles are costly and not economical to the transport of such bulky volume of coal every day.

Capacity of coal stock in power plants are quite modest; for example, only capable to meet the consumption of 2-4 days at the No.4 plant in Ulaan-baatar. Because of various reasons there are difficulties in expanding stock capacity of power plants.

Because of these situations damage and collapse of transport service of coal means the collapse of energy in production activities, in heating and in people's daily life.

Petrol products (diesel, gasoline, etc.) are imported mostly from Russia by rail tankers to main urban centers, which are then distributed to locals by tankers on roads. Again the stock capacity is quite modest to fill only one or two days. It is found occasionally queuing of vehicles at petrol stands waiting for the arrival of petrol supply in Uraan-baatar even in normal weekdays. The depleted petrol in transport would mean immovable vehicles; difficulty in transport of goods to market and peoples' daily movements in commuting, business, shopping, etc.

2) Import of foodstuff

Fresh vegetable from China and crops from Russia depend on rail transport since the road transport network has not been improved yet to satisfy the need of such international movement. Damages and disruption of railways would mean these supplies unstable together with price fluctuation in the market.

3) Export of Cargoes

Although volumes are not large enough as coal, there are some cargoes exported, which contribute to the growth, diversification and earning of foreign currencies. They are copper, fluorite, wool, cashmere, animal skin, etc. Those commodities require stable transport service in order to have credibility in delivery in the competitive international markets.

(7) Conclusion

Considering the value of EIRR at 13.05% and other factors such that there are un-quantifiable indirect benefits, that the economy is not in a stable development stage yet and belongs in the least less developing countries (LLDC) which are common in need of funds for infrastructure development, and that EIRR of other developing countries are seen often placing the feasible value at 10-12%, it is concluded the short term project is economically feasible and worthy for urgent implementation.

20 - 2 Financial Analysis

(1) Objectives and Methods of Analysis

The acceptability of a project is analyzed from the aspect of national economy in economic analysis. Conversely, financial analysis is made to check if revenue increases and cost savings can be expected to result from the short-term urgent project and if the profit can be increased as a result of such revenue increases and cost savings. As an important index for this purpose, the financial internal rate of return (FIRR) is used in financial analysis.

The FIRR can be obtained by the following equation, based on cash flow data developed from the revenue, investment and administration expenses of the project.

$$0 = \sum_{t=1}^{n} \text{Cash Flow}_t \ / \ (1+\text{FIRR})^{t-1}$$

Where,

n = time period of analysis

Cash Flow_t = cash flow of every different year

Cash Flow = operating profit + depreciation - investment (salvage value to be added as a negative investment in the last year of project period)

(2) Major Prerequisites

1) Subject of Analysis

The earning capacity of the short-term urgent project is checked by analyzing the amount of investment required for the project and raising of funds for that purpose, the loss of transportation revenue and expenditure in case train operations are interrupted by disasters, and the savings of rehabilitation cost resulting from damage reduced by the project.

2) Analytical Period

The period of the project is assumed to end in 2034. It is assumed that revenues and administrative operating costs will increase every year at constant rate through the years subjected to demand forecast (1995 to 2005, 2005 to 2010, and 2010 to 2020),

and will remain on the same level after that during the project life.

3) Amount of Investment

Market prices are used in financial analysis. As custom duty on general imported goods was abolished by the tax reform in May 1997, only value-added tax (10%) is imposed on all equipment. Average 20% income tax is included in personnel cost for local laborers.

4) Depreciation

The straight line method is used for depreciation. Any earth structure constructed under this rehabilitation project will have equal useful life of 100 years according to the regulations of MR. This could be a problem, as differences in physical life are ignored and generally speaking 100 years are considered a little too long. Nevertheless this is adopted in calculating the amount of depreiciation, since it is based on the laws of Mongolia. As a result, re-investment is not required during the project life. The remainder of investment amount, less the accrued depreciation, becomes the salvage value.

5) Raising of Funds

① Foreign Currency Funds

For the foreign currency needed for the purchase of imported equipment of the investment amount, loans furnished by international organizations or government agencies in overseas countries will be used. Financial parameters applicable to Mongolia are assumed to be as shown below.

Interest Rate	: 2.3% p.a.
Loan Term	: 30 years (grace of 10 years)
Method of Repayment	: 20 years semi-annual equal installment

② Domestic Currency Funds

Current commercial interest rate in Mongolia is very high and it seems almost impossible to carry out projects with domestic currency obtained from bank loans. Since financial support from the government, such as grants-in-aid, also cannot be expected, it is inevitable to obtain necessary domestic currency funds from MR's own funds. Therefore, feasibility of this project will be studied assuming that all

required funds will be obtained from MR's own funds, except for those from foreign currency loan.

(3) Number of Shutdowns that can be Prevented

The same numbers as for the economic analysis are used here (refer to Table 20-1-1). It is assumed that during the construction period the effectiveness of the shutdown prevention program is proportional to the amount of investment up to the previous year.

(4) Revenues and Expenses

It is assumed that the transportation revenue and expense to be lost due to the shutdowns of railway service by disaster for the section between Sukhe-baatar and Bayan unless the short-term urgent project is carried out, are attributed to this project. Estimated loss of the revenue and expense is obtained from the number of occurrences of damage that can be prevented by the project, multiplied by the average time loss for each case by the scale of damage. Loss occurs in case of scale L and M only. In case of scale S, passengers and freight wait for resuming of the railway service and no loss is assumed.

Table 20-2-1 Ratio of Prevented Loss (Unit: Hour)

Scale	Average Time Loss by Shutdown	Time Loss that can be Prevented by the Project
L	24.0	9.0
M	18.0	17.3
S	8.3	0 *
TOTAL		26.3
Ratio of Prevented Loss		0.30%

* No loss is assumed in case of scale S.

Transportation volume for the subject section obtained from the OD Table on demand forecast is shown in Table 20-2-2.

Passenger and freight fare rates at the time of investigation are obtained from the revenue and volume of MR transportation in 1995 by adding 37.8% of consumer price index increase in the government statistics (Table 20-2-3). These rates are used throughout the period of this project. Other transportation revenue is assumed equal to 5% of total passenger and freight revenue based on the past records.

Later, in September 1996, Mongolian Railway revised its tariff. The rate of increase was almost equal to the above inflation rate as a whole, but freight charge was raised higher and passenger fare lower. This revision is advantageous for MR, because freight occupies bigger share than passenger transportation in MR's business. If the new fare rates was adopted in our analysis, the results would be much better. That means the analysis in this report is on safer side.

Table 20-2-2 Transportation Volume of Improved Section

YEAR	1995	2005	2010	2020
Passenger (Thousand person km / year)				
Domestic	324,697	436,971	482,716	533,740
Arrival	11,509	15,639	17,267	19,073
Departure	18,535	30,399	36,986	49,706
Transit	3,768	3,768	3,768	3,768
Total	358,509	486,777	540,737	606,287
Freight (Thousand ton km / year)				
Domestic Coal	356,378	575,189	680,967	749,063
Domestic General Goods	132,724	225,125	280,281	348,949
Imported Petroleum	101,776	184,985	227,293	270,566
Imported General Goods	111,165	182,499	216,691	237,013
Exported Ore	127,819	127,819	127,819	127,819
Exported General Goods	54,613	88,014	107,077	143,911
Transit	59,553	59,553	59,553	59,553
Total	944,028	1,443,182	1,699,679	1,936,874
TOTAL(Thousand person ton km / year)	1,302,538	1,929,960	2,240,417	2,543,161

Table 20-2-3 Fares and Freight Charges

	Business Record 1995		After Prices Adjusted	
	Revenue	Transportation Volume	Fares and Charges	
Unit	Million Tugrik	Million per km Million ton km	Tugrik / per. Km Tugrik / ton km	
Passenger Fare Revenue	4,793	681	7.039	9.702
Freight Charge Revenue	10,741	2,284	4.703	6.482
Other Transportation Revenue	841			

Transportation revenue calculated from the above transportation volume and fare rates are shown in Table 20-2-4.

Table 20-2-4 Fare Revenue of Improved Section

YEAR		2005	2010	2020
Passenger	(Million Tugrik)	4,723	5,246	5,882
Freight	(Million Tugrik)	9,355	11,018	12,556
Others	(Million Tugrik)	704	813	922
Total Transportation Revenue	(Million Tugrik)	14,782	17,077	19,360
US$ Equivalent	(Thousand US$)	26,876	31,050	35,199

Table 20-2-5 shows the transportation revenue and expense to be lost due to the shutsowns of railway service by disasters unless the short-term urgent project is carried out. It was calculated from the transportation revenue and expense of the section to be improved by the project, multiplied by the ratio of prevented loss in Table 20-2-1.

Table 20-2-5 Estimated Loss of Transportation Revenue and Operating Cost

(Unit: Thousand US Dollars)

YEAR	2005	2010	2020
Transportation Revenue	81	93	106
Administrative Operating Cost	50	57	68
Operating Profit	31	36	38

(5) Estimated Savings of Rehabilitation Cost

The savings of rehabilitation cost are estimated from the number of interruption occurrences that can be prevented by the short-term urgent project, multiplied by the amount of cost for each damage. Rehabilitation cost per each disaster is the same as in the economic analysis, but market prices are used in financial analysis. If affected facilities are left without improvement, deterioration will be accelerated and the cost will increase. Therefore, the rehabilitation cost is assumed to be increased by 20% from 2015 and by 40% from 2025. Table 20-2-6 shows rehabilitation cost for each damage and Table 20-2-7 shows savings of rehabilitation cost.

Table 20-2-6 Rehabilitation Cost for each Damage

(Unit: Thousand US Dollars)

Scale \ Year	up to 2014	up to 2024	from 2025
L	1,921	2,305	2,689
M	136	163	190
S	91	109	127

Table 20-2-7 Savings of Rehabilitation Cost

(Unit: Thousand US Dollar)

Scale \ Year	2005	2015	2025
L	718	861	1,005
M	131	157	183
S	121	145	169
Total Savings	970	1,164	1,358

(6) Results of Analyses

Based upon the above conditions, sensitivity analyses for the following six cases were conducted as well as the analysis for the base case. The results are as per attached Appendixes 20-2-1～7. Financial internal rates of return (FIRR) for each case are shown in Table 20-2-8.

Case Ⅰ Construction cost increased by 10%.

Case Ⅱ Construction cost increased by 20%.

Case Ⅲ Number of occurrence of interruptions that can be prevented reduced by 10%.,

Case Ⅳ Number of occurrence of interruptions that can be prevented reduced by 20%.

Case Ⅴ Combination of cases Ⅰ and Ⅲ above.

Case Ⅵ Combination of cases Ⅱ and Ⅳ above.

Table 20-2-8 FIRR and Sensitivity Analysis

CASE	FIRR	CASE	FIRR
Base Case	8.67%		
Case Ⅰ	7.88%	Case Ⅱ	7.21%
Case Ⅲ	7.80%	Case Ⅳ	6.91%
Case Ⅴ	7.08%	Case Ⅵ	5.70%

(7) Evaluation

1) Financial Internal Rate of Return

FIRR for the base case is 8.67%.

The FIRR indicates the rate of return on the total invested capital and it means that the relevant project is financially feasible if necessary funds can be raised at an interest rate below this level. If foreign currency portion of the construction funds required for the short-term urgent project can be raised at a rate of 2.3% and the remaining can be raised from own funds, as described in the prerequisite, there are no problems with the funding for this project.

In sensitivity analyses, the FIRR becomes lower in case of the number of interruptions decrease than in case of the construction costs increase, but the difference is not so significant. Even in the worst case (sensitivity analysis case VI), the FIRR is 5.70% and it is not so serious as to obstruct the implementation of the project.

2) Study on Scale of Investment

Current commercial interest rate in Mongolia is so high that it is almost impossible for Mongolian Railway to raise the funds for the project with borrowing from domestic banks. Financial support from the government, such as grants-in-aid, also cannot be expected. Recently, under such severe financial situation, MR has carried out indispensable investment only with foreign currency loan and own funds and has no records of having received bank loans in the country.

The amount of MR's own funds used for the short-term urgent project will reach its peak for about 2.6 million US Dollars (about 1,425 million Tugrik) in 2004. However, as from 1998 MR must start payment of interest and repayment of loans borrowed in the past and the annual payment will come to the maximum amount of over six million Dollars (about 3,300 million Tugrik) in 2005 (Appendix 20-2-8). Therefore, it is very important for MR to raise the funds with care taking loans for all prior projects into consideration.

CHAPTER 21

CONCLUSION AND RECOMMENDATION

Chapter 21
Conclusion and Recommendation

21 - 1 Conclusion

(1) Outline of the Project

The trunk line between Sukhe-baatar and Zamyn-uud of the Mongolian Railway is an important transport route in Mogolia. Especially, the railway is playing a key role as the artery for freight distribution in terms of long-distance and international transport, partly because of the delay in road development. However, the bridges and earth structures of the railway are superannuated, and furthermore, natural disasters often occur every year in the rainy season from June through August. This compels the railway to cancel train operation, causing enormous unfavorable effects on the Mongolian economy due to the stoppage of freight distribution in the country. In view of the above circumstances, a Master Plan of the rehabilitation of railway structures has been drawn up and Short-term Urgent Projects have also been planned, mainly for the Sukhe-baatar · Bayan section of about 450 km where natural disasters frequently occur. In this case, in order to ensure safe and reliable transport throughout the year, care has been taken to establish disaster-resistant structures or to enable restoration in a short time in case of disasters.

Under the Master Plan (target year, 2020), 184 object places will be rehabilitated by stages and by making an investment totaling about US$ 26.2 million.

As the Short-term Urgent Projects (target year, 2005), 72 object places of high priority were selected from the Master Plan. The projects aim at river bank protection (7 places), slope stability (12 places) , bridge rehabilitation(11 places), and drain improvement(42 places).

The construction period of the Short-term Urgent Projects is 7 years from 1998 to 2004 including the preparatory stage. The total amount of the investment in the projects in about US$ 12.2 million at the price as of August 1996. It consists of about US$ 6.5 million for river bank protection, about US$ 0.7 million for slope stability, about US$ 0.5 million for bridge rehabilitation, and about US$ 4.5 million for drain improvement.

(2) Evaluation of the Short-term Urgent Projects

1) Technical aspect

Since there are many similar countermeasure items in the 72 object places of the Short-term Urgent Projects, the rehabilitation was planned by establishing 17 Standard Sections and 55 Sections for Application for each category of countermeasures, as shown in Table 21-1.

The rehabilitation plan was drawn up under the procedure shown in Fig.21-1, taking into consideration the experience in rehabilitation work execution and technical power of the Mongolian Railway.

The rehabilitation plan thus drawn up mainly concerns general civil works and there will be no special problem from the technical aspect of the Mongolian Railway regarding design and construction execution. Therefore, the Short-term Urgent Projects are estimated to be sufficiently feasible.

2) Environmental aspect

The Short-term Urgent Projects mainly concern the rehabilitation planning of the existing line, and will not have large unfavorable effects, including pollution, on social and natural environments. In executing the projects, however, it is necessary for the Mongolian Railway to get guidance from the governmental agencies concerned and pay special care regarding the vibration, noise, river pollution, waste disposal and so forth entailed by the construction.

3) Economic aspect

The economic internal rate of return (EIRR) of the Short-term Urgent Projects is 13.05%. If indirect social and economic benefits entailed by the project execution are considered, the projects are estimated to be significant from the national economic standpoint.

4) Financial aspect

The financial internal rate of return (FIRR) of the Short-term Urgent Projects is 8.67%. It is possible to carry out this project in view of profitability.

5) Comprehensive evaluation (Conclusion)

The Short-term Urgent Projects aiming at the rehabilitation of the existing line are technically feasible, and will not have large unfavorable effects on environmental conditions.

The EIRR is 13.05%, and , if other indirect benefits are considered, the projects are estimated to be feasible from the national economic standpoint.

The FIRR is 8.67%. However, in view of repayment of the existing loans and the funds necessary for future projects of the Mongolian Railway, it is very important for MR to raise the funds with care taking the very server financial standings of the Mongolian Railway into consideration as this project aims at the stability of transportation.

The Short-term Urgent Projects concern the rehabilitation planning for the railway structures where natural disasters in the rainy season compel the Mongolian Railway to cancel train operation, and emphasis is placed on ensuring stable transport. From the comprehensive standpoint, the projects are evaluated to be adequate and also feasible from technical, environmental, economic, and financial aspects.

The implementation of the projects, coupled with the guarding against disasters including the checkup by patrol during rainfall , will enable the stable transport on the trunk line of the Mongolian Railway.

Furthermore, the Mongolian Railway is a life line providing freight transport services closely related to people's living, such as coal transport for power generation (accounting for 80 % of domestic railway freight traffic volume) and import of oil and consumer goods for Mongolian people. Therefore, the projects which mainly concern natural disaster countermeasures are important for stable railway transport and require early implementation.

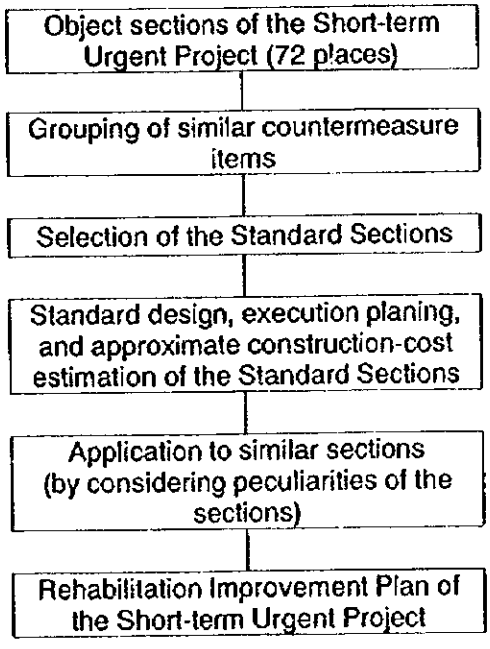

Fig.21-1 Procedure for the Planning

Table21--1 Outline of the Short-term Urgent Projects

Item	Countermeasure	Standard Section	No.of Sections for Application
River Bank Protection (7places)	Track transformation	31pk2～4	0
	Revetment	54pk4～5	5
Slope Stability (12 places)	Slope surface improvement (I)	13pk3	1
	Slope surface improvement (II)	61pk10	3
	Slope surface improvement (III)	282pk9～283pk2	1
	Slope surface improvement (IV)	267pk2～3	1
	Concrete lining	18pk10～19pk1	0
	Telecommunication line removal	251pk2	0
Bridge Rehabilitation (11 places)	Beam replacement	334pk3	6
	Repair	255pk3	3
Drain Improvement (42 places)	Drain in Sukhe-baatar St.	23pk2	0
	Box culvert (2 x1.5m)	253pk3	17
	Box culvert (2.5 x 2m)	389pk1	15
	Box culvert (2.5 x 2.5m)	536pk1	0
	Bridge (11.5 m)	235pk3	2
	Bridge (13.5m)	125pk8	1
	River width expansion	399pk1	0
Object sections (72 places in total)		17 places	55 places

21-2 Recommendation

The following issues are recommended to the Mongolian Railway, for executing the projects and also for improving natural disaster countermeasures, maintenance and operation , and business administration of the railway.

(1) Natural Disaster Countermeasures

1) Strengthening of software sectors

Concerning the disaster countermeasures, together with the reinforcement of hardware sectors by the project execution, it is important to further strengthen software sectors, such as disaster guarding systems and train operation control during rainfall.

2) Application of the standard countermeasures to all lines.

Concerning the countermeasures against natural disasters and superannuation of facilities on trunk and branch lines of the Mongolian Railway other than the section between Sukhe-baatar and Bayan, it is essential to positively promote necessary studies by utilizing the countermeasures planned this time for the standard sections by kind of countermeasures, so as to ensure stable transport in the Mongolian Railway.

3) Drainage countermeasures in Sukhe-baatar station yard

As for the drainage countermeasures in Sukhe-baatar station yard, drainage facilities in the station yard have been planned, in this Study, as an urgent measure. However, since the major cause of the problem is the inflow of water from Sukhe-baatar city areas, it is necessary to establish countermeasures against flood in Sukhe-baatar City, through consultations with the municipal government, and to utilize these countermeasures for strengthening drainage countermeasures in Sukhe-baatar station yard.

(2) Smooth Construction Promotion and Environmental Consideration

1) Establishment of construction execution systems

In the projects, various kinds of countermeasures are taken and object places are also located dispersedly. Therefore, in actually implementing the projects, it is necessary to study systems for the construction execution and work process administration which pay sufficient consideration to the prevention of train accidents and injuries, after drawing up detailed work schedules and also grasping the entire construction work.

2) Technical Cooperation

For the systematic and smooth implementation of this project, it is effective to promote disaster countermeasures from both hardware and software aspects by obtaining technical cooperation of countries with advanced railways through accepting experts from such countries.

3) Waste disposal

The waste from the construction should be carried to adequate places and be disposed in order to prevent the occurrence of social problems after the disposal. Especially, the spoil earth from the river expansion at the 399 pk1 point should be disposed under the guidance of the agencies concerned.

4) Protection of ecological environment

When there is no well-developed road to a construction site, ruts will be made on the grassland due to the passage of automobiles, exerting unfavorable influence on weak ecological environment. Therefore, the construction materials and equipment as well as the construction workers should be carried by the railway as much as possible.

(3) Curtailment of Investment

1) Fund procurement for the projects

For ensuring sound finance of the Mongolian Railway, it is essential to procure funds taking the severe financial standings of the Mongolian Railway into consideration in order to realize the projects, in view of the repayment of the existing loans and the funds necessary for other projects (for example, procurement of rolling stock).

2) Investment in other projects

From the managerial aspect of the Mongolian Railway, efforts should be made to introduce funds at the lowest interest possible, in making investment in other projects and newly obtaining loans in the future.

Since the projects concern disaster countermeasures and rehabilitation of railway structures, there will be no increase in demand by the projects. Therefore, the rolling stock cost and the like have not been earmarked in the project cost.

Especially, in additionally procuring rolling stock, it is separately necessary to curtail investment to the extent possible, taking into consideration such factors as the trend in demand, and inspection and repair of rolling stock.

(4) Maintenance, Administration and Operation, and Management Improvement

1) Modernization of transport administration, etc.

① Review and improvement of train diagram and traffic control work

Train diagrams are achievements of railways, and it is necessary to conduct train operation administration (including command judgement and operational adjustment) in accordance with basic diagrams and daily "execution plan diagrams" as well. The execution plan diagram is used as a basis for operational adjustment and the like because all plans for the day (such as trains operated and maintenance work) are described in it beforehand.

Therefore, it is advisable to introduce train diagrams which cover the entire day from 0:00 to 24:00.

② Scheduling of regular freight trains

Just like passenger trains, the minimum number of regular freight trains should be scheduled and irregular trains should be separately scheduled to cope with traffic fluctuations. This will become a basis of freight transport modernization and lead to the increase in demand.

③ Operational safety system and management improvement (Future task)

In the Mongolian Railway, operational safety systems such as block, signaling, and interlocking systems are sophisticated, enabling smooth introduction of Centralized Traffic Control(CTC) system and the like in the future. However, since facilities of these operational safety systems are superannuated, their replacement and improvement will become necessary with the increase in transport demand in future. In the replacement and improvement, it is advisable to study such matters as the introduction of CTC and promote management improvement based on the study. Furthermore, the introduction of optical cables which is now under planning will become further effective.

For further effective utilization of the optical cables, it is necessary to study the introduction of cable transmission or small-capacity light carrier devices, for communication between main stations (optical transmission terminals) and other stations, etc. In addition, together with the introduction of optical fiber cables and the

promotion of the replacement of superannuated facilities and the utilization of CTC in the future, it will become essential to strengthen power-source facilities for these main facilities.

2) Replacement and further introduction of rolling stock

In the future, it will become necessary to replace superannuated passenger cars, freight cars, and locomotives and also introduce further rolling stock.

Especially, it is essential to study the performance of locomotives to be newly introduced, taking into consideration such factors as transport capacity reinforcement and speedup.

3) Track-related improvement

① Improvement of basic record books of railway structure maintenance

Structures will gradually deteriorate due mainly to : the superannuation by the lapse of time ; function reduction by external natural forces such as rainfall, water flow, frozen soil, and earthquake; and obsolescence entailed by transport modernization such as the speedup of trains and increase in load.

For ensuring safe train operation and transport capacity and also for reducing direct and indirect damage from disasters. it is important to conduct adequate maintenance of heavily-worn structures, Furthermore, it is advisable from the economic standpoint to prevent the deterioration of facilities and prolong their life by taking appropriate measures, such as repair and reinforcement, before their becoming fatally worn and depending upon the degree of deterioration. In this regard, in the Mongolian Railway which has many railway structures, adequate maintenance and administration are important for the structures themselves and also from the managerial aspect.

For conducting adequate maintenance and administration of the structures, it is advisable to accurately and promptly grasp the situation of entire structures and also to preserve the record of the situation as basic record books of railway structure maintenance. Furthermore, it is also advisable to inspect all structures at least once in a few years, record the situation of the structure deformation in the basic record books, and systematically take adequate measures based on the results of inspection.

② Establishment of permissible cant deficiency and maximum train speed

The maximum cant restricts the inward inclination of trains, and the permissible cant

deficiency restricts the outward inclination of trains. The two are closely related each other. In the Mongolian Railway, although there is a specified rule on the maximum cant, no consideration has been made so far concerning the permissible cant deficiency. Just like the maximum cant, it is important to establish the permissible cant deficiency.

In the case of the Mongolian Railway, the maximum cant deficiency (Cd) is estimated to be 115 mm from the theoretical limit of the outward inclination. This estimated value is the same as the value in use in Russian railways. Therefore, it is advisable to establish the maximum train speed at passing curves, by utilizing this value of cant deficiency. The formula for calculating the maximum train speed (Vmax) is follows.

$Vmax = \sqrt{R(C+Cd)/12.5}$ when Vmax: Maximum train speed(km/h)

C : Established cant (Actual cant) (mm)

Cd: Permissible cant deficiency (mm)

R : Curve radius (m)

③ Promotion of crushed stone utilization for ballast

In the Mongolian Railway, the main component of ballast is unscreened gravel. However, unscreened gravel is liable to have unfavorable influence on track structure, because it is short of elasticity, susceptible to deformation, and poor in the performance of absorbing impacts of trains. Therefore, from the standpoint of track maintenance, it is advisable to promote the utilization of crushed stones for ballast, in order to sustain good track conditions for a long time. Since the utilization of crushed stones for all lines takes large amounts of time and cost, it is advisable, as the second best measure, to promote the utilization of screened gravel by eliminating the fine grain portion of less than 20 mm out of the ballast gravel.

④ Utilization of crushed stones for ballast at turnout portions, and speedup of trains

Turnouts are complicated in terms of track structure, and also have many weak points. Enormous labor will be needed to sustain favorable track conditions when unscreened gravel is used for ballast. Therefore, it is advisable to urgently promote the utilization of crushed stones, as stated in the above item ③.

Furthermore, although it is not long since the permissible train speed at passing the

straight-line side of a turnout was increased to 70km/h, the realization of 90km/h just like on ordinary sections is desirable. This will become possible by using crushed stones for ballast at turnout portions on main tracks. In realizing the 90 km/h operation, safety should be sufficiently confirmed beforehand by conducting vibration tests and other necessary examinations of turnouts concerning gaps in crossing, guardrails, points, and rail joints.

4) Management improvement

① Efficient operation of personnel

The introduction of CTC will enable the reduction of station personnel in charge of train operation handling, and will also enable unmanned operation of signal stations (train interchange facilities) which may be newly constructed due to the shortage of track capacity in the future. Furthermore, personnel in charge of customer services can be concentrated to key stations. This will lead to the efficient operation of personnel and will contribute to the management improvement of the Mongolian Railway.

② Promotion of related enterprises

Most revenues of the non-railway sectors in the Mongolian Railway are form the railway sectors of the organization and the employees of the railway sectors. The rationalization by drastic personnel reduction is also approaching its limit. The Mongolian Railway has recently started the development of related enterprises targeted at general external customers by newly establishing the Corporate Planning Department. In the future, therefore, it is necessary to study the further expansion of such related enterprises, in order to promote the management improvement of the Mongolian Railways.

(5) Others

1) Improvement of curves near Honkhor

It is considered necessary to improve the sections near Honkhor where curves with a small radius exist in succession. However, since such improvement requires a large amount of investment, the improvement should be materialized after conducting sufficient studies on related factors including the effects of the investment.

2) Damaged bridges on the Third Power Station Line

As for the damaged bridges on the Third Power Station Line which have been in use after the temporary repair, it is necessary to urgently study fill-scale rehabilitation works, in order to ensure smooth transport of coal.

3) Internationalization of Standards (Example of Soil investigation)

A soil investigation has been conducted this time as a study entrusted to a local company. The Mongolian local soil investigation company has made evaluations by conducting Russian-style tests using appliances produced on the basis of Russian standards. In the future, cooperation of other countries will become necessary in addition to that from Russia. Therefore it is essential, from the technological standpoint, to evaluate the test results using universal standards, such as ASTM (American Society for Testing and Materials) and BS (British Standards) not only for soil investigation but also other investigation.