

(2) Improvements

PKP has started to install the optical fiber information network covering important trunk lines up to the major border stations since 1991. Together with electronic exchangers, which are to be installed at regional offices and major stations, the optical fiber network will act as a basic information path to PKP and is essential for data processing such as the management information system and centralized seat reservation system, which is indispensable for CMK improvement.

The optical fiber network includes CMK line between Warszawa - Katowice, and the contents are as follows.

|   |                  |
|---|------------------|
| Optical fiber cable with 12 cores<br>between Warszawa - Katowice: | 300 km           |
| PCM carrier system:   | 140 MB and 34 MB |
| Electronic exchanger (Katowice):                                  | 3,000 lines      |

Although financing for this is not yet set, it should be completed within several years even in the "No improvement case".

### 3.3.6 Time Schedule

The time schedule of the project is assumed as shown in Fig. 3.3.11.

|                                    | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|------------------------------------|------|------|------|------|------|------|
| Feasibility study                  | ■    |      |      |      |      |      |
| Detailed design                    |      | ■    |      |      |      |      |
| Approval, financing                |      | ■    | ■    |      |      |      |
| Track renewal                      |      |      | ■    | ■    | ■    |      |
| Construction of flyover            |      |      | ■    | ■    | ■    |      |
| Improvement of electric facilities |      |      | ■    | ■    |      |      |
| Rolling stock                      |      |      |      |      |      |      |
| Design                             |      | ■    |      |      |      |      |
| Trial Train set manufacture        |      |      | ■    |      |      |      |
| Test running of trial train set    |      |      |      | ■    |      |      |
| Manufacture                        |      |      |      |      | ■    |      |
| Training, test running             |      |      |      |      | ■    |      |
| Inauguration                       |      |      |      |      |      | ◎    |

(Note) Track renewal is assumed to be implemented from 1992 up to 1997 even in the case of the "No improvement cast"

Fig 3.3.11 Implementation Schedule (Options 200 km/h)

### 3.3.7 Cost Estimation

#### 1) General

Cost estimation is based on the prices of 1992. The year 1992 is in the midst of transition from a centrally-planned economy to the market economy in Poland. Consequently, some price levels look to be unreasonably low compared to the world price levels of market economics.

#### 2) Investment

##### (1) Investment for Rolling Stock for 1998

##### a) Unit prices for the 160 km/h case (including the 'No improvement case')

Unit prices for electric locomotive and passenger coach are taken from actual prices of PKP in 1992.

##### b) Unit prices for the 200 km/h case

Unit prices for the 200km/h (international price) in Table 3.3.4 show the average prices of western countries, which are much higher than the prices of Polish-made rolling stock for the 160km/h case described above. The higher cost of rolling stock in western countries comes from the difficulty of introduction of automation in manufacturing and higher labor cost. The cost of rolling stock, if they are manufactured in Poland, could be saved considerably.

Unit prices (domestic production price) show the assumed prices for domestic production in Poland. It should be noted, however, that prices reflect the reasonable costs only by competitive procedures in free market economy. If Poland needs good domestic suppliers for rolling stock in the future as she had in the past, this can only be possible by competition among domestic and foreign suppliers probably in eastern Europe.

##### c) Unit price for the 250 km/h case

Unit price for EMU for the 250km/h case were based on the Japanese experience, because of the difficulty of Polish domestic production. However, final assembly in Poland will be attempted.

##### d) Maintenance equipment

The present maintenance depots in Warszawa, Katowice and Krakow districts will be used, and maintenance equipment for electronic devices will be prepared for the 200km/h and 250km/h cases.

The investment needed for rolling stock is obtained with the above mentioned unit prices and the number of rolling stock given in Table 3.3.3.

- (2) Investment for Track and Structure up to 1998

See Table 3.3.5

- (3) Investment for Electric Facilities up to 1998

See Table 3.3.6

- (4) Investment for Each Year

See Table 3.3.7-12 which are based on time schedule, given in Section 3.3.6

### 3) Operation and Maintenance Cost

- (1) Unit Costs for Operation and Maintenance

Unit costs for operation and maintenance are as shown in Table 3.3.13 which is based on actual results in 1990.

- (2) Operation Costs and Rolling Stock Maintenance Cost

The operation costs and rolling stock maintenance costs for 1998 which are estimated based on the unit costs in Table 3.3.13 and volume of works (Table 3.1.14). The operation costs and rolling stock maintenance costs for 2005 and 2015 (Table 3.3.15).

- (3) Track Maintenance Costs

The track maintenance costs which are estimated based on the number of workers, materials and machines, common for all the year after 1998 (Table 3.3.16).

- (4) Maintenance Costs for Electric Facilities

The maintenance costs for electric facilities which are estimated based on the unit costs in Table 3.3.13 and an increase of facilities and equipment, common for all the year after 1998 (Table 3.3.17).

**Table 3.3.4 Initial Investment Cost on Rolling Stocks**

(Million Zl)

| Case/Cost                 | Unit Price | Number | Cost      |
|---------------------------|------------|--------|-----------|
| <b>Without Case</b>       |            |        |           |
| Electric Locomotive       | 7,000      | 24     | 168,000   |
| Domestic Portion          | 7,000      |        | 168,000   |
| Foreign Portion           | 0          |        | 0         |
| Coaches                   | 5,500      | 216    | 1,188,000 |
| Domestic Portion          | 5,500      |        | 1,188,000 |
| Foreign Portion           | 0          |        | 0         |
| Total Cost                |            |        | 1,356,000 |
| Domestic Portion          |            |        | 1,356,000 |
| Foreign Portion           |            |        | 0         |
| <b>Option 1: 160 km/h</b> |            |        |           |
| Electric Locomotive       | 7,000      | 19     | 133,000   |
| Domestic Portion          | 7,000      |        | 133,000   |
| Foreign Portion           | 0          |        | 0         |
| Coaches                   | 5,500      | 152    | 836,000   |
| Domestic Portion          | 5,500      |        | 836,000   |
| Foreign Portion           | 0          |        | 0         |
| Total Cost                |            |        | 969,000   |
| Domestic Portion          |            |        | 969,000   |
| Foreign Portion           |            |        | 0         |
| <b>Option 2: 200 km/h</b> |            |        |           |
| Electric Locomotive       | 37,490     | 15     | 562,350   |
| Domestic Portion          | 18,745     |        | 281,175   |
| Foreign Portion           | 18,745     |        | 281,175   |
| Coaches                   | 9,250      | 120    | 1,110,000 |
| Domestic Portion          | 3,825      |        | 999,000   |
| Foreign Portion           | 925        |        | 111,000   |
| Maintenance Equipment     | 8,000      |        | 8,000     |
| Domestic Portion          | 1,600      |        | 1,600     |
| Foreign Portion           | 6,400      |        | 6,400     |
| Total Cost                |            |        | 1,680,350 |
| Domestic Portion          |            |        | 1,281,775 |
| Foreign Portion           |            |        | 398,575   |
| <b>Option 3: 250 km/h</b> |            |        |           |
| Coaches (EMU)             | 23,500     | 150    | 3,525,000 |
| Domestic Portion          | 2,350      |        | 325,200   |
| Foreign Portion           | 21,150     |        | 3,172,500 |
| Maintenance Equipment     | 12,000     |        | 12,000    |
| Domestic Portion          | 2,400      |        | 2,400     |
| Foreign Portion           | 9,600      |        | 9,600     |
| Total Cost                |            |        | 3,537,000 |
| Domestic Portion          |            |        | 354,900   |
| Foreign Portion           |            |        | 3,182,100 |
| <b>Option 4: 200 km/h</b> |            |        |           |
| Electric Locomotive       | 49,010     | 15     | 735,150   |
| Domestic Portion          | 4,901      |        | 73,515    |
| Foreign Portion           | 44,109     |        | 661,635   |
| Coaches                   | 15,000     | 120    | 1,800,000 |
| Domestic Portion          | 1,500      |        | 180,000   |
| Foreign Portion           | 13,500     |        | 1,620,000 |
| Maintenance Equipment     | 8,000      |        | 8,000     |
| Domestic Portion          | 1,600      |        | 1,600     |
| Foreign Portion           | 6,400      |        | 6,400     |
| Total Cost                |            |        | 2,543,150 |
| Domestic Portion          |            |        | 255,115   |
| Foreign Portion           |            |        | 2,288,035 |

**Table 3.3.5 Investment Cost on Track and Structure**

(Million Zl)

| Case                          | Without Case   | Option 1       | Option 2 & 4     | Option 3         |
|-------------------------------|----------------|----------------|------------------|------------------|
| Renewal of tracks (1)         | 518,000        | 518,000        | 518,000          | 518,000          |
| Domestic Portion              | 518,000        | 518,000        | 518,000          | 518,000          |
| Foreign Portion               | 0              | 0              | 0                | 0                |
| Turnout                       | 62,000         | 62,000         | 225,000          | 152,000          |
| Domestic Portion              | 62,000         | 62,000         | 0                | 0                |
| Foreign Portion               | 0              | 0              | 255,000          | 152,000          |
| Maintenance roads (1)         | 96,000         | 96,000         | 96,000           | 96,000           |
| Domestic Portion              | 96,000         | 96,000         | 96,000           | 96,000           |
| Foreign Portion               | 0              | 0              | 0                | 0                |
| Fences                        | 0              | 0              | 65,000           | 86,000           |
| Domestic Portion              | 0              | 0              | 65,000           | 86,000           |
| Foreign Portion               | 0              | 0              | 0                | 0                |
| Grade separation (1)          | 73,200         | 77,100         | 77,100           | 77,100           |
| Domestic Portion              | 73,200         | 77,100         | 77,100           | 77,100           |
| Foreign Portion               | 0              | 0              | 0                | 0                |
| Track layout improvement      | 0              | 30,000         | 30,000           | 30,000           |
| Domestic Portion              | 0              | 30,000         | 30,000           | 30,000           |
| Foreign Portion               | 0              | 0              | 0                | 0                |
| Mine damage protection (2)    | 0              | 40,000         | 40,000           | 40,000           |
| Domestic Portion              | 0              | 20,000         | 20,000           | 20,000           |
| Foreign Portion               | 0              | 20,000         | 20,000           | 20,000           |
| Track maintenance machine (3) | 0              | 4,000          | 40,000           | 40,000           |
| Domestic Portion              | 0              | 0              | 0                | 0                |
| Foreign Portion               | 0              | 4,000          | 40,000           | 40,000           |
| <b>Total</b>                  | <b>749,200</b> | <b>827,100</b> | <b>1,091,100</b> | <b>1,039,100</b> |
| Domestic Portion              | 749,200        | 803,100        | 806,100          | 827,100          |
| Foreign Portion               | 0              | 24,000         | 285,000          | 212,000          |

Note: (1) Renewal of tracks, maintenance roads and grade separation are to be carried out after 1992 in accordance with PKP program. Investment cost shows amount of investment after 1995.

(2) Mine damage protection shows cost for alarm system to detect the track sinking.

(3) Track maintenance machines are to be commonly used with other PKP lines, and costs are shared to CMK as follows.

|                       |      |
|-----------------------|------|
| Multiple tie-tamper   | 100% |
| Track measurement car | 40%  |
| Rail grinder          | 20%  |

Table 3.3.6 Investment Cost on Electric Facilities

(Million Zl)

| Case                 | Without Case | Option 1 | Option 2 & 4 | Option 3  |
|----------------------|--------------|----------|--------------|-----------|
| Overhead equipment   | 0            | 0        | 0            | 332,640   |
| Domestic Portion     | 0            | 0        | 0            | 332,640   |
| Foreign Portion      | 0            | 0        | 0            | 0         |
| Substation           | 0            | 0        | 20,000       | 53,000    |
| Domestic Portion     | 0            | 0        | 10,000       | 43,000    |
| Foreign Portion      | 0            | 0        | 10,000       | 10,000    |
| Inverters            | 0            | 0        | 20,000       | 20,000    |
| Domestic Portion     | 0            | 0        | 10,000       | 10,000    |
| Foreign Portion      | 0            | 0        | 10,000       | 10,000    |
| Rectifiers           | 0            | 0        | 0            | 33,000    |
| Domestic Portion     | 0            | 0        | 0            | 33,000    |
| Foreign Portion      | 0            | 0        | 0            | 0         |
| Signalling           | 33,611       | 39,511   | 94,018       | 511,190   |
| Domestic Portion     | 33,611       | 39,511   | 94,018       | 208,826   |
| Foreign Portion      | 0            | 0        | 0            | 302,364   |
| Blocking             | 0            | 0        | 44,800       | 0         |
| Domestic Portion     | 0            | 0        | 44,800       | 0         |
| Foreign Portion      | 0            | 0        | 0            | 0         |
| ATP                  | 33,611       | 32,261   | 41,968       | 0         |
| Domestic Portion     | 33,611       | 32,261   | 41,968       | 0         |
| Foreign Portion      | 0            | 0        | 0            | 0         |
| ATC                  | 0            | 0        | 0            | 503,940   |
| Domestic Portion     | 0            | 0        | 0            | 201,576   |
| Foreign Portion      | 0            | 0        | 0            | 302,364   |
| Level crossing       | 0            | 7,250    | 7,250        | 7,250     |
| Domestic Portion     | 0            | 7,250    | 7,250        | 7,250     |
| Foreign Portion      | 0            | 0        | 0            | 0         |
| Telecommunication    | 81,556       | 81,556   | 81,556       | 81,556    |
| Domestic Portion     | 47,495       | 47,495   | 47,495       | 47,495    |
| Foreign Portion      | 34,061       | 34,061   | 34,061       | 34,061    |
| Optical cable        | 46,056       | 46,056   | 46,056       | 46,056    |
| Domestic Portion     | 36,845       | 36,845   | 36,845       | 36,845    |
| Foreign Portion      | 9,211        | 9,211    | 9,211        | 9,211     |
| PCM system           | 26,500       | 26,500   | 26,500       | 26,500    |
| Domestic Portion     | 7,950        | 7,950    | 7,950        | 7,950     |
| Foreign Portion      | 18,550       | 18,550   | 18,550       | 18,550    |
| Electronic exchanger | 9,000        | 9,000    | 9,000        | 9,000     |
| Domestic Portion     | 2,700        | 2,700    | 2,700        | 2,700     |
| Foreign Portion      | 6,300        | 6,300    | 6,300        | 6,300     |
| Total                | 115,167      | 121,067  | 195,574      | 978,386   |
| Domestic Portion     | 81,106       | 87,006   | 151,513      | 6,311,961 |
| Foreign Portion      | 34,061       | 34,061   | 44,061       | 346,425   |

**Table 3.3.7 Investment Cost on the Project (Without Case)**

| (Million Zl)          |          |                |                |                  |                  |
|-----------------------|----------|----------------|----------------|------------------|------------------|
| Case                  | 1994     | 1995           | 1996           | 1997             | Total            |
| Track and structure   | 0        | 268,900        | 241,700        | 238,600          | 749,200          |
| Foreign Portion       |          |                |                |                  | 0                |
| Domestic Portion      |          | 268,900        | 241,700        | 238,600          | 749,200          |
| OH equipment          |          |                |                |                  | 0                |
| Foreign Portion       |          |                |                |                  | 0                |
| Domestic Portion      |          |                |                |                  | 0                |
| Substation            |          |                |                |                  | 0                |
| Foreign Portion       |          |                |                |                  | 0                |
| Domestic Portion      |          |                |                |                  | 0                |
| Signalling            |          | 6,722          | 10,083         | 16,806           | 33,611           |
| Foreign Portion       |          |                |                |                  | 0                |
| Domestic Portion      |          | 6,722          | 10,083         | 16,806           | 33,611           |
| Telecommunication     |          | 16,311         | 24,467         | 40,778           | 81,556           |
| Foreign Portion       |          | 6,851          | 10,276         | 17,127           | 34,254           |
| Domestic Portion      |          | 9,460          | 14,191         | 23,651           | 47,302           |
| Maintenance equipment |          |                |                |                  | 0                |
| Foreign Portion       |          |                |                |                  | 0                |
| Domestic Portion      |          |                |                |                  | 0                |
| Electric Loco.        |          |                |                | 134,400          | 134,400          |
| Foreign Portion       |          |                |                |                  | 0                |
| Domestic Portion      |          |                |                | 134,400          | 134,400          |
| Passenger car         |          |                |                | 950,400          | 950,400          |
| Foreign Portion       |          |                |                |                  | 0                |
| Domestic Portion      |          |                |                | 950,400          | 950,400          |
| <b>Total</b>          | <b>0</b> | <b>291,933</b> | <b>276,250</b> | <b>1,380,984</b> | <b>1,949,167</b> |
| Foreign Portion       | 0        | 6,851          | 10,276         | 17,127           | 34,254           |
| Domestic Portion      | 0        | 285,082        | 265,974        | 1,363,857        | 1,914,913        |

**Table 3.3.8 Investment Cost on the Project (Option 1: 160 km/h)**

| (Million Zl)          |      |                |                |                  |                  |
|-----------------------|------|----------------|----------------|------------------|------------------|
| Case                  | 1994 | 1995           | 1996           | 1997             | Total            |
| Track and structure   | 0    | 273,900        | 252,500        | 300,700          | 827,100          |
| Foreign Portion       |      |                | 4,040          | 24,056           | 28,096           |
| Domestic Portion      |      |                | 248,460        | 276,644          | 799,004          |
| OH equipment          |      |                |                |                  | 0                |
| Foreign Portion       |      |                |                |                  | 0                |
| Domestic Portion      |      |                |                |                  | 0                |
| Substation            |      |                |                |                  | 0                |
| Foreign Portion       |      |                |                |                  | 0                |
| Domestic Portion      |      |                |                |                  | 0                |
| Signalling            |      | 7,902          | 11,853         | 19,756           | 39,511           |
| Foreign Portion       |      |                |                |                  | 0                |
| Domestic Portion      |      | 7,902          | 11,853         | 19,756           | 39,511           |
| Telecommunication     |      | 16,311         | 24,467         | 40,778           | 81,556           |
| Foreign Portion       |      | 8,651          | 10,276         | 17,127           | 34,254           |
| Domestic Portion      |      | 9,460          | 14,191         | 23,651           | 47,302           |
| Maintenance equipment |      |                |                |                  | 0                |
| Foreign Portion       |      |                |                |                  | 0                |
| Domestic Portion      |      |                |                |                  | 0                |
| Electric Loco.        |      |                |                | 106,400          | 106,400          |
| Foreign Portion       |      |                |                |                  | 0                |
| Domestic Portion      |      |                |                | 106,400          | 106,400          |
| Passenger car         |      |                |                | 668,800          | 668,800          |
| Foreign Portion       |      |                |                |                  | 0                |
| Domestic Portion      |      |                |                | 668,800          | 668,800          |
| <b>Total</b>          |      | <b>298,113</b> | <b>288,820</b> | <b>1,136,434</b> | <b>1,723,367</b> |
| Foreign Portion       |      | 6,851          | 14,316         | 41,183           | 62,350           |
| Domestic Portion      |      | 291,262        | 274,504        | 1,095,251        | 1,661,017        |

Note: Cost of electric locomotives and passenger cars were evaluated as 80 % of purchasing costs.



Table 3.3.9 Investment Cost on the Project (Option 2: 200 km/h)

| Case                  | (Million ZI) |                |                |                  |                  |
|-----------------------|--------------|----------------|----------------|------------------|------------------|
|                       | 1994         | 1995           | 1996           | 1997             | Total            |
| Track and structure   |              | 253,900        | 299,500        | 537,700          | 1,091,100        |
| Foreign Portion       |              |                | 40,133         | 284,981          | 325,114          |
| Domestic Portion      |              | 253,900        | 259,367        | 252,719          | 765,986          |
| OH equipment          |              |                |                |                  | 0                |
| Foreign Portion       |              |                |                |                  | 0                |
| Domestic Portion      |              |                |                |                  | 0                |
| Substation            |              | 4,000          | 6,000          | 10,000           | 20,000           |
| Foreign Portion       |              | 2,000          | 3,000          | 5,000            | 10,000           |
| Domestic Portion      |              | 2,000          | 3,000          | 5,000            | 10,000           |
| Signalling            |              | 18,804         | 28,205         | 47,009           | 94,018           |
| Foreign Portion       |              |                |                |                  | 0                |
| Domestic Portion      |              | 18,804         | 28,205         | 47,009           | 94,018           |
| Telecommunication     |              | 16,311         | 24,467         | 40,778           | 81,556           |
| Foreign Portion       |              | 6,851          | 10,276         | 17,127           | 34,254           |
| Domestic Portion      |              | 9,460          | 14,191         | 23,651           | 47,302           |
| Maintenance equipment |              |                |                | 8,000            | 8,000            |
| Foreign Portion       |              |                |                | 6,400            | 6,400            |
| Domestic Portion      |              |                |                | 1,600            | 1,600            |
| Electric Loco.        |              | 37,490         |                | 524,860          | 562,350          |
| Foreign Portion       |              | 18,745         |                | 262,430          | 281,175          |
| Domestic Portion      |              | 18,745         |                | 262,430          | 281,175          |
| Passenger car         |              | 74,000         |                | 1,036,000        | 1,110,000        |
| Foreign Portion       |              | 14,800         |                | 207,200          | 222,000          |
| Domestic Portion      |              | 59,200         |                | 828,800          | 888,000          |
| <b>Total</b>          |              | <b>404,505</b> | <b>358,172</b> | <b>2,204,347</b> | <b>2,967,024</b> |
| Foreign Portion       |              | 42,396         | 53,409         | 783,138          | 878,943          |
| Domestic Portion      |              | 362,109        | 304,763        | 1,421,209        | 2,088,081        |

Table 3.3.10 Investment Cost on the Project (Option 3: 250 km/h)

| Case                  | (Million ZI) |                |               |                  |                  |
|-----------------------|--------------|----------------|---------------|------------------|------------------|
|                       | 1994         | 1995           | 1996          | 1997             | Total            |
| Track and structure   |              | 253,900        | 310,500       | 474,700          | 1,039,100        |
| Foreign Portion       |              |                | 40,055        | 212,191          | 252,245          |
| Domestic Portion      |              | 253,900        | 270,446       | 262,509          | 786,855          |
| OH equipment          |              | 66,528         | 99,792        | 166,320          | 332,640          |
| Foreign Portion       |              | 0              | 0             | 0                | 0                |
| Domestic Portion      |              | 66,528         | 99,792        | 166,320          | 332,640          |
| Substation            |              | 10,600         | 15,900        | 26,500           | 53,000           |
| Foreign Portion       |              | 2,014          | 3,021         | 5,035            | 10,070           |
| Domestic Portion      |              | 8,586          | 12,879        | 21,465           | 42,930           |
| Signalling            |              | 102,238        | 153,357       | 255,595          | 511,190          |
| Foreign Portion       |              | 60,320         | 90,481        | 150,801          | 301,602          |
| Domestic Portion      |              | 41,918         | 62,876        | 104,794          | 209,588          |
| Telecommunication     |              | 16,311         | 24,467        | 40,778           | 81,556           |
| Foreign Portion       |              | 6,851          | 10,276        | 17,127           | 34,254           |
| Domestic Portion      |              | 9,460          | 14,191        | 23,651           | 47,302           |
| Maintenance equipment |              |                |               | 12,000           | 12,000           |
| Foreign Portion       |              |                |               | 9,600            | 9,600            |
| Domestic Portion      |              |                |               | 2,400            | 2,400            |
| Electric Loco.        |              |                |               |                  | 0                |
| Foreign Portion       |              | 0              |               | 0                | 0                |
| Domestic Portion      |              | 0              |               | 0                | 0                |
| Passenger car         |              | 235,000        |               | 3,290,000        | 3,525,000        |
| Foreign Portion       |              | 211,500        |               | 2,961,000        | 3,172,500        |
| Domestic Portion      |              | 2,350          |               | 329,000          | 352,500          |
| <b>Total</b>          |              | <b>684,577</b> | <b>60,406</b> | <b>4,265,893</b> | <b>5,554,486</b> |
| Foreign Portion       |              | 280,685        | 143,832       | 3,355,754        | 3,780,271        |
| Domestic Portion      |              | 403,892        | 460,184       | 910,139          | 1,774,215        |

**Table 3.3.11 Investment Cost on the Project (Option 4: 200 km/h)**

| (Million Zl)          |      |                |                |                  |                  |
|-----------------------|------|----------------|----------------|------------------|------------------|
| Case                  | 1994 | 1995           | 1996           | 1997             | Total            |
| Track and structure   |      | 253,900        | 299,500        | 537,700          | 1,091,100        |
| Foreign Portion       |      |                | 40,133         | 284,981          | 325,114          |
| Domestic Portion      |      | 259,300        | 259,367        | 252,719          | 765,986          |
| OH equipment          |      |                |                |                  | 0                |
| Foreign Portion       |      |                |                |                  | 0                |
| Domestic Portion      |      |                |                |                  | 0                |
| Substation            |      | 4,000          | 6,000          | 10,000           | 20,000           |
| Foreign Portion       |      | 2,000          | 3,000          | 5,000            | 10,000           |
| Domestic Portion      |      | 2,000          | 3,000          | 5,000            | 10,000           |
| Signalling            |      | 18,804         | 28,205         | 47,009           | 94,018           |
| Foreign Portion       |      |                |                |                  | 0                |
| Domestic Portion      |      | 188,804        | 28,205         | 47,009           | 94,018           |
| Telecommunication     |      | 16,311         | 24,467         | 40,778           | 81,556           |
| Foreign Portion       |      | 6,851          | 10,276         | 17,127           | 34,254           |
| Domestic Portion      |      | 9,460          | 14,191         | 23,651           | 49,302           |
| Maintenance equipment |      |                |                | 8,000            | 8,000            |
| Foreign Portion       |      |                |                | 6,400            | 6,400            |
| Domestic Portion      |      |                |                | 1,600            | 1,600            |
| Electric Loco.        |      | 49,010         |                | 686,140          | 735,150          |
| Foreign Portion       |      | 44,109         |                | 617,526          | 661,635          |
| Domestic Portion      |      | 4,901          |                | 68,614           | 73,515           |
| Passenger car         |      | 120,000        |                | 1,680,000        | 1,800,000        |
| Foreign Portion       |      | 108,000        |                | 1,512,000        | 1,620,000        |
| Domestic Portion      |      | 12,000         |                | 168,000          | 180,000          |
| <b>Total</b>          |      | <b>462,025</b> | <b>350,172</b> | <b>3,009,627</b> | <b>3,829,824</b> |
| Foreign Portion       |      | 160,960        | 53,409         | 2,443,034        | 2,657,403        |
| Domestic Portion      |      | 301,065        | 304,763        | 566,593          | 1,172,421        |

**Table 3.3.12 Additional Investment on Coaches and EMU**

| (Million Zl)     |         |         |
|------------------|---------|---------|
| Case/Year        | 1994    | 1995    |
| Without          | 132,000 | 132,000 |
| Foreign Portion  | 0       | 0       |
| Domestic Portion | 132,000 | 132,000 |
| Option 1         |         | 209,000 |
| Foreign Portion  |         | 0       |
| Domestic Portion |         | 209,000 |
| Option 2         | 138,750 | 277,500 |
| Foreign Portion  | 27,750  | 55,500  |
| Domestic Portion | 111,000 | 222,000 |
| Option 3         |         | 705,000 |
| Foreign Portion  |         | 634,500 |
| Domestic Portion |         | 70,500  |
| Option 4         | 225,000 | 450,000 |
| Foreign Portion  | 202,500 | 405,000 |
| Domestic Portion | 22,500  | 45,000  |

**Table 3.3.13 Unit Cost for Operation and Maintenance**

| Kind of Costs                                  | Results in<br>1990 (1) | Estimation<br>in 1992 (2) | Used value |
|--|------------------------|---------------------------|------------|
| Locomotive crew cost (mil. zt/1,000 h)         | 19.83                  | 37.84                     |            |
| ditto for express train (3)                    |                        | 75.67                     | 75.67      |
| Passenger crew cost (mil. zt/1,000 h)          | 39.99                  | 76.28                     | 76.28      |
| Locomotive maint. (mil.zt/1,000 km)            | 1.503                  | 2.8                       | 2.8        |
| ditto for 5,400 kw 200 km/h                    |                        |                           | 3.046      |
| EMU for 250 km/h maint. (mil. zt/1,000 km) (4) |                        |                           | 1.367      |
| Coach maint. (mil.zt/coach-year)               | 69.39                  |                           |            |
| ditto for express train (5)                    | 104.09                 | 192.94                    | 192.94     |
| ditto for 200 km/h                             |                        |                           | 289.41     |
| Overhead equip. maint. (mil. zt/km)            | 4.12                   | 7.8                       | 7.8        |
| Substation maint. (mil. zt/MW)                 | 21.53                  | 40.78                     | 40.78      |
| Signal maint./asset value                      | 0.0247                 | 0.0247                    | 0.0247     |
| Telecom. maint./asset value                    | 0.0258                 | 0.0258                    | 0.0258     |
| Electric energy per KWH (zt) (6)               |                        | 578                       | 578        |

- Note (1) Excluding depreciation, Source: PKP Statistics 1990  
 (2) Contents of PKP costs  
 (3) 2 drivers for express from 1991  
 (4) Estimated from Japanese results and personnel costs  
 (5) Overhaul interval of express coach is 12 months, compared to 18 months of others.  
 (6) Actual results at CMK in June 1992

|                | 1990   | 1992<br>(Budget) | 92/90 |
|----------------|--------|------------------|-------|
| Deprecation    | 2,527  | 6,851            | 2.711 |
| Personnel cost | 6,027  | 11,501           | 1.908 |
| Material cost  | 10,380 | 19,151           | 1.845 |
| Total          | 18,934 | 37,503           | 1.981 |

**Table 3.3.14 Annual Cost for Operation and Rolling Stock Maintenance, 1998**

| Alternative  | No. improve | 160 km/h | 200 km/h | 250 km/h |
|--|-------------|----------|----------|----------|
| Number of passengers/day   | 14,913      | 16,382   | 18,060   | 19,000   |
| Number of coaches/train  | 9           | 8        | 8        | 10       |
| Weight of train (ton)  | 460         | 418      | 416      | 480      |
| Number of trains/day   | 40          | 52       | 52       | 52       |
| Needed Train sets  | 24          | 19       | 15       | 15       |
| Number of locomotives  | 24          | 19       | 15       |          |
| Total number of coaches  | 216         | 152      | 120      | 150      |
| <b>War. East - Watowice</b>  |             |          |          |          |
| Distance (km)  | 303         | 303      | 303      | 303      |
| Time down (min)  | 180         | 165      | 145      | 131      |
| Time up (min)  | 180         | 165      | 145      | 131      |
| <b>War. East - Krakow</b>  |             |          |          |          |
| Distance (km)  | 298         | 298      | 298      | 298      |
| Time down (min)  | 175         | 160      | 142      | 132      |
| Time up (min)  | 170         | 160      | 142      | 132      |
| Train km/year (thou.)  | 4,387       | 5,703    | 5,703    | 5,703    |
| Train hour/year (thou.)  | 42.89       | 51.40    | 45.39    | 41.60    |
| Gross-ton-km (mil)   | 2,018       | 2,384    | 2,373    | 2,738    |
| Energy consum/G. ton-km (wh)                                       | 31.1        | 31.6     | 37.7     | 40.2     |
| Energy consum/year (MWH)   | 62,765      | 75,336   | 89,449   | 110,055  |
| <b>Unit cost (mil. zt)</b>   |             |          |          |          |
| Drive crew cost/1,000 h  | 75.67       | 75.67    | 75.67    | 75.68    |
| Coach crew cost/1,000 h  | 76.28       | 76.28    | 76.28    | 76.29    |
| Loco. maint. cost/1,000 km   | 2.800       | 2.800    | 3.046    |          |
| EMU maint. cost/1,000 km   |             |          |          | 1.367    |
| Coach maint. cost/year   | 19.294      | 192.94   | 289.41   |          |
| Energy cost/kwh (zt)   | 578         | 578      | 578      | 578      |
| <b>Costs for operation and rolling stock maintenance (mil. zt)</b> |             |          |          |          |
| Locomotive crew cost   | 3,245       | 3,890    | 3,435    | 3,148    |
| Passenger crew cost  | 3,271       | 3,921    | 3,463    | 3,173    |
| Loco./EMI maint. cost  | 12,284      | 15,970   | 17,374   | 77,967   |
| Coaches maint/ cost  | 41,675      | 29,327   | 34,729   |          |
| Energy cost  | 36,278      | 43,544   | 51,702   | 63,612   |
| Total (1998)   | 96,754      | 96,652   | 110,702  | 147,900  |

**Table 3.3.15 Annual Cost of Operation and Rolling Stock Maintenance 2005 and 2015**

| Alternative   | No. improve | 160 km/h | 200 km/h | 250 km/h |
|---|-------------|----------|----------|----------|
| <b>2005</b>   |             |          |          |          |
| Number of passengers/day                                    | 16,614      | 18,262   | 20,121   | 21,166   |
| Number of coaches/train                                     | 10          | 8        | 9        | 10       |
| Weight of train (ton)                                       | 502         | 418      | 458      | 480      |
| Number of trains/day  | 40          | 52       | 52       | 52       |
| Costs for operation and rolling stock maintenance (mil. zt) |             |          |          |          |
| Locomotive crew cost  | 3,245       | 3,890    | 3,435    | 3,148    |
| Passenger crew cost   | 3,271       | 3,921    | 3,463    | 3,173    |
| Loco./EMU maint. cost                                       | 12,284      | 15,970   | 17,374   | 77,967   |
| Coaches maint/ cost   | 46,306      | 29,327   | 39,070   |          |
| Energy cost   | 39,590      | 46,544   | 56,921   | 63,612   |
| Total (2005)  | 104,697     | 96,652   | 120,263  | 147,900  |
| <b>2015</b>   |             |          |          |          |
| Number of passengers/day                                    | 19,280      | 21,195   | 23,350   | 24,563   |
| Number of coaches/train                                     | 11          | 10       | 11       | 12       |
| Weight of train (ton)                                       | 544         | 502      | 542      | 576      |
| Number of trains/day  | 40          | 52       | 52       | 52       |
| Costs for operation and rolling stock maintenance (mil.zt)  |             |          |          |          |
| Locomotive crew cost  | 3,245       | 3,890    | 3,435    | 3,148    |
| Passenger crew cost   | 3,271       | 3,921    | 3,463    | 3,173    |
| Loco./EMU maint. cost                                       | 12,284      | 15,970   | 17,374   | 93,560   |
| Coaches maint. cost   | 50,936      | 36,659   | 47,753   |          |
| Energy cost   | 42,903      | 52,295   | 67,361   | 76,334   |
| Total (2015)  | 112,640     | 112,734  | 139,385  | 176,215  |

**Table 3.3.16 Track Maintenance Costs (Common for All the Year after 1998)**

| Alternatives                  | No. improve | 160 km/h | 200 km/h | 250 km/h |
|-------------------------------|-------------|----------|----------|----------|
| (mil. Zl)                     |             |          |          |          |
| Number of employees (persons) | 691         | 443      | 417      | 417      |
| Personnel costs/emp.          | 37.4        | 37.4     | 40.0     | 48.0     |
| Total personnel costs         | 25,843      | 16,568   | 16,680   | 20,016   |
| Material costs                | 7,000       | 6,000    | 5,100    | 5,100    |
| Machine operation             | 5,000       | 4,000    | 8,000    | 8,000    |
| Machine repair                | 1,200       | 1,000    | 2,000    | 2,000    |
| Total                         | 39,043      | 27,568   | 31,780   | 35,116   |

**Table 3.3.17 Maintenance Costs for Electric Facilities (Common for All the Year after 1998)**

| Alternatives         | No. improve | 160 km/h | 200 km/h | 250 km/h |
|----------------------|-------------|----------|----------|----------|
| (mil. Zl)            |             |          |          |          |
| Substation, inverter |             |          | 612      | 612      |
| Rectifiers           |             |          |          | 1,122    |
| Overhead equipment   |             |          |          | 1,202    |
| Signaling            | 830         | 976      | 2,322    | 6,739    |
| Telecom              | 2,104       | 2,104    | 2,104    | 2,104    |
| Total                | 2,934       | 3,080    | 5,038    | 11,780   |

### 3.4 Project Evaluation

#### 3.4.1 Procedure of Economic and Financial Evaluation

It is usual for the public sector decide to allocate its limited budget to certain projects while investments to other projects are postponed and/or suspended. The economic and financial evaluations supply several criteria to assist decision makers to prioritize the projects.

The economic evaluation relates to the allocation of scarce national resources. Various benefits which are expected to arise by the project are considered and calculated. Costs to implement the project are estimated based on necessary project scale. The costs are usually converted to the "economic cost", which denotes the project costs to the national economy.

The costs and the benefits are calculated as a difference between "with" and "without" project. The projects needs additional costs to the economy which could be allocated to the other projects. The project generates additional benefits to the economy. The economic analysis evaluates the additional costs and benefits. Major criteria to prioritize project's effectiveness and efficiency are EIRR (Economic Internal Rate of Return), NPV (Net Present Value) and B/C (Benefit Cost Ratio).

The EIRR is a discount rate which satisfies the following equation.

$$\sum_{i=1}^k \{(\text{Net Benefit of the } i\text{-th year}) / (1 + \text{EIRR})^i\} = 0$$

where, k is number of years of the project life.

In other words, the EIRR is a discount rate which makes a total net benefit of the project in present value to be zero. The EIRR indicates an efficiency of the project to the national economy. The NPV is a total amount of annual net benefit discounted by the social discount rate of the nation. This value indicates an amount of social surplus of the project to the economy. The B/C is a ratio of a total benefit against a total cost of the project. The benefit and the cost are discounted by the social discount rate of the economy. This value denotes the efficiency of the project as well as the EIRR.

Generally speaking, the EIRR and the B/C indicates an efficiency of the project, while the NPV shows an amount of net surplus of the project to the economy. If a scale of the project is large enough, the NPV has a tendency to become bigger, even if its EIRR is low. On the contrary, if a scale of the project is small, the NPV may be small, even if its EIRR is high.

The financial analysis evaluates profitability to an entity to implement the project and to operate the business. The financial analysis deals with the financial cost and the financial revenue. These are measured by market price of the economy, because the analysis brings profitability of the business entity into focus. The cost should be the price which the entity pays actually.

To analyze the profitability of the project, financial reports of the entity are projected. Profit and Loss Statement denotes the profitability of the project. Statement of Fund shows sources of funds, application of funds and cash flow. Annual profit or loss of the project can be analyzed by the projected Profit and Loss Statement. Necessity and the amount of funds can be understood by the projected Cash Flow of the entity which

consists of net operating revenue (operating revenue minus operating cost) and depreciation cost reimbursed less investment cost.

FIRR (Financial Internal Rate of Return) is one of the major criteria to evaluate the viability of the project, as well. It is very much similar to the EIRR which was shown earlier. The value satisfies the following equation.

$$\sum_{i=1}^k \{ (\text{Cash Flow of the } i\text{-th year}) / (1 + \text{FIRR})^i \} = 0$$

The FIRR shows profitability of the project to the entity. If the value is lower than the prevailing interest rate in the market, the project is not justified financially. Because the value shows the maximum interest rate which the project can afford. However, if the project aims at public welfare, this criterion is not so much strict as long as the project does not suffer from a deficit.

Projects can be evaluated and can be prioritized by the above mentioned procedure. However, limitations of the evaluation should be noted. At first, there are many unmeasurable benefits and costs which are not included in the evaluation. The second, it is very difficult to forecast long future.

### 3.4.2 Project Description

The CMK Line Improvement Project aims at an introduction of high speed passenger train operation between Warsaw and Katowice/Krakow.

As stated earlier, the study team prepared four options to evaluate the improvement projects as follows:

- Option 1: High speed passenger train service at an operating speed of 160 km/h
- Option 2: High speed passenger train service at an operating speed of 200 km/h
- Option 3: High speed passenger train service at an operating speed of 250 km/h
- Option 4: High speed passenger train service at an operating speed of 200 km/h with imported rolling stocks

The Option 1 is a modification of the current CMK Line train service, while the other options are upgrades of the service. The difference between the Option 2 and 4 is the price of rolling stock to be purchased. Option 2 assumes to buy domestic rolling stocks, while Option 4 assumes to buy foreign made.

Major effects expected by the project are considered as follows:

- Investment cost for the improvement
- Time saving benefit of the improved CMK line users who consists of the existing railway passengers and diverted passengers from sedans and buses.
- Vehicle operating cost saving of former sedan and bus users
- Operation and maintenance cost increase of the improved CMK Line and related railway lines of PKP
- Increase of consumers' surplus of generated railway passengers by the improved service

- Increase of PKP fare revenue and decrease of bus fare revenue

As to freight transport service on the CMK line, the study team assumed that the service would continue on the other parallel lines with CMK. Costs and revenue of the service was assumed to be same for PKP even if the project is executed.

### 3.4.3 Financial Evaluation

#### 1) Major Premise

- (1) Pricing date: Prices of June 1992
- (2) Foreign exchange rate: 1 US dollar = 13,500 Zl = 130 Japanese Yen
- (3) Project life: Twenty years after the commencement of the operation

#### 2) Financial Analysis

##### (1) Investment Cost

##### a) Initial Investment Cost

Table 3.4.1 shows a summary of financial investment cost of the CMK Line improvement project by case (refer Table 1-5 in Annex 2). Turnover tax on rolling stock which are produced in Poland is exempted, if they are purchased for investment. Customs duty of 15 % of the price on imported rolling stocks and on imported maintenance equipment are included.

The costs of rolling stock in "without" case (Table 1 in Annex 2) show discounted costs, because the rolling stocks will be in operation until 1997.

The investment cost of Option 1 is lower than the "without" case. It is because of the difference of the train operation plan proposed. Number of rolling stock in the case of Option 1 is less than the "without" case.

**Table 3.4.1 Total Investment Cost by Case** (Million Zl)

| Case                              | Investment Cost |
|-----------------------------------|-----------------|
| Without                           | 2,239,164       |
| Option 1 (160 km/h)               | 2,000,001       |
| Option 2 (200 km/h)               | 3,490,326       |
| Option 3 (250 km/h)               | 6,858,383       |
| Option 4 (200 km/h, Foreign Cars) | 4,732,852       |

##### b) Additional Investment Costs

As the CMK railway transport demand grow higher year by year, the number of rolling stock should be increased to cope with the demand. Table 3.4.2 show the additional investment of rolling stock by case and by year.



**Table 3.4.2 Additional Investment Cost of Rolling Stock**  
(Million Zł)

| Option           | 2004    | 2014    |
|------------------|---------|---------|
| Passenger car    |         |         |
| Without          | 132,000 | 132,000 |
| Foreign Portion  | 0       | 0       |
| Domestic Portion | 132,000 | 132,000 |
| Option 1         | 0       | 209,000 |
| Foreign Portion  | 0       | 0       |
| Domestic Portion | 0       | 209,000 |
| Option 2         | 142,913 | 285,825 |
| Foreign Portion  | 31,912  | 63,825  |
| Domestic Portion | 111,000 | 222,000 |
| Option 3         | 0       | 800,175 |
| Foreign Portion  | 0       | 729,675 |
| Domestic Portion | 0       | 70,500  |
| Option 4         | 255,375 | 510,750 |
| Foreign Portion  | 232,875 | 465,750 |
| Domestic Portion | 22,500  | 45,000  |

c) Reinvestment

Reinvestment is not appropriated, because the project life of any investment item are not less than the project life of 20 years.

d) Residual Value

Residual value is appropriated at the last year of the project life. Some investment items have longer useful lives than the project life. Assets invested for this project still have value until the useful life expires. The residual value is calculated according to years left for the rest of useful life by each investment item. Residual value for the additional investment is calculated as well (Table 3.4.9 - 13).

(2) Revenue

Increase of railway passenger fare revenue is appropriated as revenue of the project. Fare revenue increase of the CMK line and its connection lines are considered. According to a fare table of PKP, fare level of the second class seat of CMK line between Warsaw and Katowice/Krakow is 113,000 Zł by "express" including 25,000 Zł of seat reservation fee.

Increase of fare revenue on the CMK connection lines was calculated based on average travel distance of CMK line users. The distance was calculated as 400km. Therefore, travel distance on these lines is 100km, travel distance of the CMK line being about 300km. Fare level of the second class to travel 400km by express trains is 104,000 Zł, while the fare of the CMK section is 88,000 (excluding seat reservation fee). The difference of 16,000 Zł is considered as the fare revenue increase on the other lines for one passenger.

Table 3.4.3 summarizes the fare revenue increase by case and by year. The table shows the increased revenue based on the official fare table. Passengers with discount tickets were not considered at this stage.

**Table 3.4.3 Fare Revenue Increase by Project**  
(Annual, Million Zł)

| Case            | 1998           | 2005           | 2015           |
|-----------------|----------------|----------------|----------------|
| <b>Option 1</b> |                |                |                |
| CMK Line        | 61,001         | 67,972         | 78,984         |
| Other PKP Lines | 8,637          | 9,624          | 11,184         |
| <b>Total</b>    | <b>69,639</b>  | <b>77,596</b>  | <b>90,168</b>  |
| <b>Option 2</b> |                |                |                |
| CMK Line        | 129,798        | 144,646        | 167,867        |
| Other PKP Lines | 18,378         | 20,481         | 23,769         |
| <b>Total</b>    | <b>148,176</b> | <b>165,127</b> | <b>191,636</b> |
| <b>Option 3</b> |                |                |                |
| CMK Line        | 168,568        | 187,747        | 217,897        |
| Other PKP Lines | 23,868         | 26,584         | 30,853         |
| <b>Total</b>    | <b>192,436</b> | <b>214,331</b> | <b>248,750</b> |
| <b>Option 4</b> |                |                |                |
| CMK Line        | 129,798        | 144,646        | 167,867        |
| Other PKP Lines | 18,378         | 20,481         | 23,769         |
| <b>Total</b>    | <b>148,176</b> | <b>165,127</b> | <b>191,636</b> |

(3) Expense

a) Maintenance and Operation Cost

As described in section 3.3.7, maintenance and operation cost of the CMK line was estimated based on financial reports of PKP. Table 3.4.4 - 7 summarize the financial cost by case and by year.

By the improvement of the CMK line, passengers on the other lines are also increased, as explained in section (2) where revenue calculation was described. The increased passengers increase not only fare revenue but also maintenance and operation cost of the other lines. To estimate the increment, increased passenger-kilometers of the other lines of PKP was calculated based on the information supplied by the transport demand forecast procedure. Then, by multiplying average maintenance and operation cost per one passenger-kilometer with the increased passenger-kilometers, likely increment was estimated. The average cost per one passenger-kilometer was estimated as 147.85 Zł based on financial reports of PKP.

Table 3.4.8 shows the estimated maintenance and operation cost increase on the other lines of PKP.

b) Depreciation

Depreciation on depreciable assets were appropriated by case. Although replacement assets such as track are included in the capital investment of the project, they are considered as depreciable assets for simplification. Useful life by asset was determined by materials supplied by the PKP. Depreciation method is the straight line method. Table 3.4.9 - 13 show the calculated depreciation cost by case together with the residual value.

c) Interest Expense

Interest expenses on short term and long term loans were appropriated.

**Table 3.4.4 Maintenance and Operation Cost of CMK Line**  
(Without Case:Financial)  
(Million Zl)

|                      | 1998           | 2005           | 2015           |
|----------------------|----------------|----------------|----------------|
| Operation Cost       | 42,794         | 46,106         | 49,419         |
| Drivers              | 3,245          | 3,245          | 3,245          |
| Passenger Crew       | 3,271          | 3,271          | 3,271          |
| Energy               | 36,278         | 39,590         | 42,903         |
| Maintenance Cost     | 95,936         | 100,567        | 105,197        |
| Rolling Stocks       | 53,959         | 58,590         | 63,220         |
| Locomotives          | 12,284         | 12,284         | 12,284         |
| Passenger cars       | 41,675         | 46,306         | 50,936         |
| Electric Facilities  | 2,934          | 2,934          | 2,934          |
| Substation, inverter |                |                |                |
| Overhead equipment   |                |                |                |
| Signalling           | 830            | 830            | 830            |
| Telecommunication    | 2,104          | 2,104          | 2,104          |
| Track Maintenance    | 39,043         | 39,043         | 39,043         |
| Personnel cost       | 25,843         | 25,843         | 25,843         |
| Material             | 7,000          | 7,000          | 7,000          |
| Machinery            | 6,200          | 6,200          | 6,200          |
| <b>Total</b>         | <b>138,730</b> | <b>146,673</b> | <b>154,616</b> |

**Table 3.4.5 Maintenance and Operation Cost of CMK Line**  
(Option 1: Financial)  
(Million Zl)

|                      | 1998           | 2005           | 2015           |
|----------------------|----------------|----------------|----------------|
| Operation Cost       | 51,355         | 51,355         | 60,106         |
| Drivers              | 3,890          | 3,890          | 3,890          |
| Passenger Crew       | 3,921          | 3,921          | 3,921          |
| Energy               | 34,544         | 43,544         | 52,295         |
| Maintenance Cost     | 75,945         | 76,742         | 93,277         |
| Rolling Stocks       | 45,297         | 45,297         | 52,629         |
| Locomotives          | 15,970         | 15,970         | 15,970         |
| Passenger cars       | 29,327         | 29,327         | 36,659         |
| Electric Facilities  | 3,080          | 3,080          | 3,080          |
| Substation, inverter |                |                |                |
| Overhead equipment   |                |                |                |
| Signalling           | 976            | 976            | 976            |
| Telecommunication    | 2,104          | 2,104          | 2,104          |
| Track Maintenance    | 27,568         | 27,568         | 27,568         |
| Personnel cost       | 16,568         | 16,568         | 16,568         |
| Material             | 6,000          | 6,000          | 6,000          |
| Machinery            | 5,000          | 5,000          | 5,000          |
| <b>Total</b>         | <b>127,300</b> | <b>127,300</b> | <b>143,383</b> |

**Table 3.4.6 Maintenance and Operation Cost of CMK Line**  
(Option 2/4: Financial)  
(Million Zl)

|                      | 1998           | 2005           | 2015           |
|----------------------|----------------|----------------|----------------|
| Operation Cost       | 58,600         | 63,819         | 73,459         |
| Drivers              | 3,433          | 3,435          | 3,435          |
| Passenger Crew       | 3,463          | 3,463          | 3,463          |
| Energy               | 51,702         | 56,921         | 67,361         |
| Maintenance Cost     | 88,921         | 93,262         | 101,945        |
| Rolling Stocks       | 52,103         | 56,444         | 54,127         |
| Locomotives          | 17,374         | 17,374         | 17,374         |
| Passenger cars       | 34,729         | 39,070         | 47,753         |
| Electric Facilities  | 5,038          | 5,038          | 5,038          |
| Substation, inverter | 612            | 612            | 612            |
| Overhead equipment   |                |                |                |
| Signalling           | 2,322          | 2,322          | 2,322          |
| Telecommunication    | 2,104          | 2,104          | 2,104          |
| Track Maintenance    | 31,780         | 31,780         | 31,780         |
| Personnel cost       | 16,680         | 16,680         | 16,680         |
| Material             | 5,100          | 5,100          | 5,100          |
| Machinery            | 10,000         | 10,000         | 10,000         |
| <b>Total</b>         | <b>147,521</b> | <b>157,081</b> | <b>176,204</b> |

**Table 3.4.7 Maintenance and Operation Cost of CMK Line**  
(Option 3: Financial)  
(Million Zl)

|                      | 1998           | 2005           | 2015           |
|----------------------|----------------|----------------|----------------|
| Operation Cost       | 69,933         | 69,933         | 82,655         |
| Drivers              | 3,148          | 3,148          | 3,148          |
| Passenger Crew       | 3,173          | 3,173          | 3,173          |
| Energy               | 63,612         | 63,612         | 76,334         |
| Maintenance Cost     | 124,862        | 124,862        | 140,455        |
| Rolling Stocks       | 77,967         | 77,967         | 93,560         |
| Locomotives          | 77,967         | 77,967         | 93,560         |
| Passenger cars       |                |                |                |
| Electric Facilities  | 11,779         | 11,779         | 11,779         |
| Substation, inverter | 1,734          | 1,734          | 1,734          |
| Overhead equipment   | 1,202          | 1,202          | 1,202          |
| Signalling           | 6,739          | 6,739          | 6,739          |
| Telecommunication    | 2,104          | 2,104          | 2,104          |
| Track Maintenance    | 35,116         | 35,116         | 35,116         |
| Personnel cost       | 20,016         | 20,016         | 20,016         |
| Material             | 5,100          | 5,100          | 5,100          |
| Machinery            | 10,000         | 10,000         | 10,000         |
| <b>Total</b>         | <b>194,795</b> | <b>194,795</b> | <b>223,110</b> |

**Table 3.4.8 Maintenance and Operation Cost Increase on the Other Lines of PKP**

| Case     | (Million Zl) |         |         |
|----------|--------------|---------|---------|
|          | 1998         | 2005    | 2015    |
| Option 1 | 6473.9       | 7212.8  | 8399.8  |
| Option 2 | 12649.6      | 14073.0 | 16334.6 |
| Option 3 | 16338.3      | 18195.1 | 21114.5 |

**Table 3.4.9 Depreciation Cost (Without:Financial)**

|                       | Useful life | Depreciation  |               |               | Residual value |
|-----------------------|-------------|---------------|---------------|---------------|----------------|
|                       |             | 1998 - 2004   | 2005 - 2014   | 2015 - 2017   |                |
| Track and structure   | 25          | 29,968        | 29,968        | 29,968        | 149,840        |
| OH equipment          | 45          | 0             | 0             | 0             | 0              |
| Substation            | 30          | 0             | 0             | 0             | 0              |
| Signalling            | 20          | 1,681         | 1,681         | 1,681         | 0              |
| Telecommunication     | 20          | 4,078         | 4,078         | 4,078         | 0              |
| Maintenance equipment | 20          | 0             | 0             | 0             | 0              |
| Electric Loco         | 30          | 5,600         | 5,600         | 5,600         | 22,400         |
| Passenger car         | 30          | 39,600        | 44,000        | 48,400        | 352,000        |
| <b>Total</b>          |             | <b>80,926</b> | <b>85,326</b> | <b>89,726</b> | <b>524,240</b> |

**Table 3.4.10 Depreciation Cost (Option 1:Financial)**

|                       | Useful life | Depreciation  |               |               | Residual value |
|-----------------------|-------------|---------------|---------------|---------------|----------------|
|                       |             | 1998 - 2004   | 2005 - 2014   | 2015 - 2017   |                |
| Track and structure   | 25          | 33,084        | 33,084        | 33,084        | 165,420        |
| OH equipment          | 45          | 0             | 0             | 0             | 0              |
| Substation            | 30          | 0             | 0             | 0             | 0              |
| Signalling            | 20          | 1,975         | 1,975         | 1,975         | 0              |
| Telecommunication     | 20          | 4,078         | 4,078         | 4,078         | 0              |
| Maintenance equipment | 20          | 0             | 0             | 0             | 0              |
| Electric Loco         | 30          | 4,433         | 4,433         | 4,433         | 17,733         |
| Passenger car         | 30          | 27,867        | 27,867        | 34,833        | 299,567        |
| <b>Total</b>          |             | <b>71,437</b> | <b>71,437</b> | <b>78,404</b> | <b>482,720</b> |

**Table 3.4.11 Depreciation Cost (Option 2:Financial)**  
(Million ZI)

|                       | Useful life | Depreciation   |                |                | Residual value   |
|-----------------------|-------------|----------------|----------------|----------------|------------------|
|                       |             | 1998 - 2004    | 2005 - 2014    | 2015 - 2017    |                  |
| Track and structure   | 25          | 43,644         | 43,644         | 43,644         | 218,220          |
| OH equipment          | 45          | 0              | 0              | 0              | 0                |
| Substation            | 30          | 667            | 667            | 667            | 6,667            |
| Signalling            | 20          | 4,701          | 4,701          | 4,701          | 0                |
| Telecommunication     | 20          | 4,078          | 4,078          | 4,078          | 0                |
| Maintenance equipment | 20          | 448            | 448            | 448            | 0                |
| Electric Loco         | 30          | 20,151         | 20,151         | 20,151         |                  |
| Passenger car         | 30          | 38,110         | 42,874         | 52,401         | 201,509          |
| <b>Total</b>          |             | <b>111,798</b> | <b>116,562</b> | <b>126,090</b> | <b>1,145,722</b> |

**Table 3.4.12 Depreciation Cost (Option 3:Financial)**  
(Million ZI)

|                       | Useful life | Depreciation   |                |                | Residual value   |
|-----------------------|-------------|----------------|----------------|----------------|------------------|
|                       |             | 1998 - 2004    | 2005 - 2014    | 2015 - 2017    |                  |
| Track and structure   | 25          | 41,564         | 41,564         | 41,564         | 218,220          |
| OH equipment          | 45          | 7,392          | 7,392          | 7,392          | 0                |
| Substation            | 30          | 1,767          | 1,767          | 1,767          | 6,667            |
| Signalling            | 20          | 25,560         | 25,560         | 25,560         | 0                |
| Telecommunication     | 20          | 4,078          | 4,078          | 4,078          | 0                |
| Maintenance equipment | 20          | 672            | 672            | 672            | 0                |
| Electric Loco         | 30          | 0              | 0              | 0              | 278,132          |
| Passenger car         | 30          | 133,363        | 133,363        | 160,035        | 1,285,388        |
| <b>Total</b>          |             | <b>214,394</b> | <b>214,394</b> | <b>241,067</b> | <b>1,788,406</b> |

**Table 3.4.13 Depreciation Cost (Option 4:Financial)**  
(Million ZI)

|                       | Useful life | Depreciation   |                |                | Residual value   |
|-----------------------|-------------|----------------|----------------|----------------|------------------|
|                       |             | 1998 - 2004    | 2005 - 2014    | 2015 - 2017    |                  |
| Track and structure   | 25          | 43,644         | 43,644         | 43,644         | 218,220          |
| OH equipment          | 45          | 0              | 0              | 0              | 0                |
| Substation            | 30          | 667            | 667            | 667            | 6,667            |
| Signalling            | 20          | 4,701          | 4,701          | 4,701          | 0                |
| Telecommunication     | 20          | 4,078          | 4,078          | 4,078          | 0                |
| Maintenance equipment | 20          | 448            | 448            | 448            | 0                |
| Electric Loco         | 30          | 27,813         | 27,813         | 27,813         | 278,132          |
| Passenger car         | 30          | 68,100         | 76,613         | 93,638         | 1,285,388        |
| <b>Total</b>          |             | <b>149,451</b> | <b>157,963</b> | <b>174,988</b> | <b>1,788,406</b> |

#### (4) Financing

The project needs a great amount of capital investment. Therefore, three kinds of financial sources were considered for the financial analysis of the project.

The first is a loan from the World Bank as a long term loan. Current conditions of the loan are as follows:

Period : 15 years with 5-year grace period  
Interest rate : 7.6 % p.a.

The second is a loan from EBRD as a long term loan as well. Current conditions of the EBRD loan are as follows:

Period : 15 years at the maximum  
Interest rate : 4.75 - 5.25 % p.a.

The third is a loan from banks in Poland for short term, because the project may need a working fund for its financial management. Prevailing interest rate in June 1992 for a short term (1 year) loan in Poland is between 52% and 58%. Therefore, 55% of the interest rate was assumed for the short term loan in this evaluation.

Government subsidies for the construction cost and for the interest expenses were considered as other financial sources.

#### (5) Analysis

##### a) Policy of the Financial Analysis

In this analysis, three points were analyzed to evaluate financial viability of the project. They are:

- FIRR
- the first year the project generates net profit
- the first year the project cancels its accumulated net deficit

As to loans for the project financing, the World Bank long term loan and the short term loan from banks in Poland were assumed. Other than the loans to finance the project, government subsidies to the initial investment and to the short term interest expense were analyzed.

Two kinds of government subsidies above mentioned and the fare level of PKP were considered as variables to make the project to be financially viable in this analysis. Before we proceed to the analysis, we should mention that the Option 1 was excluded from the analysis. This option aims at a frequent high speed train service with existing PKP rolling stocks. The option also aims at an efficient train operation by the proposed new operation system as well as other options. Therefore, number of rolling stock necessary for the option is less than the "without" improvement case. It results smaller initial investment cost than the without case (refer to Table 3.4.1). On the other hand, the fare revenue by this option increases by the improved level of service as shown in Table 3.4.3. The financial analysis deals with an increment of cost and an increment of revenue. Then, this option can be said financially viable without any analysis naturally.

The followings are the results of analysis on Option 2, 3 and 4.

b) FIRR

Table 3.4.14 shows FIRR by the option and by the fare level.

**Table 3.4.14 FIRR of CMK Line Improvement Project (%)**

| Fare level | Option 2 | Option 3 | Option 4 |
|------------|----------|----------|----------|
| 0.75       | 5.83     | -        | 0.70     |
| 1.00       | 9.40     | -        | 2.87     |
| 1.50       | 15.69    | 2.81     | 6.80     |

Fare level of 0.75 shows the existing fare, because only a half of PKP passengers pays official fare and the rest pays a half of the official fare. Fare level of 1.00 means that every passenger pays the official fare, and the fare level of 1.50 means the fare level is increased by 50%.

Generally speaking, the total number of passengers will decrease when fare level is raised, for example, total number of passengers in a case of 1.00 and 1.50 will be smaller than in a case of discounted fare level of 0.75. However, due to a lack of reliable data on demand elasticity to prices, it is assumed in this preliminary study that the total number of passengers will remain constant irrespective of fare levels.

Option 2 can be said viable at the fare level of 1.00 and 1.50, if a criterion is that the FIRR should be higher than the interest rate of the long term loan of the project. Other options can not be financially viable if the project is not be able to get the loan with much lower interest rate.

c) The First Year the Project Generates Net Profit

The project should generate a net profit to operate the line financially favorably. Table 3.4.15 shows the first year the project generates a net profit. Only the Option 2 generates a net profit at a fare level of 1.50. Other options do not generate net profits. It means that the Option 3 and 4 would not be realistic as long as other financial arrangements were not introduced.

**Table 3.4.15 First Year Net Profit**

| Fare level | Option 2 | Option 3 | Option 4 |
|------------|----------|----------|----------|
| 0.75       | -        | -        | -        |
| 1.00       | 2001*    | -        | -        |
| 1.50       | 1998     | -        | -        |

\*: after 2003, the option suffers a deficit

Table 3.4.16 shows the first year of a net profit with government subsidy to the interest expense of the short term loan. All the options are financially viable if the fare level is not less than 1.00.



**Table 3.4.16 First Year Net Profit with Government Subsidy to Short Term Loan**

| Fare level | Option 2 | Option 3 | Option 4 |
|------------|----------|----------|----------|
| 0.75       | 1999*    | -        | -        |
| 1.00       | 1998     | -        | -        |
| 1.50       | 1998     | -        | 1998     |

Table 3.4.17 shows a case of government subsidy to the initial investment of the project. A half of the cost is assumed to be subsidized.

**Table 3.4.17 First Year Net Profit with Government Subsidy to Initial Investment Cost**

| Fare level | Option 2 | Option 3 | Option 4 |
|------------|----------|----------|----------|
| 0.75       | 1999*    | -        | -        |
| 1.00       | 1998     | -        | -        |
| 1.50       | 1998     | -        | -        |

\*: The option suffers a deficit after 2006

Option 3 can not be viable even if the fare level is 1.50. At least the fare level of 1.00 is necessary to make the project viable.

d) The First Year the Project Generates Accumulated Net Profit

Without the government subsidy, the project does not generate accumulated net profit except the Option 2 at a fare level of 1.50. In the case of the government subsidy to the short term loan interest expense, Option 2 shows an accumulated net profit since 2011 at a fare level of 0.75 and since 2003 at the fare level of 1.00. The Option 4 shows the profit since 2009 at a fare level of 1.50. The Option 3 never generates the profit during the project life.

The government subsidy to the initial investment cost of the project did not affect so much as the subsidy to the interest expense. Option 2 at a fare level of 1.00 can generate an accumulated net profit since 1998, while the Option 4 generates the profit since 1999 at a fare level of 1.50.

3) Financial Evaluation

Option 2 is viable if the PKP's discount ticket system is abolished. If the government subsidize a half of the initial investment or the government subsidize the short term interest expense, the project is considered viable and favorable.

Option 3 is not viable, even if the highest fare level and the subsidy are assumed.

Option 4 is viable, if the government subsidy is given to this project at a fare level of 1.50. However, the difference of this option from the Option 2 is the rolling stocks. Expensive imported rolling stocks are not preferable for the project.

Table 6-8 in Annex 2 show Profit and Loss projections, financial cash flow projections and financial programs of the options.

### 3.4.4 Economic Evaluation

#### 1) Major Premise

Pricing date, foreign exchange rate and project life as premises for the economic evaluation are same as the financial evaluation.

#### 2) Benefits

Benefits of the project appropriated in this analysis are time saving benefit and cost saving benefit. These are considered as an additional surplus to the national economy by the project. Vehicle operation cost saving of buses and sedans is expected by a change of modal choice of passengers because of the improved railway service. This saving was treated as a benefit of the project. Maintenance and operation cost increase of PKP was not considered as cost but disbenefit of the project. Therefore, the cost was subtracted from the benefit.

##### (1) Time Saving Benefit

Passengers who use the CMK line obtain benefit from reduced travel time of the service. The passengers consist of diverted passengers from buses and sedans and passengers who have used the former unimproved railway service.

Table 3.4.18 shows the annual time saving by mode. Railway shows positive value while bus and sedan show negative values. It means that a total travel time of railway passengers increases by the increased diverted passengers from buses and sedans although travel time of railway is decreased by the project. On the other hand, a total travel time of buses and sedans passengers decreases sufficiently. The time saving grows by year as transport demand grows. A higher speed train service attracts much more passengers to the railway and it results bigger time saving as compared the Option 1 with the Option 3.

Time value to convert the saved time into money term was derived from an annual average income of employee in Poland. The Statistical Bulletin by the Central Statistics Office shows the income of 10,532.9 thousand Zl for 85 days in 1992. Working days in one year are 265 in Poland. Therefore the average annual income is estimated as 32,838 thousand Zl. Annual working hours in Poland is 1,855 hours assuming seven hours work per day. The time value is calculated as 17,702 Zl per hour in 1992.

Future time values are expected to grow. Because, as the economy grows, time becomes scarce goods in general. The time value in Poland was assumed to grow in proportion to the GDP per capita. Table 3.4.19 shows the estimated future time values.

The future time saving benefit, which was calculated from the annual time saving and the time values, is shown in Table 3.4.20. Time saving benefit of railway mode user is negative reflecting the change in travel time by the project.

As to the railway passengers, who were generated(induced) by the improved railway service, an increased surplus of the passengers should be appropriated as well, although the benefit is not the exact time saving benefit. The surplus is usually measured as a half of the time saving benefit compared with the without case. Because, the first passenger who is generated by the service has almost no

surplus, while the last passenger generated obtains full surplus of the reduced travel time.

Table 3.4.21 shows the increased surplus of the generated railway passengers converted to money term.

**Table 3.4.18 Change in Passenger Travel Time by the Project**

|                 | (000 hours/year) |                 |                 |
|-----------------|------------------|-----------------|-----------------|
| Option          | 1998             | 2005            | 2015            |
| <b>Option 1</b> |                  |                 |                 |
| Railway         | 206.7            | 232.6           | 275.1           |
| Bus             | -2,168.1         | -2,244.8        | -2,314.1        |
| Sedan           | -648.5           | -963.6          | -1,276.3        |
| <b>Total</b>    | <b>-2,609.9</b>  | <b>-2,975.8</b> | <b>-3,315.2</b> |
| <b>Option 2</b> |                  |                 |                 |
| Railway         | 362.0            | 401.9           | 468.7           |
| Bus             | -4,615.4         | -4,784.5        | -4,926.9        |
| Sedan           | -1,379.1         | -2,051.3        | -2,715.6        |
| <b>Total</b>    | <b>-5,632.5</b>  | <b>-6,434.0</b> | <b>-7,173.7</b> |
| <b>Option 3</b> |                  |                 |                 |
| Railway         | 453.4            | 503.4           | 589.4           |
| Bus             | -5,995.7         | -6,209.9        | -6,394.2        |
| Sedan           | -1,790.9         | -2,662.7        | -3,522.3        |
| <b>Total</b>    | <b>-7,333.2</b>  | <b>-8,369.1</b> | <b>-9,327.0</b> |
| <b>Option 4</b> |                  |                 |                 |
| Railway         | 362.0            | 401.9           | 468.7           |
| Bus             | -4,615.4         | -4,784.5        | -4,926.9        |
| Sedan           | -1,379.1         | -2,051.3        | -2,715.6        |
| <b>Total</b>    | <b>-5,632.5</b>  | <b>-6,434.0</b> | <b>-7,173.7</b> |

**Table 3.4.19 Estimated Future Time Value**

|      | (1992 price:Zl) |                |            |
|------|-----------------|----------------|------------|
| Year | GDP/capita      | Average Income | Time Value |
| 1998 | 38,402,676      | 39,101,151     | 21,079     |
| 2000 | 40,658,626      | 41,398,133     | 22,317     |
| 2005 | 48,518,836      | 49,401,305     | 26,631     |

**Table 3.4.20 Estimated Time Saving Benefit**  
(Million Zł)

| Option   | 1998    | 2005    | 2015    |
|----------|---------|---------|---------|
| Option 1 | 55,013  | 79,249  | 125,726 |
| Railway  | -4,657  | -6,194  | -10,435 |
| Bus      | 45,701  | 59,781  | 87,759  |
| Sedan    | 13,669  | 25,662  | 48,401  |
| Option 2 | 118,726 | 171,345 | 272,054 |
| Railway  | -7,631  | -10,703 | -17,777 |
| Bus      | 97,288  | 127,419 | 186,846 |
| Sedan    | 29,070  | 54,629  | 102,985 |
| Option 3 | 154,576 | 222,881 | 353,714 |
| Railway  | 9,558   | -13,407 | -22,353 |
| Bus      | 126,383 | 165,378 | 242,491 |
| Sedan    | 37,751  | 70,911  | 133,576 |
| Option 4 | 118,726 | 171,345 | 272,054 |
| Railway  | -7,631  | -10,703 | -17,777 |
| Bus      | 97,288  | 127,419 | 186,846 |
| Sedan    | 29,070  | 54,629  | 102,985 |

**Table 3.4.21 Increased Surplus of Generated Railway Passengers**  
(Million Zł)

| Case     | 1998  | 2005  | 2015  |
|----------|-------|-------|-------|
| Option 1 | 327   | 460   | 761   |
| Option 2 | 1,422 | 2,003 | 3,313 |
| Option 3 | 2,619 | 3,264 | 5,390 |
| Option 4 | 1,422 | 2,003 | 3,313 |

(2) Cost Saving Benefit

Bus passengers and sedan users divert to the improved railway. It results in a benefit of vehicle operating cost saving to the national economy as mentioned before.

The vehicle operation cost of buses in Poland was estimated based on materials supplied by the MTME on PKS Warsaw. According to the materials, PKS Warsaw operates long distance buses along the CMK corridor. The financial cost and the economic cost per one passenger-km is shown in Table 3.4.22.

The financial cost is the supplied value and the economic cost is estimated by the study team. Transfers, which are not the cost nor the benefit to the economy, were excluded from the financial cost as follows:

- Depreciation : turnover tax rate is 20 %, but the tax is exempted for investment use
- Fuel, oil, grease : 32 % of the financial cost

- Personnel cost : income tax is 20%  
: social insurance charge is 45%
- Tires and tubes : turnover tax rate is 20%, but the tax is exempted for investment use

Other transfers such as government subsidies were not added to each cost. Because, it is said that there is no government subsidy to the costs in the table in Poland.

The economic cost was raised to 123.43 Zl per one passenger-km according to the cost increase of financial reports of PKS Warsaw in 1992.

Table 3.4.23 shows the cost saving benefit of the bus vehicle operation cost.

The financial vehicle operating cost of sedans in Poland was obtained by the MTME as well. Table 3.4.24 shows the cost in financial and economic term assuming a representative passenger car is Polonez 1500.

The financial cost was converted to the economic cost by adjusting the transfer factors as well as the bus cost. Transfer elements are as follows:

- Fuel : Turnover tax rate is 57%
- Oil : Turnover tax rate is 20%
- Tires and tubes : Turnover tax rate is 20%
- Depreciation : Turnover tax rate to buy the car is 20%

Annual vehicle operating cost saving of sedans by the project is shown in Table 3.4.25.

Maintenance and operation cost increase of the CMK line is considered as a disbenefit of the project as mentioned before. The financial costs are converted into the economic costs with adjustments as well. However, the adjustment was made on only the personnel cost. The converted costs are shown in Table 3.4.26 - 29.

Maintenance and operation cost increase on the other lines of PKP is the cost of the project to the economy. The financial cost shown in Table 3.4.8 was used as the economic cost.

**Table 3.4.22 Vehicle Operating Cost of Bus in 1991** (Zl)

| Cost Item                           | Financial Cost per pkm | Economic Cost per pkm |
|-------------------------------------|------------------------|-----------------------|
| Depreciation of buses               | 7.37                   | 7.37                  |
| Insurance                           | 7.03                   | 7.03                  |
| Taxes                               | 0.30                   | 0.00                  |
| Repair                              | 29.38                  | 29.38                 |
| Personnel cost(Drivers & Mechanics) | 23.74                  | 10.45                 |
| Personnel cost(Overhead)            | 18.27                  | 8.04                  |
| Fuel, oil, grease                   | 27.87                  | 21.11                 |
| Tire and tubes                      | 2.83                   | 2.83                  |
| Other materials                     | 0.07                   | 0.07                  |
| Personnel(Drivers & Conductors)     | 17.81                  | 7.84                  |
| Repair                              | 0.17                   | 0.17                  |
| Allowance to Drivers                | 3.86                   | 1.70                  |
| Other cost(parking, etc.)           | 3.00                   | 3.00                  |
| <b>Total</b>                        | <b>141.70</b>          | <b>98.98</b>          |

Source: Financial cost was supplied by the MTME

**Table 3.4.23 Savings in Bus Operation Cost** (Million Zl)

| Case     | 1998   | 2005   | 2015   |
|----------|--------|--------|--------|
| Option 1 | 15,962 | 16,539 | 17,097 |
| Option 2 | 43,397 | 35,249 | 36,393 |
| Option 3 | 44,137 | 45,755 | 47,232 |
| Option 4 | 33,974 | 35,249 | 36,393 |

**Table 3.4.24 Vehicle Operating Cost of Passenger Car per Vehicle-km in 1992** (Zl)

| Cost Item              | Financial Cost | Economic Cost  |
|------------------------|----------------|----------------|
| Fuel                   | 726.00         | 462.42         |
| Oil                    | 82.50          | 68.75          |
| Tires and tubes        | 54.86          | 45.71          |
| Maintenance and Repair | 500.00         | 500.00         |
| Depreciation           | 416.67         | 347.22         |
| Insurance              | 220.00         | 220.00         |
| <b>Total</b>           | <b>2000.02</b> | <b>1644.11</b> |

**Table 3.4.25 Vehicle Operating Cost Saving of Sedans** (Million Zl)

| Case     | 1998   | 2005    | 2015    |
|----------|--------|---------|---------|
| Option 1 | 28,880 | 43,032  | 57,009  |
| Option 2 | 61,385 | 91,590  | 121,345 |
| Option 3 | 79,738 | 118,895 | 157,376 |

**Table 3.4.26 Maintenance and Operation Cost of CMK Line**  
(Without Case: Economic)  
(Million ZI)

|                      | 1998           | 2005           | 2015           |
|----------------------|----------------|----------------|----------------|
| Operation Cost       | 39,145         | 42,457         | 45,770         |
| Drivers              | 1,428          | 1,428          | 1,428          |
| Passenger Crew       | 1,439          | 1,439          | 1,439          |
| Energy               | 36,278         | 39,590         | 42,903         |
| Maintenance Cost     | 81,464         | 86,095         | 90,725         |
| Rolling Stocks       | 53,959         | 58,590         | 63,220         |
| Locomotives          | 12,284         | 12,284         | 12,284         |
| Passenger cars       | 41,675         | 46,306         | 50,936         |
| Electric Facilities  | 2,934          | 2,934          | 2,934          |
| Substation, inverter |                |                |                |
| Overhead equipment   |                |                |                |
| Signalling           | 830            | 830            | 830            |
| Telecommunication    | 2,104          | 2,104          | 2,104          |
| Track Maintenance    | 24,571         | 24,571         | 24,571         |
| Personnel cost       | 11,371         | 11,371         | 11,371         |
| Material             | 7,000          | 7,000          | 7,000          |
| Machinery            | 6,200          | 6,200          | 6,200          |
| <b>Total</b>         | <b>120,609</b> | <b>128,552</b> | <b>136,495</b> |

**Table 3.4.27 Maintenance and Operation Cost of CMK Line**  
(Option 1: Economic)  
(Million ZI)

|                      | 1998           | 2005           | 2015           |
|----------------------|----------------|----------------|----------------|
| Operation Cost       | 46,981         | 46,981         | 55,732         |
| Drivers              | 1,712          | 1,712          | 1,725          |
| Passenger Crew       | 1,725          | 1,725          | 1,725          |
| Energy               | 43,544         | 43,544         | 52,295         |
| Maintenance Cost     | 66,667         | 66,667         | 73,999         |
| Rolling Stocks       | 45,297         | 45,297         | 52,629         |
| Locomotives          | 15,970         | 15,970         | 15,970         |
| Passenger cars       | 29,327         | 29,327         | 36,659         |
| Electric Facilities  | 3,080          | 3,080          | 3,080          |
| Substation, inverter |                |                |                |
| Overhead equipment   |                |                |                |
| Signalling           | 976            | 976            | 976            |
| Telecommunication    | 2,104          | 2,104          | 2,104          |
| Track Maintenance    | 18,290         | 18,290         | 18,290         |
| Personnel cost       | 7,290          | 7,290          | 7,290          |
| Material             | 6,000          | 6,000          | 6,000          |
| Machinery            | 5,000          | 5,000          | 5,000          |
| <b>Total</b>         | <b>113,648</b> | <b>113,648</b> | <b>129,731</b> |

**Table 3.4.28 Maintenance and Operation Cost of CMK Line**  
(Option 2/4: Economic)  
(Million Zl)

|                      | 1998           | 2005           | 2015           |
|----------------------|----------------|----------------|----------------|
| Operation Cost       | 54,737         | 59,956         | 70,396         |
| Drivers              | 1,511          | 1,511          | 1,511          |
| Passenger Crew       | 1,524          | 1,524          | 1,524          |
| Energy               | 51,702         | 56,921         | 67,361         |
| Maintenance Cost     | 79,580         | 83,921         | 92,604         |
| Rolling Stocks       | 52,103         | 56,444         | 65,127         |
| Locomotives          | 17,374         | 17,374         | 17,374         |
| Passenger cars       | 34,729         | 39,070         | 47,753         |
| Electric Facilities  | 5,038          | 5,038          | 5,038          |
| Substation, inverter | 612            | 612            | 612            |
| Overhead equipment   |                |                |                |
| Signalling           | 2,322          | 2,322          | 2,322          |
| Telecommunication    | 2,104          | 2,104          | 2,104          |
| Track Maintenance    | 22,439         | 22,439         | 22,439         |
| Personnel cost       | 7,339          | 7,339          | 7,339          |
| Material             | 5,100          | 5,100          | 5,100          |
| Machinery            | 10,000         | 10,000         | 10,000         |
| <b>Total</b>         | <b>134,317</b> | <b>143,877</b> | <b>163,000</b> |

**Table 3.4.29 Maintenance and Operation Cost of CMK Line**  
(Option 3: Economic)  
(Million Zl)

|                      | 1998           | 2005           | 2015           |
|----------------------|----------------|----------------|----------------|
| Operation Cost       | 66,393         | 66,393         | 79,115         |
| Drivers              | 1,385          | 1,385          | 1,385          |
| Passenger Crew       | 1,396          | 1,396          | 1,396          |
| Energy               | 63,612         | 63,612         | 76,334         |
| Maintenance Cost     | 113,653        | 113,653        | 129,246        |
| Rolling Stocks       | 77,967         | 77,967         | 93,560         |
| Locomotives          | 77,967         | 77,967         | 93,560         |
| Passenger cars       |                |                |                |
| Electric Facilities  | 11,779         | 11,779         | 11,779         |
| Substation, inverter | 1,734          | 1,734          | 1,734          |
| Overhead equipment   | 1,202          | 1,202          | 1,202          |
| Signalling           | 6,739          | 6,739          | 6,739          |
| Telecommunication    | 2,104          | 2,104          | 2,104          |
| Track Maintenance    | 23,907         | 23,907         | 23,907         |
| Personnel cost       | 8,807          | 8,807          | 8,807          |
| Material             | 5,100          | 5,100          | 5,100          |
| Machinery            | 10,000         | 10,000         | 10,000         |
| <b>Total</b>         | <b>180,046</b> | <b>180,046</b> | <b>208,361</b> |



### 3) Costs

Economic costs of the project are initial investment cost, additional investment cost and reinvestment cost. However, the reinvestment cost was not appropriated as well as the financial analysis. Residual value was appropriated at the last year of the project life as a negative investment. The economic costs were derived from the financial costs after adjusting transfer elements as well.

#### (1) Initial Investment Cost

The adjustment was made only on the imported rolling stocks and the imported railway track maintenance machine, because the turnover taxes are exempted regarding investment purpose. Customs duty on the above products is 15% of the price. The duty was excluded from the financial cost. The economic initial investment cost of the project by option are shown in Table 9-13 in Annex 2.

#### (2) Additional Investment Cost

Additional investment cost is also converted from the financial cost to the economic cost. The additional investment was made only on the passenger cars. So, adjustment relates to the customs duty only. Table 3.4.30 shows the economic additional investment cost of the project.

#### (3) Residual Value

The invested resources to the project have economic value to the economy until the useful life expires. The residual value of the economic investment cost was appropriated at the last year of the project life as a negative investment as mentioned before. The value is shown in Table 3.4.31.

**Table 3.4.30 Additional Investment Cost (Economic)**  
(Million ZI)

| Option           | Economic Cost |         |
|------------------|---------------|---------|
|                  | 2004          | 2014    |
| Passenger car    |               |         |
| Without          | 132,000       | 132,000 |
| Foreign Portion  | 0             | 0       |
| Domestic Portion | 132,000       | 132,000 |
| Option 1         |               | 209,000 |
| Foreign Portion  |               | 0       |
| Domestic Portion |               | 209,000 |
| Option 2         | 138,750       | 277,500 |
| Foreign Portion  | 27,750        | 55,500  |
| Domestic Portion | 111,000       | 222,000 |
| Option 3         |               | 705,000 |
| Foreign Portion  |               | 634,500 |
| Domestic Portion |               | 70,500  |
| Option 4         | 225,000       | 450,000 |
| Foreign Portion  | 225,000       | 405,000 |
| Domestic Portion | 225,000       | 45,000  |

**Table 3.4.31 Residual Value of Investment**

(Million Zl)

| Investment        | Useful life | Without        | Residual Value |                  |                  |                 |
|-------------------|-------------|----------------|----------------|------------------|------------------|-----------------|
|                   |             |                | Option 1       | Option 2         | Option 3         | Option 4        |
| Track & structure | 25          | 149,840        | 165,420        | 218,220          | 207,820          | 218,220         |
| OH equipment      | 45          | 0              | 0              | 0                | 184,800          | 0               |
| Substation        | 30          | 0              | 0              | 6,667            | 17,667           | 6,667           |
| Signalling        | 20          | 0              | 0              | 0                | 0                | 0               |
| Telecommunication | 20          | 0              | 0              | 0                | 0                | 0               |
| Maint. equipment  | 20          | 0              | 0              | 0                | 0                | 0               |
| Electric Loco.    | 30          | 22,400         | 17,733         | 187,450          | 0                | 245,050         |
| Passenger car     | 30          | 352,000        | 299,567        | 698,375          | 1,809,500        | 1132,500        |
| <b>Total</b>      |             | <b>524,240</b> | <b>482,720</b> | <b>1,110,712</b> | <b>2,219,787</b> | <b>1602,437</b> |

## 4) Analysis

Table 14 - 16 in Annex 2 show the result of the economic analysis on the Options 2, 3 and 4. A social discount rate to calculate the NPV and the B/C was assumed 12%. This value was not considered inadequate because the rate is set based on a real term.

The EIRR of the Option 2 indicates 18.8%. This value seems to justify the project. The NPV is positive and the B/C of the Option is bigger than 1.00. In the case of the Option 3, the EIRR is 5.8% and the NPV and the B/C are negative. The Option 4 shows the EIRR of 10.6%. This value seems favorable. However, the NPV is negative and the B/C is less than 1.00.

Table 3.4.32 shows the results of a sensitivity analysis.

The sensitivity analysis result indicate that the Option 2 is stable even the increases by 20% or the benefit decreases by 20%. Other Options are very difficult to say viable from this result.

**Table 3.4.32 Result of Sensitivity Analysis**

|                         | Option 2 | Option 3   | Option 4 |
|-------------------------|----------|------------|----------|
| <b>EIRR (%)</b>         |          |            |          |
| 1 Base Case             | 18.8     | 5.8        | 10.6     |
| 2 Cost 20 % Up          | 12.1     | 3.6        | 6.9      |
| 3 Benefit 20 % Down     | 15.4     | 4.1        | 8.2      |
| 4 2 & 3                 | 9.6      | 2.1        | 5.0      |
| <b>NPV (Million Zl)</b> |          |            |          |
| 1 Base Case             | 469,846  | -1,206,607 | -151,906 |
| 2 Cost 20 % Up          | 13,551   | -2,036,913 | -732,552 |
| 3 Benefit 20 % Down     | 225,529  | -1,489,644 | -396,224 |
| 4 2 & 3                 | -230,766 | -2,319,951 | -976,869 |
| <b>B/C</b>              |          |            |          |
| 1 Base Case             | 1.63     | 0.54       | 0.89     |
| 2 Cost 20 % Up          | 1.01     | 0.41       | 0.63     |
| 3 Benefit 20 % Down     | 1.30     | 0.43       | 0.71     |
| 4 2 & 3                 | 0.33     | 0.50       | 0.50     |

## 5) Economic Evaluation

The Option 2 can be said viable. The EIRR is considered high enough to justify the project to the economy.

The Option 3 can not be justified because the EIRR is too low. Resources can be invested to much more efficient projects.

Option 4 seems viable. However, the difference of this option from the Option 2 exists only on the imported rolling stock. It seems that efforts to produce the domestic rolling stocks should be important.

### 3.5 Conditions for Implementation

The following conditions are recommended to be prepared to implement the project. Option 2, which was evaluated as the most viable option among others, was assumed to describe this conditions.

- (1) Mixed operation of general freight trains and high-speed passenger trains should be avoided. The mixed operation will result in:
  - (a) delays of passenger trains;
  - (b) more maintenance work of tracks;
  - (c) necessity of maintenance facilities for freight rolling stocks; and
  - (d) necessity of more expensive turnouts.

The freight trains should be transferred to the parallel two lines with CMK.

- (2) Technology development for the high-speed train operation should be implemented as soon as possible. Rolling stocks should be manufactured in Poland. Tracks, signalling and telecommunication system, power supply system, etc. need extensive improvements of the operation as shown in Annex 1. Regarding damages to the tracks near Katowice by old coal mines, an appropriate alarm system should be installed to secure high speed operation.
- (3) Currently, various discount tickets are issued by PKP. However, this will worsen the financial situation of PKP. The discount should be abolished to secure favorable operation. Efforts to obtain railway patronage from competing transport modes will become much more important, as the free market economy progresses in Poland. Positive business activities to obtain the patronage should be kept in mind strongly.

The CMK line has an advantage to have the track with good alignment for the high speed train operation. And the line will link with the High Speed Railway Network Plan in Europe. The CMK will share a part of the network with the high speed train operation. The study team believes that the project is feasible. However, since this study stays at a preliminary stage, further feasibility study would be preferable to ascertain the viability of such an important line.



## ANNEX 1 TECHNOLOGY DEVELOPMENT FOR HIGH SPEED RAILWAY

### 1. Introduction

The experience of extensive high speed commercial operations is only 10 years in Europe and 26 years in Japan, compared over 150 years of conventional railways. Railway engineering is a field based on accumulated experience. Many unknown factors remain in the area of high speed operation. Thus PKP needs to develop the system carefully. This Annex 1 deals with the technology development for high speed railway.

### 2. Establishment of Technology Development Organization

PKP should establish the organization, system, philosophy, target and strategy for technology development. The technology development department should be established at the PKP head office and it will manage the target and strategy of the entire PKP technology base and the CNTK (Railway Technical Research Institute). PKP technology development will continue for over 20 years. Therefore, the CNTK needs to recruit young engineers in the long term view. The profit of an enterprise is in proportion to the investment in the technology development or vice versa.

JR companies have disbursed 0.35% (tax free) of the total annual sales amount to finance the Railway Technical Research Institute. Moreover, each JR company provides additional funding for its own technology development. The PKP is one of the largest railways in the world and has a huge amount of facilities, track, rolling stock and machines. Therefore, technology development is one of the most efficient means to manage the PKP efficiently and to reduce operation costs. The investment for technology development will return to the benefit of PKP's finances several times over.

### 3. Safety Level

The safety level should be defined for trains, passengers, residents and workers. Safety facilities, e.g. train operations, signaling, rules and manuals for safety will influence the project cost. Level of safety differs in each railway due to different historical, social, and economical backgrounds. The division between by hand and by machine, fail safe and fail out should be defined taking the safety level into consideration.

### 4. Target Speed

The PKP should evaluate the current PKP technology prior to clarifying target technologies to be acquired. SNCF and RENFE run at a speed of 300km/h, JR, DB and FS around 250km/h - 270km/h. JR, Taiwan and Korea will achieve the speed of 300 km/h in this century.

### 5. Development Items and Test Running

There are many items to be developed for the high speed operation. The number of these items is approximately 230, and they are shown in the attached Table-1. These items are integrated from the development planning of the Takido Shinkansen, the North East Corridor Improvement Project (Washington - New York) that Japan cooperated with, and the recent development of high speed operation cars (300 - 350km/h). CNTK will require manpower to develop technology of approximately 1,000 man-months.

PKP has a plan for test running on the CMK. The PKP needs a test train set that consists of 1 locomotive, 1 measuring car, 1 laboratory car and 1 rest car. Measured data will be analyzed at the laboratory car at once and be reflected in the repair works assigned at fixed facilities on the following days. PKP engineers will provide a considerable amount of technology, know how and experience through test running with the assistance of Western railway experts. There is a vast accumulation of know how in JR, SNCF and DB on standards for the data evaluation, measurement criteria, and techniques and countermeasures for the repair of ground facilities. It is not necessary to deviate from the straight path to accumulating test running technology. Items to be measured and examples of measured data at a JNR test running (maximum speed is 319 km/h in 1980) are shown in the attached Table-2. There are 12 categories: the rolling stock capacity/structures/motion/components/electric components, train operations, trolley and pantograph electric noise, signaling functions, track, wind velocity caused by passing train and noise. The measuring items numbered approximately 70 in the case of JR. PKP will acquire maintenance technology during test and training running over 2 years. The experience of high speed operations, particularly in the winter, is extremely important because Poland's specific climate conditions must be taken into account.

Table-1 Study, Research, Survey and Development Items for High Speed Train Operation

| Field              | Sub-Items  | Main contents   | Detailed development technology   |   |
|--------------------|--|---|---|---|
| Train operation    | control and quality of train operation             | Target of on time operation and definition CNK's 'on time'<br>Recommended quality is 95% on time operation (within 5 minutes delay)   | <ul style="list-style-type: none"> <li>- control of train by train diagram</li> <li>- control of 'reserved time' for speed down by maintenance works</li> <li>- recovery method of delayed train by the speed over 200kph</li> <li>- definition of 200km/h (continuous speed, train capacity 220)</li> <li>- 30 minutes forecast of train operation by a computer system</li> </ul>   |   |
|                    | CTC command operation                              | Ability of human, will, training, prevent error, operation in emergency, saving of man power, economical, easy maintenance.   | <ul style="list-style-type: none"> <li>- by hand vs by machine(automatic command, automatic train route control, distinguish of train, velocity of wind, rain fall, water level of rivers).</li> <li>- scope of work of commander, necessary information, necessary communication(command) facility.</li> <li>- manual for train control</li> <li>- manual for emergency treatment</li> <li>- record and report</li> <li>- information exchange at the border of control territory</li> </ul> |   |
|                    | CTC command center organization                    | Cooperation with each field prevent error, operation in emergency, connection with B-20, location of CTC  | <ul style="list-style-type: none"> <li>- train operation commander</li> <li>- passenger service commander</li> <li>- substation control commander</li> <li>- track work control commander</li> <li>- telecommunication facility commander</li> </ul>  |   |
|                    | Man-machine  | Ability of human, will, training, prevent error, operation in emergency, saving of man power,   | <ul style="list-style-type: none"> <li>- layout of control equipment, control board, command key board in the room of CTC</li> <li>- indication(layout of indication, style of letter &amp; drawing, color, distance of visual capacity)</li> <li>- communication facility(telephone, TV display)</li> <li>- equipment &amp; system for emergency measure</li> <li>- training, education</li> <li>- mock-up model of CTC board</li> </ul>   |   |
|                    | Emergency counter-measures                         | Ability of human, will, training, prevent error   | Ground facilities   | <ul style="list-style-type: none"> <li>- CTC system facility</li> <li>- signaling equipment</li> <li>- turnout</li> <li>- rail break</li> <li>- power supply</li> </ul>   |
|                    |  |   | Rolling stock failure:(finding failure and recovery by driver)  | <ul style="list-style-type: none"> <li>- command from CTC to a driver</li> <li>- with assistance of expert system</li> <li>- indication of failure in the cabin</li> <li>- to pick up the failure train and shunting</li> <li>- reserved train set</li> </ul> |
|                    |  |   | Passenger services  | <ul style="list-style-type: none"> <li>- information to passenger</li> <li>- passenger transfer to another train</li> <li>- air circulation when current off</li> </ul>   |
| Maintenance of CTC | High maintenance technology to prevent down of CTC | <ul style="list-style-type: none"> <li>- holding of high maintenance technology(company)</li> <li>- countermeasures for fire accident</li> <li>- to use non easy fire cable in CTC building</li> <li>- to prevent invaders</li> <li>- observer service</li> </ul> |   |   |
| Signaling          | Level of safety                                    | quality of safety, level of safety, economical  | <ul style="list-style-type: none"> <li>- automatic train stop system</li> <li>- dead man system</li> <li>- reliability of the system</li> <li>- indication of train running location</li> <li>- multiple unit facility system</li> <li>- signal in the cabin</li> <li>- signal color be better to distinguish and by distance</li> <li>- inspection of train number</li> </ul>  |   |
|                    | Facilities   | Signaling system, multiple unit, maintenance capacity, economical   | <ul style="list-style-type: none"> <li>- way side signal</li> <li>- signal in the cabin</li> <li>- track circuit</li> <li>- power sources for signaling</li> <li>- compatible with other signaling system</li> <li>- choice of frequency</li> <li>- on/off of ATC at the border with other signaling system</li> </ul>  |   |
|                    | Maintenance  | maintenance capacity, economical, reliability   | <ul style="list-style-type: none"> <li>- test method of signaling equipment</li> <li>- trial circuit for test, test equipment</li> <li>- reliability (MTBF)</li> <li>- countermeasure to prevent disturbance by high frequency</li> <li>- countermeasure for noise signal from thyristor - chopper equipment</li> <li>- improvement of reliability on remote controlled facility (e.g. switch for turnout, interlocking, electric power supply)</li> </ul>                                    |   |



| Field             | Sub-Items                   | Main contents  | Detailed development technology  |
|-------------------|-----------------------------|--|--|
| Signaling         | Maintenance                 | maintenance capacity, economical, reliability  | <ul style="list-style-type: none"> <li>- anti vibration of equipment on way side</li> <li>- emergency button on track wayside to make signal red</li> <li>- holding high maintenance technology(maintenance by outside company, e.g. ZNUS)</li> <li>- maintenance of black box(maintenance by outside company, ZNUS)</li> <li>- education and training</li> </ul>  |
| Track             | Structure                   | High speed operation track structure   | <ul style="list-style-type: none"> <li>- design and quality improvement of UIC 60 rail, PC(pre-stressed concrete) sleeper, double elastic fastening</li> <li>- nose movable ranganized turnout crossing</li> <li>- design and installation of cant and transition curve</li> <li>- quality improvement of rail welding</li> <li>- detection system of rail crack and breakage</li> </ul>   |
|                   | Train speed and maintenance | train speed, passing train   | <ul style="list-style-type: none"> <li>- mixed train or passenger train and light weight freight train only</li> <li>- amount of cant, cant deficient, riding quality</li> <li>- track maintenance volume and technology(e.g. 40m chord)</li> <li>- track inspection every 10 days and at the speed of 200km/h (e.g. at JR)</li> <li>- track maintenance by outside company(e.g. at JR)</li> <li>- plan of maintenance depot and put on / off turnout (e.g. portable turnout at JR)</li> </ul>   |
| Bridge            |                             | prevent impact for riding quality  | <ul style="list-style-type: none"> <li>- vertical alignment curve by reflection of a bridge</li> </ul>   |
| Telecommunication | Facilities                  | for CTC, car driver, conductor, maintenance base and field worker,                                   | <ul style="list-style-type: none"> <li>- commander telephone (all together, separate)</li> <li>- telephone on train (to driver, conductor and public telephone)</li> <li>- on wayside</li> <li>- portable wireless</li> </ul>  |
| Power supply      | Power supply                | rolling stock and power source, power supply system, necessary power of train, future maximum speed, | <ul style="list-style-type: none"> <li>- future maximum speed / power of rolling stock / AC or DC</li> <li>- current substation facility (need to be replaced ? aged, efficiency, maintenance)</li> <li>- increasing capacity of substation</li> <li>- capacity of overhead catenary</li> <li>- influence to other electric consumer by railway peak load</li> <li>- innovation method from DC to AC, if necessary</li> </ul>  |
|                   | Remote control center       | command center, reliability, saving manpower   | <ul style="list-style-type: none"> <li>- to prevent induction disturbance to electronic system</li> <li>- improvement of insulation of circuit</li> <li>- minimize damage by own</li> <li>- improvement of reliability of remote control fuse</li> <li>- perfect suspension of feeding at the time of maintenance work</li> <li>- finding system of defect point</li> <li>- recording of switch working in order to maintenance plan</li> <li>- to prevent error command, man-machine</li> </ul> |
|                   | Substation                  | improvement of reliability for remote control equipment, modernization of facility                   | <ul style="list-style-type: none"> <li>- to prevent mis-switching/movement by high frequency wave</li> <li>- reliability of switching section of overhead line</li> <li>- improvement insulation of low level electric current</li> <li>- to prevent invasion of surge to communication circuit</li> <li>- improvement of load efficiency</li> <li>- double route to power supply</li> <li>- fire measurement</li> </ul>   |
|                   | Overhead line               | high speed overhead catenary, reliability improvement  | <ul style="list-style-type: none"> <li>- type of OHC taking in consideration maintenance and recovery of breakage</li> <li>- OHC mast, strengthen of trolley wire</li> <li>- material of trolley wire</li> <li>- tension, damper</li> <li>- breakage by animal</li> <li>- countermeasure for fire</li> <li>- reservation of data</li> </ul>  |
| Maintenance       | Maintenance depot           | location, track and facility layout, facilities  | <ul style="list-style-type: none"> <li>- working time is day or night</li> <li>- selection of location, layout, facility</li> <li>- transport line of material</li> <li>- siding track for broken CMX train and other train</li> <li>- commuting of employee</li> </ul>  |
|                   | Track maintenance           | maintenance work(track and electric facilities)  | <ul style="list-style-type: none"> <li>- working time is day or night</li> <li>- work volume estimation</li> <li>- employee's safety against high speed train</li> <li>- outside company maintenance</li> <li>- training of skilled worker</li> <li>- maintenance technology and speed down by maintenance work(e.g. after ballast cleaning work - 160km/h)</li> </ul>   |

| Field                      | Sub-Items  | Main contents  | Detailed development technology   |
|----------------------------|--|--|---|
| Maintenance                | Track maintenance technology   | high speed operation track maintenance   | <ul style="list-style-type: none"> <li>- high speed operation track maintenance technology</li> <li>- long wave track irregularity control(40n chord)</li> <li>- control system by computer</li> <li>- standard for track irregularity</li> <li>- high speed running track inspection car</li> <li>- automatic measurement of rolling stock oscillation</li> <li>- review of continuous welded rail control</li> <li>- rail grinding, rail crack / defect inspection</li> </ul> |
|                            | OHC maintenance  | maintenance of over head catenary  | <ul style="list-style-type: none"> <li>- high speed operation OHC maintenance technology</li> <li>- perfect suspension of feeding at the time of maintenance work</li> <li>- control system by computer</li> <li>- standard for OHC irregularity</li> <li>- high speed running OHC inspection car</li> </ul>  |
|                            | Rolling stock maintenance  | maintenance philosophy, border of fail safe / out, reliability   | <ul style="list-style-type: none"> <li>- definition for advanced repair / after broken repair</li> <li>- definition for running components on fail safe/out</li> <li>- definition for periodic inspection on km - base/ day base</li> <li>- cleaning of passenger car cabin (outside company)</li> <li>- drain of waste toilet water</li> </ul>   |
|                            |  | test running   | <ul style="list-style-type: none"> <li>- clarification the maximum capacity of rolling stock</li> <li>- clarification of reliability</li> <li>- definition of periodic maintenance term</li> <li>- reservation of data</li> </ul>   |
| Coal mining subsidence     | coal mining damage   | <ul style="list-style-type: none"> <li>- forecast of track irregularity by ground sinking</li> <li>- economic evaluation on investment for inspection / alarm equipment, track maintenance cost and speed up effect</li> <li>- clarification of track irregularity against derailment</li> <li>- continuous inspection equipment of track movement</li> <li>- inspection and alarm equipment for land movement</li> <li>- inspection technology for underground structure</li> </ul> |   |
| Environmental preservation | forecast for environment protection measurement in Poland, study on other country's issues | <ul style="list-style-type: none"> <li>- study other country's environmental protection standard, countermeasure, measuring technology,</li> <li>- study on vibration</li> <li>- development technology for environment measuring technique, and countermeasure</li> </ul>   |   |
|                            | countermeasure for noise problem   | <ul style="list-style-type: none"> <li>- acceptable track structure criteria for forecast future environment standard(track, structure, rolling stock, pantograph, spark)</li> <li>- reduction of aerodynamic noise of car body and pantograph</li> <li>- reduction of number of pantograph, type</li> <li>- noise of track, corrugate wearing</li> </ul>  |   |
|                            | countermeasure for vibration   | - vibration of structure   |   |
|                            | noise for electric wave  | - noise for radio and TV and countermeasure  |   |
|                            | waste water  | <ul style="list-style-type: none"> <li>- waste water from car toilet</li> <li>- waste water included oil from workshop and depot</li> </ul>  |   |
|                            | ballast flying   | <ul style="list-style-type: none"> <li>- clarify by test running</li> <li>- to equip fence</li> <li>- safety for track patrol</li> </ul>   |   |

| Field             | Sub-item                                   | Main contents   | Detailed development technology   |
|-------------------|--|---|---|
| Rolling stock     | Environment preservation                   | noise, vibration, reduction of noise & aerodynamic resistance   | - reduction of aerodynamic noise and resistance; smoothing of car body, shape of car head<br>- pantograph; number, shape  |
|                   |  | noise for radio wave  | - noise for train radio wireless<br>- noise for TV and radio in public  |
|                   | Environment preservation and energy saving | energy saving, aerodynamic resistance, lightweight of car   | - energy saving by lightweight of car<br>- smoothing of car body, shape of car head<br>- reduction of load impact for track<br>- lightweight car body / bogie / electric component<br>- VVVF motor, higher rotation (r.p.m. revolutions per minute)<br>- aluminum car body structure<br>- smaller car cross section, lower height gravity center of car |
|                   | Safety for high speed running              | running stability   | - vertical / lateral oscillation acceleration<br>- riding quality<br>- prevent oscillation of car in the rear   |
|                   |  | running safety  | - derailment coefficient by low wheel load or high lateral wheel load<br>- excess wheel load, impact by flat wheel<br>- safety at rail break<br>- mechanical / disk / regenerating brake<br>- measurement equipment on live load of car connecting with braking   |
|                   |  | Braking capacity  | - braking distance<br>- detection of skid and its countermeasure<br>- time lag between receiving signal and action of brake equipment<br>- steps of speed   |
|                   |  | safety on passing with high speed train   | - vibration of car body by passing train<br>- wind velocity by high speed train and safety for field worker<br>- stability of loaded cargo on a wagon; fastening of container, flying of bulk cargo, sheet & rope of wagon<br>- flying of ballast   |
|                   |  | countermeasure for high frequency   | - to prevent mis-action of track circuit by high frequency<br>- to prevent mis-action of substation equipment by frequency from power / regeneration running  |
|                   | High speed technology                      | power running capacity  | - acceleration time, distance<br>- power supply<br>- VVVF   |
|                   |  | Adhesion capacity   | - coefficient at rain and snow fall, especially, head and 2nd wheel<br>- coefficient of adhesion at power running and brake action<br>- detection of skid and slip and countermeasure   |
|                   |  | Bogie, axle   | - design of bogie, material, limit of fatigue strength<br>- strength of axle and material   |
|                   |  | Current collection capacity   | - type of pantograph<br>- pressure to up lift and tension of trolley wire<br>- limitation of fatigue of trolley wire<br>- detaching with trolley and train operation<br>- wave propagation speed by tension and trolley material  |
| Passenger service | Riding quality                             | - vibration / acceleration of room, analysis of frequency to prevent passenger's fatigue<br>- comfortable / material / design of seat in view point of passenger fatigue  |   |
|                   | Airtight for passenger car                 | - level of airtight at the time of passing with other train (CHK has no tunnel, problem is small)<br>- noise isolation of passenger room<br>- continuous air ventilation<br>- to separate of noisy components from passenger room   |   |
|                   | Accommodation of passenger car             | - air conditioning<br>- toilet, washbasin, buffet, shop<br>- facility for handicapped person<br>- seat layout in a car, reclining seat  |   |
| Snow and freezing | Countermeasure to snow                     | - to prevent to absorb snow into equipment<br>- to prevent freezing of equipment<br>- shape of snowplow of car head<br>- slip by ice on the rail surface<br>- dropping ice from car body and flying of ballast, and damage for car by them (damage for under floor equipment, window glass) |   |

Table-2 Measuring Items at High Speed Test Running of JNR

JNR executed a high speed test running to clarify the possibility of 260 km/h commercial operation in 1980 on the Tohoku Shinkansen line. The test running was carried out by 37 trips (one way) during 2 months and maximum speed was 319 km/h.

| Survey items  | Measuring items   |
|---|---|
| Rolling stock capacity:<br>power running,<br>regeneration braking<br>running resistance | speed, 1st voltage, 2nd voltage, power,<br>efficiency of power, current of main motor,<br>running resistance  |
| Rolling stock structure:<br>lateral force Q,<br>vertical land P, stress of bogie        | Q and P, bolster anchor stress, lateral and<br>vertical acceleration of axle box, bending<br>strain of axle, strain/stress of axle box<br>suspension, strain of suspension spring,<br>strain of bogie frame |
| Rolling stock motion:<br>car body motion, bogie motion                                  | lateral and vertical vibration acceleration of<br>car body and bogie  |
| Rolling stock components:<br>running gear, axle, bearing                                | torque of wheel axle, up/down motion,<br>vibration acceleration of gear box and axle<br>box, temperature of running gear, axle box<br>and lubrication oil   |
| Train operation:<br>capacity of brake   | - Test on brake testing machine;<br>initial speed at braking, braking time,<br>temperature of brake shoe, disk and cylinder   |
|   | - Field test<br>initial speed at breaking, breaking time,<br>braking distance, oil pressure in brake<br>cylinder, temperature of shoe and disk,<br>emergency braking  |
| Electric components:  | rectification of main motor, temperature of<br>main motor, temperature of resister  |
| Trolley and pantograph  | detaching between trolley and pantograph,<br>contact pressure of pantograph with trolley,<br>up lift amount by pantograph, bending<br>moment of trolley, acceleration speed of<br>trolley                   |
| Electric noise  | electric noise  |

| Survey items           | Measuring items   |
|------------------------|---|
| Signaling              | to confirm planned signaling function; ATC, detection of train location, train number, response by speed and allowance  |
| Track                  | track irregularity, vertical load, lateral force, rail, fastening and sleeper stress, axle box acceleration (with track irregularity), riding quality (with track irregularity) |
| Wind velocity by train | wind velocity on the ground, air pressure, ballast movement   |
| Noise                  | noise of pantograph, wheel/rail, wheel flat, train head, effect of noise absorb wall  |

Annex 2 Tables Used in Economic and Financial Evaluation

Table 1 Initial Investment Cost (Without : Financial)

| Investment / Year     | 1994   | 1995    | 1996    | 1997      | Total        |
|-----------------------|--------|---------|---------|-----------|--------------|
|                       |        |         |         |           | (Million ZI) |
| Track and structure   | 0      | 268,900 | 241,700 | 238,600   | 749,200      |
| Foreign Portion       |        |         |         |           | 0            |
| Domestic Portion      |        | 268,900 | 241,700 | 238,600   | 749,200      |
| OH equipment          |        |         |         |           | 0            |
| Foreign Portion       |        |         |         |           | 0            |
| Domestic Portion      |        |         |         |           | 0            |
| Substation            |        |         |         |           | 0            |
| Foreign Portion       |        |         |         |           | 0            |
| Domestic Portion      |        |         |         |           | 0            |
| Signalling            |        | 6,722   | 10,083  | 16,806    | 33,611       |
| Foreign Portion       |        |         |         |           | 0            |
| Domestic Portion      |        | 6,722   | 10,083  | 16,806    | 33,611       |
| Telecommunication     |        | 16,311  | 24,467  | 40,778    | 81,556       |
| Foreign Portion       |        | 6,851   | 10,276  | 17,127    | 34,254       |
| Domestic Portion      |        | 9,460   | 14,191  | 23,651    | 47,302       |
| Maintenance equipment |        |         |         |           | 0            |
| Foreign Portion       |        |         |         |           | 0            |
| Domestic Portion      |        |         |         |           | 0            |
| Electric Loco.        |        |         |         | 134,400   | 134,400      |
| Foreign Portion       |        |         |         |           | 0            |
| Domestic Portion      |        |         |         | 134,400   | 134,400      |
| Passenger car         |        |         |         | 950,400   | 950,400      |
| Foreign Portion       |        |         |         |           | 0            |
| Domestic Portion      |        |         |         | 950,400   | 950,400      |
| Subtotal              | 0      | 291,933 | 276,250 | 1,380,984 | 1,949,167    |
| Foreign Portion       | 0      | 6,851   | 10,276  | 17,127    | 34,254       |
| Domestic Portion      | 0      | 285,082 | 265,974 | 1,363,857 | 1,914,913    |
| Engineering Fee       | 43,218 | 14,597  | 13,813  | 14,809    | 86,437       |
| Foreign Portion       |        |         |         |           | 0            |
| Domestic Portion      | 43,218 | 14,597  | 13,813  | 14,809    | 86,437       |
| Contingency           | 4,322  | 30,653  | 29,006  | 139,579   | 203,560      |
| Foreign Portion       | 0      | 685     | 1,028   | 1,713     | 3,425        |
| Domestic Portion      | 4,322  | 29,968  | 27,979  | 137,867   | 200,135      |
| Total                 | 47,540 | 337,183 | 319,069 | 1,535,373 | 2,239,164    |
| Foreign Portion       | 0      | 7,536   | 11,304  | 18,839    | 37,679       |
| Domestic Portion      | 47,540 | 329,647 | 307,765 | 1,516,533 | 2,201,485    |

**Table 2 Initial Investment Cost (Option 1 : Financial)**

| Investment / Year     | (Million ZI) |         |         |           |           |
|-----------------------|--------------|---------|---------|-----------|-----------|
|                       | 1994         | 1995    | 1996    | 1997      | Total     |
| Track and structure   | 0            | 273,900 | 252,500 | 300,700   | 827,100   |
| Foreign Portion       | 0            | 0       | 4,040   | 24,056    | 28,096    |
| Domestic Portion      | 0            | 273,900 | 248,460 | 276,644   | 799,004   |
| OH equipment          | 0            | 0       | 0       | 0         | 0         |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 0       | 0       | 0         | 0         |
| Substation            | 0            | 0       | 0       | 0         | 0         |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 0       | 0       | 0         | 0         |
| Signalling            | 0            | 7,902   | 11,853  | 19,756    | 39,511    |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 7,902   | 11,853  | 19,756    | 39,511    |
| Telecommunication     | 0            | 16,311  | 24,467  | 40,778    | 81,556    |
| Foreign Portion       | 0            | 6,851   | 10,276  | 17,127    | 34,254    |
| Domestic Portion      | 0            | 9,460   | 14,191  | 23,651    | 47,302    |
| Maintenance equipment | 0            | 0       | 0       | 0         | 0         |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 0       | 0       | 0         | 0         |
| Electric Loco.        | 0            | 0       | 0       | 106,400   | 106,400   |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 0       | 0       | 106,400   | 106,400   |
| Passenger car         | 0            | 0       | 0       | 668,800   | 668,800   |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 0       | 0       | 668,800   | 668,800   |
| Subtotal              | 0            | 298,113 | 288,820 | 1,136,434 | 1,723,367 |
| Foreign Portion       | 0            | 6,851   | 14,316  | 41,183    | 62,350    |
| Domestic Portion      | 0            | 291,262 | 274,504 | 1,095,251 | 1,661,017 |
| Engineering Fee       | 47,408       | 14,905  | 14,441  | 18,062    | 94,816    |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 47,408       | 14,905  | 14,441  | 18,062    | 94,816    |
| Contingency           | 4,741        | 31,302  | 30,326  | 115,450   | 181,818   |
| Foreign Portion       | 0            | 685     | 1,432   | 4,118     | 6,235     |
| Domestic Portion      | 4,705        | 30,617  | 28,894  | 111,332   | 175,584   |
| Total                 | 52,149       | 344,320 | 333,587 | 1,269,946 | 2,000,001 |
| Foreign Portion       | 0            | 7,536   | 15,748  | 45,301    | 68,584    |
| Domestic Portion      | 52,149       | 336,784 | 317,839 | 1,224,645 | 1,931,417 |

**Table 3 Initial Investment Cost (Option 2 : Financial)**

|                       | (Million Zl)  |                |                |                  |                  |
|-----------------------|---------------|----------------|----------------|------------------|------------------|
| Investment / Year     | 1994          | 1995           | 1996           | 1997             | Total            |
| Track and structure   | 0             | 253,900        | 299,500        | 537,700          | 1,091,100        |
| Foreign Portion       | 0             | 0              | 40,133         | 284,981          | 325,114          |
| Domestic Portion      | 0             | 253,900        | 259,367        | 252,719          | 765,986          |
| OH equipment          | 0             | 0              | 0              | 0                | 0                |
| Foreign Portion       | 0             | 0              | 0              | 0                | 0                |
| Domestic Portion      | 0             | 0              | 0              | 0                | 0                |
| Substation            | 0             | 4,000          | 6,000          | 10,000           | 20,000           |
| Foreign Portion       | 0             | 2,000          | 3,000          | 5,000            | 10,000           |
| Domestic Portion      | 0             | 2,000          | 3,000          | 5,000            | 10,000           |
| Signalling            | 0             | 18,804         | 28,205         | 47,009           | 94,018           |
| Foreign Portion       | 0             | 0              | 0              | 0                | 0                |
| Domestic Portion      | 0             | 18,804         | 28,205         | 47,009           | 94,018           |
| Telecommunication     | 0             | 16,311         | 24,467         | 40,778           | 81,556           |
| Foreign Portion       | 0             | 6,851          | 10,276         | 17,127           | 34,254           |
| Domestic Portion      | 0             | 9,460          | 14,191         | 23,651           | 47,302           |
| Maintenance equipment | 0             | 0              | 0              | 8,960            | 8,960            |
| Foreign Portion       | 0             | 0              | 0              | 7,360            | 7,360            |
| Domestic Portion      | 0             | 0              | 0              | 1,600            | 1,600            |
| Electric Loco.        | 0             | 40,302         | 0              | 564,225          | 604,526          |
| Foreign Portion       | 0             | 21,557         | 0              | 301,795          | 323,351          |
| Domestic Portion      | 0             | 18,745         | 0              | 262,430          | 281,175          |
| Passenger car         | 0             | 76,220         | 0              | 1,067,080        | 1,143,300        |
| Foreign Portion       | 0             | 17,020         | 0              | 238,280          | 255,300          |
| Domestic Portion      | 0             | 59,200         | 0              | 828,800          | 888,000          |
| <b>Subtotal</b>       | <b>0</b>      | <b>409,537</b> | <b>358,172</b> | <b>2,275,752</b> | <b>3,043,460</b> |
| Foreign Portion       | 0             | 47,427         | 53,409         | 854,542          | 955,379          |
| Domestic Portion      | 0             | 362,109        | 304,763        | 1,421,209        | 2,088,081        |
| Engineering Fee       | 64,782        | 14,651         | 17,909         | 32,222           | 129,563          |
| Foreign Portion       | 0             | 0              | 0              | 0                | 0                |
| Domestic Portion      | 64,782        | 14,651         | 17,909         | 32,222           | 129,563          |
| Contingency           | 6,478         | 42,419         | 37,608         | 230,797          | 317,302          |
| Foreign Portion       | 0             | 4,743          | 5,341          | 85,454           | 95,538           |
| Domestic Portion      | 6,478         | 37,676         | 32,267         | 145,343          | 221,764          |
| <b>Total</b>          | <b>71,260</b> | <b>466,606</b> | <b>413,689</b> | <b>2,538,771</b> | <b>3,490,326</b> |
| Foreign Portion       | 0             | 52,170         | 58,750         | 939,996          | 1,050,917        |
| Domestic Portion      | 71,260        | 414,436        | 354,939        | 1,598,775        | 2,439,409        |



Table 4 Initial Investment Cost (Option 3 : Financial)

| Investment / Year     | (Million ZI) |         |         |           |           |
|-----------------------|--------------|---------|---------|-----------|-----------|
|                       | 1994         | 1995    | 1996    | 1997      | Total     |
| Track and structure   | 0            | 253,900 | 310,500 | 474,700   | 1,039,100 |
| Foreign Portion       | 0            | 0       | 40,055  | 212,191   | 252,245   |
| Domestic Portion      | 0            | 253,900 | 270,446 | 262,509   | 786,855   |
| OH equipment          | 0            | 66,528  | 99,792  | 166,320   | 332,640   |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 66,528  | 99,792  | 166,320   | 332,640   |
| Substation            | 0            | 10,600  | 15,900  | 26,500    | 53,000    |
| Foreign Portion       | 0            | 2,014   | 3,021   | 5,035     | 10,070    |
| Domestic Portion      | 0            | 8,586   | 12,879  | 21,465    | 42,930    |
| Signalling            | 0            | 102,238 | 153,357 | 255,595   | 511,190   |
| Foreign Portion       | 0            | 60,320  | 90,481  | 150,801   | 301,602   |
| Domestic Portion      | 0            | 41,918  | 62,876  | 104,794   | 209,588   |
| Telecommunication     | 0            | 16,311  | 24,467  | 40,778    | 81,556    |
| Foreign Portion       | 0            | 6,851   | 10,276  | 17,127    | 34,254    |
| Domestic Portion      | 0            | 9,460   | 14,191  | 23,651    | 47,302    |
| Maintenance equipment | 0            | 0       | 0       | 13,440    | 13,440    |
| Foreign Portion       | 0            | 0       | 0       | 11,040    | 11,040    |
| Domestic Portion      | 0            | 0       | 0       | 2,400     | 2,400     |
| Electric Loco.        | 0            | 0       | 0       | 0         | 0         |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 0       | 0       | 0         | 0         |
| Passenger car         | 0            | 266,725 | 0       | 3,734,150 | 4,000,875 |
| Foreign Portion       | 0            | 243,225 | 0       | 3,405,150 | 3,648,375 |
| Domestic Portion      | 0            | 23,500  | 0       | 329,000   | 352,500   |
| Subtotal              | 0            | 716,302 | 604,016 | 4,711,483 | 6,031,801 |
| Foreign Portion       | 0            | 312,410 | 143,832 | 3,801,344 | 4,257,586 |
| Domestic Portion      | 0            | 403,892 | 460,184 | 910,139   | 1,774,215 |
| Engineering Fee       | 101,546      | 22,479  | 30,201  | 48,867    | 203,093   |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 101,546      | 22,479  | 30,201  | 48,867    | 203,093   |
| Contingency           | 10,155       | 73,878  | 63,422  | 476,035   | 623,489   |
| Foreign Portion       | 0            | 31,241  | 14,383  | 380,134   | 425,759   |
| Domestic Portion      | 10,155       | 42,637  | 49,038  | 95,901    | 197,731   |
| Total                 | 111,701      | 812,659 | 697,638 | 5,236,385 | 6,858,383 |
| Foreign Portion       | 0            | 343,651 | 158,215 | 4,181,478 | 4,683,345 |
| Domestic Portion      | 111,701      | 469,008 | 539,423 | 1,054,907 | 2,175,038 |

**Table 5 Initial Investment Cost (Option 4 : Financial)**

|                       | (Million ZI) |         |         |           |           |
|-----------------------|--------------|---------|---------|-----------|-----------|
| Investment / Year     | 1997         | 1995    | 1996    | 1997      | Total     |
| Track and structure   | 0            | 253,900 | 299,500 | 537,700   | 1,091,100 |
| Foreign Portion       | 0            | 0       | 40,133  | 284,981   | 325,114   |
| Domestic Portion      | 0            | 253,900 | 259,367 | 252,719   | 765,986   |
| OH equipment          | 0            | 0       | 0       | 0         | 0         |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 0       | 0       | 0         | 0         |
| Substation            | 0            | 4,000   | 6,000   | 10,000    | 20,000    |
| Foreign Portion       | 0            | 2,000   | 3,000   | 5,000     | 10,000    |
| Domestic Portion      | 0            | 2,000   | 3,000   | 5,000     | 10,000    |
| Signalling            | 0            | 18,804  | 28,205  | 47,009    | 94,018    |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 18,804  | 28,205  | 47,009    | 94,018    |
| Telecommunication     | 0            | 16,311  | 24,467  | 40,778    | 81,556    |
| Foreign Portion       | 0            | 6,851   | 10,276  | 17,127    | 34,254    |
| Domestic Portion      | 0            | 9,460   | 14,191  | 23,651    | 47,302    |
| Maintenance equipment | 0            | 0       | 0       | 8,960     | 8,960     |
| Foreign Portion       | 0            | 0       | 0       | 7,360     | 7,360     |
| Domestic Portion      | 0            | 0       | 0       | 1,600     | 1,600     |
| Electric Loco.        | 0            | 55,626  | 0       | 778,769   | 834,395   |
| Foreign Portion       | 0            | 50,725  | 0       | 710,155   | 760,880   |
| Domestic Portion      | 0            | 4,901   | 0       | 68,614    | 73,515    |
| Passenger car         | 0            | 136,200 | 0       | 1,906,800 | 2,043,000 |
| Foreign Portion       | 0            | 124,200 | 0       | 1,738,800 | 1,863,000 |
| Domestic Portion      | 0            | 12,000  | 0       | 168,000   | 180,000   |
| Subtotal              | 0            | 484,841 | 358,172 | 3,330,016 | 4,173,029 |
| Foreign Portion       | 0            | 183,778 | 53,409  | 2,763,423 | 3,000,608 |
| Domestic Portion      | 0            | 301,065 | 304,763 | 566,593   | 1,172,421 |
| Engineering Fee       | 64,782       | 14,651  | 17,909  | 32,222    | 129,563   |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 64,782       | 14,651  | 17,909  | 32,222    | 129,563   |
| Contingency           | 6,478        | 49,949  | 37,608  | 336,224   | 430,259   |
| Foreign Portion       | 0            | 18,378  | 5,341   | 276,342   | 300,061   |
| Domestic Portion      | 6,478        | 31,572  | 32,267  | 59,882    | 130,198   |
| Total                 | 71,260       | 549,441 | 413,689 | 3,698,462 | 4,732,852 |
| Foreign Portion       | 0            | 202,154 | 58,750  | 3,039,765 | 3,300,669 |
| Domestic Portion      | 71,260       | 347,288 | 354,939 | 658,697   | 1,432,183 |

Table 6 Financial Analysis of CMK Line Improvement Project

|                          | 1994   | 1995    | 1996   | 1997     | 1998   | 1999    | 2000    | 2001    | 2002    | 2003     | 2004     | 2005     |
|--------------------------|--------|---------|--------|----------|--------|---------|---------|---------|---------|----------|----------|----------|
| Option:                  |        |         |        |          |        |         |         |         |         |          |          |          |
| FIRR(%):                 |        | 5.83    |        |          |        |         |         |         |         |          |          |          |
| Construction Cost:       |        | 1.00    |        |          |        |         |         |         |         |          |          |          |
| Fare Revenue:            |        | 0.75    |        |          |        |         |         |         |         |          |          |          |
| Interest Rate (%):       |        | 7.60    |        |          |        |         |         |         |         |          |          |          |
| Long Term Loan:          |        | 55.00   |        |          |        |         |         |         |         |          |          |          |
| Short Term Loan:         |        | 0.00    |        |          |        |         |         |         |         |          |          |          |
| Government Subsidy b):   |        |         |        |          |        |         |         |         |         |          |          |          |
| Profit and Loss          |        |         |        |          |        |         |         |         |         |          |          |          |
| Operating Revenue        | 0      | 0       | 0      | 0        | 11132  | 112948  | 114764  | 116581  | 118397  | 120213   | 122029   | 123845   |
| CMK Line Fare Revenue    | 0      | 0       | 0      | 0        | 97349  | 98939   | 100530  | 102121  | 103712  | 105303   | 106894   | 108485   |
| Other Lines Fare Revenue | 0      | 0       | 0      | 0        | 13784  | 14009   | 14234   | 14459   | 14685   | 14910    | 15135    | 15361    |
| Operating Expense        | 0      | 0       | 0      | 0        | 52313  | 52747   | 53181   | 53616   | 54050   | 54484    | 54919    | 55717    |
| Maintenance & Operation  | 0      | 0       | 0      | 0        | 21441  | 21875   | 22309   | 22744   | 23178   | 23612    | 24047    | 24481    |
| Depreciation             | 0      | 0       | 0      | 0        | 30872  | 30872   | 30872   | 30872   | 30872   | 30872    | 30872    | 31236    |
| Operating Profit         | 0      | 0       | 0      | 0        | 58819  | 60201   | 61583   | 62965   | 64347   | 65729    | 67110    | 68128    |
| Other Revenue            |        |         |        |          |        |         |         |         |         |          |          |          |
| Government Subsidy a)    | 0      | 1803    | 12630  | 26768    | 117749 | 133181  | 157464  | 200478  | 270874  | 426790   | 667699   | 1046350  |
| Interest Expense         | 0      | 0       | 991    | 7938     | 22661  | 38092   | 62356   | 106734  | 179013  | 344438   | 594856   | 985016   |
| Short Term Loan          | 0      | 0       | 11639  | 18830    | 95088  | 95088   | 94908   | 93744   | 91861   | 82352    | 72843    | 63335    |
| Long Term Loan           | 0      | 1803    | -12630 | -26768   | -58930 | -72979  | -95881  | -137513 | -206528 | -361061  | -600589  | -978222  |
| Net Profit               | 0      | -1803   | -12630 | -26768   | -58930 | -72979  | -95881  | -137513 | -206528 | -361061  | -600589  | -978222  |
| Accumulated Net Profit   |        |         | -12630 | -39399   | -98328 | -171507 | -267188 | -404701 | -611229 | -972290  | -1572878 | -2551100 |
| Financial Cash Flow      |        |         |        |          |        |         |         |         |         |          |          |          |
| Cash In                  | 0      | 0       | 0      | 0        | 89691  | 91073   | 92455   | 93837   | 95219   | 96601    | 97982    | 99364    |
| Operating Profit         | 0      | 0       | 0      | 0        | 58819  | 60201   | 61583   | 62965   | 64347   | 65729    | 67110    | 68128    |
| Other Revenue            | 0      | 0       | 0      | 0        | 30872  | 30872   | 30872   | 30872   | 30872   | 30872    | 30872    | 31236    |
| Depreciation             | 23720  | 129423  | 94620  | 1003398  | 0      | 0       | 0       | 0       | 0       | 0        | 10913    | 0        |
| Cash Out                 | 23720  | 129423  | 94620  | 1003398  | 0      | 0       | 0       | 0       | 0       | 0        | 10913    | 0        |
| Investment               |        |         |        |          |        |         |         |         |         |          |          |          |
| Residual Value           | -23720 | -129423 | -94620 | -1003398 | 89691  | 91073   | 92455   | 93837   | 95219   | 96601    | 97982    | 99364    |
| Cash Flow                | 0      | 0       | 0      | 0        | 0      | 0       | 0       | 0       | 0       | 0        | 0        | 0        |
| Financial Program        |        |         |        |          |        |         |         |         |         |          |          |          |
| Source                   | 23720  | 129423  | 94620  | 1003398  | 89691  | 91073   | 92455   | 93837   | 95219   | 96601    | 97982    | 99364    |
| Long Term Loan           | 0      | 0       | 0      | 0        | 58819  | 60201   | 61583   | 62965   | 64347   | 65729    | 67110    | 68128    |
| Operating Profit         | 0      | 0       | 0      | 0        | 30872  | 30872   | 30872   | 30872   | 30872   | 30872    | 30872    | 31236    |
| Depreciation             | 0      | 0       | 0      | 0        | 0      | 0       | 0       | 0       | 0       | 0        | 0        | 0        |
| Other Revenue            | 0      | 0       | 0      | 0        | 0      | 0       | 0       | 0       | 0       | 0        | 0        | 0        |
| Government Subsidy a)    | 0      | 0       | 0      | 0        | 0      | 0       | 0       | 0       | 0       | 0        | 0        | 0        |
| Government Subsidy b)    | 0      | 0       | 0      | 0        | 0      | 0       | 0       | 0       | 0       | 0        | 0        | 0        |
| Use                      | 23720  | 131226  | 109053 | 1044599  | 158950 | 204811  | 286516  | 419315  | 721469  | 1178156  | 1885284  | 2958767  |
| Investment               | 23720  | 129423  | 94620  | 1003398  | 0      | 0       | 0       | 0       | 0       | 0        | 10913    | 0        |
| Principal Repayment      | 0      | 0       | 1803   | 14433    | 41201  | 71631   | 129052  | 218838  | 450595  | 751366   | 1206672  | 1912417  |
| Long Term Loan           | 0      | 0       | 0      | 0        | 0      | 2372    | 15314   | 24776   | 450595  | 751366   | 125116   | 125116   |
| Short Term Loan          | 0      | 0       | 1803   | 14433    | 41201  | 69259   | 113758  | 194061  | 325479  | 626250   | 9081555  | 1787301  |
| Interest Expense         | 0      | 1803    | 12630  | 26768    | 117749 | 133181  | 157464  | 200478  | 270874  | 426790   | 667699   | 1046350  |
| Long Term Loan           | 0      | 1803    | 11639  | 18830    | 95088  | 95088   | 94908   | 93744   | 91861   | 82352    | 72843    | 63335    |
| Short Term Loan          | 0      | 0       | 991    | 7938     | 22661  | 38092   | 62356   | 106734  | 179013  | 344438   | 594856   | 985016   |
| Net Cash Flow            | 0      | -1803   | -14433 | -41201   | -69259 | -113738 | -194061 | -325479 | -626250 | -1081555 | -1787301 | -2859403 |

(Million \$)

**Table 6 Financial Analysis of CMK Line Improvement Project (Continued)**

|                                 | 2006     | 2007     | 2008      | 2009      | 2010      | 2011      | 2012      | 2013      | 2014       | 2015       | 2016       | 2017       |
|---------------------------------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|------------|------------|------------|
| Option:                         |          |          |           |           |           |           |           |           |            |            |            |            |
| FIRR(%)                         | 5.83     |          |           |           |           |           |           |           |            |            |            |            |
| Construction Cost:              | 1.00     |          |           |           |           |           |           |           |            |            |            |            |
| Fare Revenue:                   | 0.75     |          |           |           |           |           |           |           |            |            |            |            |
| Interest Rate (%)               | 7.60     |          |           |           |           |           |           |           |            |            |            |            |
| Long Term Loan:                 | 55.00    |          |           |           |           |           |           |           |            |            |            |            |
| Short Term Loan:                | 0.00     |          |           |           |           |           |           |           |            |            |            |            |
| Government Subsidy a):          |          |          |           |           |           |           |           |           |            |            |            |            |
| Government Subsidy b):          |          |          |           |           |           |           |           |           |            |            |            |            |
| <b>Profit and Loss</b>          |          |          |           |           |           |           |           |           |            |            |            |            |
| Operating Revenue               | 125833   | 127822   | 129810    | 131798    | 133786    | 135774    | 137762    | 139751    | 141739     | 143727     | 145715     | 147703     |
| CMK Line Fare Revenue           | 110226   | 111968   | 113709    | 115451    | 117192    | 118934    | 120676    | 122417    | 124159     | 125900     | 127642     | 129384     |
| Other Lines Fare Revenue        | 15607    | 15854    | 16101     | 16347     | 16594     | 16840     | 17087     | 17334     | 17580      | 17827      | 18074      | 18321      |
| Operating Expense               | 57061    | 58405    | 59749     | 61094     | 62438     | 63782     | 65126     | 66470     | 67814      | 69158      | 70502      | 71846      |
| Maintenance & Operation         | 25825    | 27169    | 28513     | 29858     | 31202     | 32546     | 33890     | 35234     | 36578      | 37923      | 39267      | 40611      |
| Depreciation                    | 31236    | 31236    | 31236     | 31236     | 31236     | 31236     | 31236     | 31236     | 31236      | 31236      | 31236      | 31236      |
| Operating Profit                | 68772    | 69416    | 70060     | 70704     | 71348     | 71992     | 72636     | 73280     | 73924      | 74568      | 75212      | 75856      |
| <b>Other Revenue</b>            |          |          |           |           |           |           |           |           |            |            |            |            |
| Government Subsidy a)           | 162648   | 252372   | 391827    | 607691    | 942130    | 1459867   | 2261875   | 35001933  | 54195512   | 84029809   | 130188012  | 201733226  |
| Interest Expense                | 1572672  | 2481055  | 3883464   | 6051615   | 9405360   | 14591061  | 22618750  | 35001933  | 54195512   | 84029809   | 130188012  | 201733226  |
| Short Term Loan                 | 53826    | 44317    | 34808     | 25299     | 15971     | 7626      | -         | 0         | 0          | 0          | 0          | 0          |
| Long Term Loan                  | -1557725 | -2455955 | -3848212  | -6006210  | -9349882  | -14526695 | -22546114 | -34928453 | -54121588  | -83960369  | -130118571 | -201663785 |
| Net Profit                      | -4108826 | -6564781 | -10412993 | -16419203 | -25769185 | -40295880 | -62841993 | -97770646 | -151892233 | -235852602 | -365971175 | -567634959 |
| Accumulated Net Profit          |          |          |           |           |           |           |           |           |            |            |            |            |
| <b>Financial Cash Flow</b>      |          |          |           |           |           |           |           |           |            |            |            |            |
| Cash In                         | 100008   | 100652   | 101296    | 101940    | 102584    | 103228    | 103872    | 104516    | 105160     | 105804     | 105804     | 105804     |
| Operating Profit                | 68772    | 69416    | 70060     | 70704     | 71348     | 71992     | 72636     | 73280     | 73924      | 74568      | 75212      | 75856      |
| Other Revenue                   | 31236    | 31236    | 31236     | 31236     | 31236     | 31236     | 31236     | 31236     | 31236      | 31236      | 31236      | 31236      |
| Depreciation                    | 0        | 0        | 0         | 0         | 0         | 0         | 0         | 0         | 0          | 0          | 0          | 0          |
| Cash Out                        | 0        | 0        | 0         | 0         | 0         | 0         | 0         | 0         | 0          | 0          | 0          | 0          |
| Investment                      | 0        | 0        | 0         | 0         | 0         | 0         | 0         | 0         | 0          | 0          | 0          | 0          |
| Residual Value                  | 0        | 0        | 0         | 0         | 0         | 0         | 0         | 0         | 0          | 0          | 0          | 0          |
| Cash Flow                       | 100008   | 100652   | 101296    | 101940    | 102584    | 103228    | 103872    | 104516    | -48665     | 105804     | 105804     | 727286     |
| <b>Financial Program Source</b> |          |          |           |           |           |           |           |           |            |            |            |            |
| Long Term Loan                  | 100008   | 100652   | 101296    | 101940    | 102584    | 103228    | 103872    | 104516    | 105160     | 105804     | 105804     | 105804     |
| Operating Profit                | 68772    | 69416    | 70060     | 70704     | 71348     | 71992     | 72636     | 73280     | 73924      | 74568      | 75212      | 75856      |
| Depreciation                    | 31236    | 31236    | 31236     | 31236     | 31236     | 31236     | 31236     | 31236     | 31236      | 31236      | 31236      | 31236      |
| Other Revenue                   | 0        | 0        | 0         | 0         | 0         | 0         | 0         | 0         | 0          | 0          | 0          | 0          |
| Government Subsidy a)           | 0        | 0        | 0         | 0         | 0         | 0         | 0         | 0         | 0          | 0          | 0          | 0          |
| Government Subsidy b)           | 0        | 0        | 0         | 0         | 0         | 0         | 0         | 0         | 0          | 0          | 0          | 0          |
| <b>Use</b>                      |          |          |           |           |           |           |           |           |            |            |            |            |
| Investment                      | 4611017  | 7161496  | 11104232  | 17202594  | 26631786  | 41282229  | 63743750  | 98641811  | 152886631  | 236811280  | 366893488  | 568520909  |
| Principal Repayment             | 0        | 0        | 0         | 0         | 0         | 0         | 0         | 0         | 0          | 0          | 0          | 0          |
| Long Term Loan                  | 2984519  | 4636125  | 7185960   | 11125680  | 17210456  | 26629542  | 41125000  | 63639878  | 98537295   | 152781471  | 236705476  | 366787683  |
| Short Term Loan                 | 125116   | 125116   | 125116    | 122744    | 109802    | 100340    | 0         | 0         | 0          | 0          | 0          | 0          |
| Interest Expense                | 2859403  | 4511008  | 7060844   | 11002936  | 17100654  | 26292202  | 41125000  | 63639878  | 98537295   | 152781471  | 236705476  | 366787683  |
| Government Subsidy a)           | 1626498  | 252372   | 391827    | 607691    | 942130    | 1459867   | 22618750  | 35001933  | 54195512   | 84029809   | 130188012  | 201733226  |
| Government Subsidy b)           | 44317    | 44317    | 34808     | 25299     | 15971     | 7626      | -         | 0         | 0          | 0          | 0          | 0          |
| Long Term Loan                  | 1572672  | 2481055  | 3883464   | 6051615   | 9405360   | 14591061  | 22618750  | 35001933  | 54195512   | 84029809   | 130188012  | 201733226  |
| Short Term Loan                 | -4511008 | -7060844 | -11002936 | -17100654 | -26529202 | -41125000 | -63639878 | -98537295 | -152781471 | -236705476 | -366787683 | -568415104 |
| Net Cash Flow                   |          |          |           |           |           |           |           |           |            |            |            |            |



Table 7 Financial Analysis of CMK Line Improvement Project (Continued)

|                            | 2006      | 2007      | 2008      | 2009       | 2010       | 2011       | 2012       | 2013       | 2014        | 2015        | 2016        | 2017        |
|----------------------------|-----------|-----------|-----------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|
| Option:                    |           |           |           |            |            |            |            |            |             |             |             |             |
| FIRR(%):                   | -2.26     |           |           |            |            |            |            |            |             |             |             |             |
| Construction Cost:         | 1.00      |           |           |            |            |            |            |            |             |             |             |             |
| Fare Revenue:              | 0.75      |           |           |            |            |            |            |            |             |             |             |             |
| Interest Rate (%):         | 7.60      |           |           |            |            |            |            |            |             |             |             |             |
| Long Term Loan:            | 55.00     |           |           |            |            |            |            |            |             |             |             |             |
| Short Term Loan:           | 0.00      |           |           |            |            |            |            |            |             |             |             |             |
| Government Subsidy b):     |           |           |           |            |            |            |            |            |             |             |             |             |
| (Million \$)               |           |           |           |            |            |            |            |            |             |             |             |             |
| <b>Profit and Loss</b>     |           |           |           |            |            |            |            |            |             |             |             |             |
| Operating Revenue          | 16330     | 16511     | 16893     | 171074     | 173655     | 176237     | 178818     | 181400     | 183981      | 186563      | 186563      | 186563      |
| CMK Line Fare Revenue      | 143072    | 145333    | 147594    | 149855     | 152117     | 154378     | 156639     | 158900     | 161162      | 163423      | 163423      | 163423      |
| Other Lines Fare Revenue   | 20258     | 20578     | 20899     | 21219      | 21539      | 21859      | 22179      | 22499      | 22820       | 23140       | 23140       | 23140       |
| Operating Expense          | 197714    | 200043    | 202373    | 204702     | 207031     | 209360     | 211689     | 214018     | 216347      | 240950      | 240950      | 240950      |
| Maintenance & Operation    | 68446     | 70975     | 73305     | 75634      | 77963      | 80292      | 82621      | 84950      | 87279       | 89609       | 89609       | 89609       |
| Depreciation               | 129068    | 129068    | 129068    | 129068     | 129068     | 129068     | 129068     | 129068     | 129068      | 151341      | 151341      | 151341      |
| Operating Profit           | -34385    | -34132    | -33880    | -33628     | -33375     | -33123     | -32871     | -32619     | -32366      | -54387      | -54387      | -54387      |
| <b>Other Revenue</b>       |           |           |           |            |            |            |            |            |             |             |             |             |
| Government Subsidy a)      |           |           |           |            |            |            |            |            |             |             |             |             |
| Interest Expense           | 14176068  | 22139781  | 34483396  | 53615862   | 832688003  | 129206146  | 200392185  | 310554978  | 481307169   | 746340422   | 1156774330  | 1792946887  |
| Short Term Loan            | 13976999  | 21975818  | 34354539  | 53522111   | 83208871   | 129178019  | 200392185  | 310554978  | 481307169   | 746340422   | 1156774330  | 1792946887  |
| Long Term Loan             | 199069    | 163963    | 128857    | 93751      | 59133      | 28128      | 0          | 0          | 0           | 0           | 0           | 0           |
| Net Profit                 | -14210453 | -22173913 | -34517276 | -53649489  | -83301379  | -129239269 | -200425056 | -310587597 | -481339535  | -746394809  | -1156828717 | -1793001274 |
| Accumulated Net Profit     | -38813758 | -60987671 | -95504947 | -149154437 | -232455816 | -361695085 | -562120141 | -872707738 | -1354047275 | -2100442083 | -3257270600 | -5050272074 |
| <b>Financial Cash Flow</b> |           |           |           |            |            |            |            |            |             |             |             |             |
| Cash In                    | 94683     | 94936     | 95188     | 95440      | 95693      | 95945      | 96197      | 96449      | 96702       | 96954       | 96954       | 96954       |
| Operating Profit           | -34385    | -34132    | -33880    | -33628     | -33375     | -33123     | -32871     | -32619     | -32366      | -54387      | -54387      | -54387      |
| Other Revenue              |           |           |           |            |            |            |            |            |             |             |             |             |
| Depreciation               | 129068    | 129068    | 129068    | 129068     | 129068     | 129068     | 129068     | 129068     | 129068      | 151341      | 151341      | 151341      |
| Cash Out                   | 0         | 0         | 0         | 0          | 0          | 0          | 0          | 0          | 0           | 0           | 0           | 0           |
| Investment                 | 0         | 0         | 0         | 0          | 0          | 0          | 0          | 0          | 0           | 0           | 0           | 0           |
| Residual Value             |           |           |           |            |            |            |            |            |             |             |             |             |
| Cash Flow                  | 94683     | 94936     | 95188     | 95440      | 95693      | 95945      | 96197      | 96449      | 96702       | 96954       | 96954       | 96954       |
| <b>Financial Program</b>   |           |           |           |            |            |            |            |            |             |             |             |             |
| Source                     |           |           |           |            |            |            |            |            |             |             |             |             |
| Long Term Loan             | 94683     | 94936     | 95188     | 95440      | 95693      | 95945      | 96197      | 96449      | 96702       | 96954       | 96954       | 96954       |
| Operating Profit           | -34385    | -34132    | -33880    | -33628     | -33375     | -33123     | -32871     | -32619     | -32366      | -54387      | -54387      | -54387      |
| Depreciation               | 129068    | 129068    | 129068    | 129068     | 129068     | 129068     | 129068     | 129068     | 129068      | 151341      | 151341      | 151341      |
| Other Revenue              |           |           |           |            |            |            |            |            |             |             |             |             |
| Government Subsidy a)      | 0         | 0         | 0         | 0          | 0          | 0          | 0          | 0          | 0           | 0           | 0           | 0           |
| Government Subsidy b)      |           |           |           |            |            |            |            |            |             |             |             |             |
| Use                        |           |           |           |            |            |            |            |            |             |             |             |             |
| Investment                 | 40050715  | 62557734  | 97408117  | 151384296  | 234964817  | 364445372  | 564741612  | 875200393  | 1357079288  | 2103323009  | 3260000385  | 5052850316  |
| Principal Repayment        | 25874647  | 40417954  | 62924720  | 97768434   | 151698814  | 235239226  | 364349427  | 564645415  | 875103944   | 1356982586  | 2103226055  | 3259903431  |
| Long Term Loan             | 461922    | 461922    | 461922    | 45506      | 407958     | 370101     | 0          | 0          | 0           | 0           | 0           | 0           |
| Short Term Loan            | 25412725  | 39956032  | 62462799  | 97312929   | 151288856  | 234869125  | 364349427  | 564645415  | 875103944   | 1356982586  | 2103226055  | 3259903431  |
| Interest Expense           | 14176068  | 22139781  | 34483396  | 53615862   | 832688003  | 129206146  | 200392185  | 310554978  | 481307169   | 746340422   | 1156774330  | 1792946887  |
| Long Term Loan             | 199069    | 163963    | 128857    | 93751      | 59133      | 28128      | 0          | 0          | 0           | 0           | 0           | 0           |
| Short Term Loan            | 13976999  | 21975818  | 34354539  | 53522111   | 83208871   | 129178019  | 200392185  | 310554978  | 481307169   | 746340422   | 1156774330  | 1792946887  |
| Net Cash Flow              | -39958032 | -62462799 | -97312929 | -151288856 | -234869125 | -364349427 | -564645415 | -875103944 | -1356982586 | -2103226055 | -3259903431 | -5052753364 |

**Table 8 Financial Analysis of CMK Line Improvement Project**

|                                 | 1994   | 1995    | 1996   | 1997     | 1998    | 1999    | 2000    | 2001     | 2002     | 2003     | 2004     | 2005         |
|---------------------------------|--------|---------|--------|----------|---------|---------|---------|----------|----------|----------|----------|--------------|
| Option:                         |        |         |        |          |         |         |         |          |          |          |          |              |
| FIRR(%):                        | 0.70   |         |        |          |         |         |         |          |          |          |          |              |
| Construction Cost:              | 1.00   |         |        |          |         |         |         |          |          |          |          |              |
| Fare Revenue:                   | 0.75   |         |        |          |         |         |         |          |          |          |          |              |
| Interest Rate (%):              | 7.60   |         |        |          |         |         |         |          |          |          |          |              |
| Long Term Loan:                 | 55.00  |         |        |          |         |         |         |          |          |          |          |              |
| Short Term Loan:                | 0.00   |         |        |          |         |         |         |          |          |          |          |              |
| Government Subsidy b):          |        |         |        |          |         |         |         |          |          |          |          |              |
|                                 |        |         |        |          |         |         |         |          |          |          |          | (Million \$) |
| <b>Profit and Loss</b>          |        |         |        |          |         |         |         |          |          |          |          |              |
| Operating Revenue               | 0      | 0       | 0      | 0        | 11132   | 112948  | 114764  | 116581   | 118397   | 120213   | 122029   | 123845       |
| CMK Line Fare Revenue           | 0      | 0       | 0      | 0        | 97349   | 98959   | 100530  | 102121   | 103712   | 105303   | 106894   | 108485       |
| Other Lines Fare Revenue        | 0      | 0       | 0      | 0        | 13784   | 14009   | 14234   | 14459    | 14685    | 14910    | 15135    | 15361        |
| Operating Expense               | 0      | 0       | 0      | 0        | 89966   | 90400   | 90834   | 91269    | 91703    | 92137    | 92572    | 97118        |
| Maintenance & Operation         | 0      | 0       | 0      | 0        | 21441   | 21875   | 22309   | 22744    | 23178    | 23612    | 24047    | 24481        |
| Depreciation                    | 0      | 0       | 0      | 0        | 68525   | 68525   | 68525   | 68525    | 68525    | 68525    | 68525    | 72637        |
| Operating Profit                | 0      | 0       | 0      | 0        | 21166   | 22548   | 23930   | 25312    | 26694    | 28076    | 29457    | 26727        |
| <b>Other Revenue</b>            |        |         |        |          |         |         |         |          |          |          |          |              |
| Government Subsidy a)           | 0      | 1803    | 18926  | 36526    | 221010  | 293236  | 405549  | 588937   | 876912   | 1425044  | 2273888  | 3656693      |
| Interest Expense                | 0      | 0       | 991    | 11401    | 31490   | 103715  | 216209  | 401390   | 691878   | 1258962  | 2126758  | 3528515      |
| Short Term Loan                 | 0      | 0       | 0      | 0        | 189520  | 189520  | 189340  | 187547   | 185034   | 166082   | 147130   | 128178       |
| Long Term Loan                  | 0      | 1803    | 17934  | 25125    | 189520  | 189520  | 189340  | 187547   | 185034   | 166082   | 147130   | 128178       |
| Net Profit                      | 0      | -1803   | -18926 | -270687  | -199844 | -270687 | -381619 | -563625  | -850218  | -1396968 | -2244431 | -3629966     |
| Accumulated Net Profit          |        |         | -18926 | -55452   | -255296 | -525983 | -907603 | -1471227 | -2321445 | -3718413 | -5962844 | -9592810     |
| <b>Financial Cash Flow</b>      |        |         |        |          |         |         |         |          |          |          |          |              |
| Cash In                         | 0      | 0       | 0      | 0        | 89691   | 91073   | 92455   | 93837    | 95219    | 96601    | 97982    | 99364        |
| Operating Profit                | 0      | 0       | 0      | 0        | 21166   | 22548   | 23930   | 25312    | 26694    | 28076    | 29457    | 26727        |
| Other Revenue                   | 0      | 0       | 0      | 0        | 68525   | 68525   | 68525   | 68525    | 68525    | 68525    | 68525    | 72637        |
| Depreciation                    | 23720  | 212258  | 94620  | 2163089  | 0       | 0       | 0       | 0        | 0        | 0        | 0        | 0            |
| Cash Out                        | 23720  | 212258  | 94620  | 2163089  | 0       | 0       | 0       | 0        | 0        | 0        | 0        | 0            |
| Investment                      |        |         |        |          |         |         |         |          |          |          |          |              |
| Residual Value                  |        |         |        |          |         |         |         |          |          |          |          |              |
| Cash Flow                       | -23720 | -212258 | -94620 | -2163089 | 89691   | 91073   | 92455   | 93837    | 95219    | 96601    | -25393   | 99364        |
| <b>Financial Program Source</b> |        |         |        |          |         |         |         |          |          |          |          |              |
| Long Term Loan                  | 23720  | 212258  | 94620  | 2163089  | 89691   | 91073   | 92455   | 93837    | 95219    | 96601    | 97982    | 99364        |
| Operating Profit                | 23720  | 212258  | 94620  | 2163089  | 21166   | 22548   | 23930   | 25312    | 26694    | 28076    | 29457    | 26727        |
| Depreciation                    | 0      | 0       | 0      | 0        | 68525   | 68525   | 68525   | 68525    | 68525    | 68525    | 68525    | 72637        |
| Other Revenue                   | 0      | 0       | 0      | 0        | 0       | 0       | 0       | 0        | 0        | 0        | 0        | 0            |
| Government Subsidy a)           | 0      | 0       | 0      | 0        | 0       | 0       | 0       | 0        | 0        | 0        | 0        | 0            |
| Government Subsidy b)           | 0      | 0       | 0      | 0        | 0       | 0       | 0       | 0        | 0        | 0        | 0        | 0            |
| <b>Financial Program Use</b>    |        |         |        |          |         |         |         |          |          |          |          |              |
| Investment                      | 23720  | 214061  | 115349 | 2220344  | 278265  | 484181  | 822255  | 1351796  | 2384240  | 3963434  | 6513465  | 10321544     |
| Principal Repayment             | 23720  | 212258  | 94620  | 2163089  | 0       | 0       | 416706  | 762860   | 1507328  | 2538590  | 4116202  | 6664851      |
| Long Term Loan                  | 0      | 0       | 1803   | 20729    | 57255   | 190946  | 416706  | 762860   | 1507328  | 2538590  | 4116202  | 6664851      |
| Short Term Loan                 | 0      | 0       | 0      | 0        | 0       | 2372    | 23598   | 33060    | 249369   | 249369   | 249369   | 249369       |
| Interest Expense                | 0      | 1803    | 18926  | 20729    | 57255   | 188574  | 393108  | 729800   | 1237960  | 2289021  | 3866833  | 6415482      |
| Long Term Loan                  | 0      | 1803    | 18926  | 20729    | 57255   | 188574  | 393108  | 729800   | 1237960  | 2289021  | 3866833  | 6415482      |
| Short Term Loan                 | 0      | 0       | 0      | 0        | 0       | 0       | 0       | 0        | 0        | 0        | 0        | 0            |
| Interest Expense                | 0      | 1803    | 18926  | 20729    | 57255   | 188574  | 393108  | 729800   | 1237960  | 2289021  | 3866833  | 6415482      |
| Long Term Loan                  | 0      | 1803    | 18926  | 20729    | 57255   | 188574  | 393108  | 729800   | 1237960  | 2289021  | 3866833  | 6415482      |
| Short Term Loan                 | 0      | 0       | 0      | 0        | 0       | 0       | 0       | 0        | 0        | 0        | 0        | 0            |
| Net Cash Flow                   | 0      | -1803   | -20729 | -57255   | -188574 | -393108 | -729800 | -1257960 | -2289021 | -3866833 | -6415482 | -10222180    |

**Table 8 Financial Analysis of CMK Line Improvement Project (Continued)**

|                                 | 2006      | 2007      | 2008      | 2009      | 2010      | 2011       | 2012       | 2013       | 2014       | 2015       | 2016        | 2017        |
|---------------------------------|-----------|-----------|-----------|-----------|-----------|------------|------------|------------|------------|------------|-------------|-------------|
| Option:                         |           |           |           |           |           |            |            |            |            |            |             |             |
| FIRR (%):                       | 0.70      |           |           |           |           |            |            |            |            |            |             |             |
| Construction Cost:              | 1.00      |           |           |           |           |            |            |            |            |            |             |             |
| Fare Revenue:                   | 0.75      |           |           |           |           |            |            |            |            |            |             |             |
| Interest Rate (%):              | 7.60      |           |           |           |           |            |            |            |            |            |             |             |
| Long Term Loan:                 | 55.00     |           |           |           |           |            |            |            |            |            |             |             |
| Short Term Loan:                | 0.00      |           |           |           |           |            |            |            |            |            |             |             |
| Government Subsidy b):          |           |           |           |           |           |            |            |            |            |            |             |             |
| (Million \$)                    |           |           |           |           |           |            |            |            |            |            |             |             |
| <b>Profit and Loss</b>          |           |           |           |           |           |            |            |            |            |            |             |             |
| Operating Revenue               | 125833    | 127822    | 129810    | 131798    | 133786    | 135774     | 137762     | 139751     | 141739     | 143727     | 145715      | 147703      |
| CMK Line Fare Revenue           | 119226    | 111958    | 113709    | 115451    | 117192    | 118934     | 120676     | 122417     | 124159     | 125900     | 127641      | 129382      |
| Other Lines Fare Revenue        | 15607     | 15854     | 16101     | 16347     | 16594     | 16840      | 17087      | 17334      | 17580      | 17827      | 18074       | 18320       |
| Operating Expense               | 98462     | 99806     | 101150    | 102495    | 103839    | 105183     | 106527     | 107871     | 109215     | 110559     | 111903      | 113247      |
| Maintenance & Operation         | 25825     | 27169     | 28513     | 29858     | 31202     | 32546      | 33890      | 35234      | 36578      | 37923      | 39267       | 40611       |
| Depreciation                    | 72637     | 72637     | 72637     | 72637     | 72637     | 72637      | 72637      | 72637      | 72637      | 72637      | 72637       | 72637       |
| Operating Profit                | 27371     | 28015     | 28659     | 29303     | 29947     | 30591      | 31235      | 31879      | 32523      | 33167      | 33811       | 34455       |
| <b>Other Revenue</b>            |           |           |           |           |           |            |            |            |            |            |             |             |
| Government Subsidy a)           | 5731425   | 8946905   | 13930545  | 21654832  | 33625999  | 52170892   | 80910637   | 125354358  | 194241770  | 301225218  | 466840896   | 723545196   |
| Interest Expense                | 5622199   | 8856651   | 13859223  | 21602462  | 33592400  | 52154452   | 80910637   | 125354358  | 194241770  | 301225218  | 466840896   | 723545196   |
| Short Term Loan                 | 109226    | 90274     | 71322     | 52370     | 33598     | 16439      | 0          | 0          | 0          | 0          | 0           | 0           |
| Long Term Loan                  | -5704054  | -8918890  | -13901885 | -21625528 | -33596051 | -52140300  | -80879402  | -125322478 | -194209247 | -301204676 | -466820354  | -723524654  |
| Net Profit                      | -15298864 | -24215733 | -38117638 | -59743167 | -93339218 | -145479518 | -226358920 | -351687398 | -545890645 | -847095321 | -1313915675 | -2037440329 |
| Accumulated Net Profit          |           |           |           |           |           |            |            |            |            |            |             |             |
| <b>Financial Cash Flow</b>      |           |           |           |           |           |            |            |            |            |            |             |             |
| Cash In                         | 100008    | 100652    | 101296    | 101940    | 102584    | 103228     | 103872     | 104516     | 105160     | 105804     | 105804      | 105804      |
| Operating Profit                | 27371     | 28015     | 28659     | 29303     | 29947     | 30591      | 31235      | 31879      | 32523      | 33167      | 33811       | 34455       |
| Other Revenue                   | 72637     | 72637     | 72637     | 72637     | 72637     | 72637      | 72637      | 72637      | 72637      | 72637      | 72637       | 72637       |
| Depreciation                    | 0         | 0         | 0         | 0         | 0         | 0          | 0          | 0          | 0          | 0          | 0           | 0           |
| Cash Out                        | 0         | 0         | 0         | 0         | 0         | 0          | 0          | 0          | 0          | 0          | 0           | 0           |
| Investment                      | 0         | 0         | 0         | 0         | 0         | 0          | 0          | 0          | 0          | 0          | 0           | 0           |
| Residual Value                  | 0         | 0         | 0         | 0         | 0         | 0          | 0          | 0          | 0          | 0          | 0           | 0           |
| Cash Flow                       | 100008    | 100652    | 101296    | 101940    | 102584    | 103228     | 103872     | 104516     | 105160     | 105804     | 105804      | 105804      |
| <b>Financial Program Source</b> |           |           |           |           |           |            |            |            |            |            |             |             |
| Long Term Loan                  | 100008    | 100652    | 101296    | 101940    | 102584    | 103228     | 103872     | 104516     | 105160     | 105804     | 105804      | 105804      |
| Operating Profit                | 27371     | 28015     | 28659     | 29303     | 29947     | 30591      | 31235      | 31879      | 32523      | 33167      | 33811       | 34455       |
| Depreciation                    | 72637     | 72637     | 72637     | 72637     | 72637     | 72637      | 72637      | 72637      | 72637      | 72637      | 72637       | 72637       |
| Other Revenue                   | 0         | 0         | 0         | 0         | 0         | 0          | 0          | 0          | 0          | 0          | 0           | 0           |
| Government Subsidy a)           | 0         | 0         | 0         | 0         | 0         | 0          | 0          | 0          | 0          | 0          | 0           | 0           |
| Government Subsidy b)           | 0         | 0         | 0         | 0         | 0         | 0          | 0          | 0          | 0          | 0          | 0           | 0           |
| <b>Financial Program Use</b>    |           |           |           |           |           |            |            |            |            |            |             |             |
| Investment                      | 16202974  | 25299239  | 39578500  | 61179032  | 94928861  | 147213478  | 228020886  | 353271371  | 547787375  | 848907433  | 1315642525  | 2039081917  |
| Principal Repayment             | 0         | 0         | 0         | 0         | 0         | 0          | 0          | 0          | 0          | 0          | 0           | 0           |
| Long Term Loan                  | 10471549  | 16352334  | 25447955  | 39524200  | 61302863  | 95042586   | 147110249  | 227917014  | 353166855  | 547682215  | 848801629   | 1315536720  |
| Short Term Loan                 | 249369    | 249369    | 249369    | 246997    | 225771    | 216309     | 0          | 0          | 0          | 0          | 0           | 0           |
| Interest Expense                | 10222180  | 16102965  | 25198587  | 39277204  | 61077092  | 94826277   | 147110249  | 227917014  | 353166855  | 547682215  | 848801629   | 1315536720  |
| Long Term Loan                  | 5731425   | 8946905   | 13930545  | 21654832  | 33625999  | 52170892   | 80910637   | 125354358  | 194241770  | 301225218  | 466840896   | 723545196   |
| Short Term Loan                 | 109226    | 90274     | 71322     | 52370     | 33598     | 16439      | 0          | 0          | 0          | 0          | 0           | 0           |
| Interest Expense                | 5622199   | 8856651   | 13859223  | 21602462  | 33592400  | 52154452   | 80910637   | 125354358  | 194241770  | 301225218  | 466840896   | 723545196   |
| Net Cash Flow                   | -16102965 | -25198587 | -39277204 | -61077092 | -94826277 | -147110249 | -227917014 | -353166855 | -547682215 | -848801629 | -1315536720 | -2038976112 |



**Table 9 Initial Investment Cost (Without : Economic)**

|                       | (Million ZI) |         |         |           |           |
|-----------------------|--------------|---------|---------|-----------|-----------|
| Investment / Year     | 1994         | 1995    | 1996    | 1997      | Total     |
| Track and structure   | 0            | 268,900 | 241,700 | 238,600   | 749,200   |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 268,900 | 241,700 | 238,600   | 749,200   |
| OH equipment          | 0            | 0       | 0       | 0         | 0         |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 0       | 0       | 0         | 0         |
| Substation            | 0            | 0       | 0       | 0         | 0         |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 0       | 0       | 0         | 0         |
| Signalling            | 0            | 6,722   | 10,083  | 16,806    | 33,611    |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 6,722   | 10,083  | 16,806    | 33,611    |
| Telecommunication     | 0            | 16,311  | 24,467  | 40,778    | 82,556    |
| Foreign Portion       | 0            | 6,851   | 10,276  | 17,127    | 34,254    |
| Domestic Portion      | 0            | 9,460   | 14,191  | 23,651    | 47,302    |
| Maintenance equipment | 0            | 0       | 0       | 0         | 0         |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 0       | 0       | 0         | 0         |
| Electric Loco.        | 0            | 0       | 0       | 134,400   | 134,400   |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 0       | 0       | 134,400   | 134,400   |
| Passenger car         | 0            | 0       | 0       | 950,400   | 950,400   |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 0       | 0       | 95,044    | 950,044   |
| Subtotal              | 0            | 291,933 | 276,250 | 1,380,984 | 1,949,167 |
| Foreign Portion       | 0            | 6,851   | 10,276  | 17,127    | 34,254    |
| Domestic Portion      | 0            | 285,082 | 265,974 | 1,363,857 | 1,914,913 |
| Engineering Fee       | 43,218       | 14,597  | 13,813  | 14,809    | 86,437    |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 43,218       | 14,597  | 13,813  | 14,809    | 86,437    |
| Contingency           | 4,322        | 30,653  | 29,006  | 139,579   | 0         |
| Foreign Portion       | 0            | 685     | 1,028   | 1,713     | 203,560   |
| Domestic Portion      | 4,322        | 29,968  | 27,979  | 137,867   | 3,425     |
| Total                 | 47,540       | 337,183 | 319,069 | 1,535,373 | 2,239,164 |
| Foreign Portion       | 0            | 7,536   | 11,304  | 18,839    | 37,679    |
| Domestic Portion      | 47,540       | 329,647 | 307,765 | 1,516,533 | 2,201,485 |

**Table 10 Initial Investment Cost (Option 1 : Economic)**

| Investment / Year     | (Million ZI) |         |         |           |           |
|-----------------------|--------------|---------|---------|-----------|-----------|
|                       | 1994         | 1995    | 1996    | 1997      | Total     |
| Track and structure   | 0            | 273,900 | 252,500 | 300,700   | 827,100   |
| Foreign Portion       | 0            | 0       | 4,040   | 24,056    | 28,096    |
| Domestic Portion      | 0            | 273,900 | 248,460 | 276,644   | 799,004   |
| OH equipment          | 0            | 0       | 0       | 0         | 0         |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 0       | 0       | 0         | 0         |
| Substation            | 0            | 0       | 0       | 0         | 0         |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 0       | 0       | 0         | 0         |
| Signalling            | 0            | 7,902   | 11,853  | 19,756    | 39,511    |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 7,902   | 11,853  | 19,756    | 39,511    |
| Telecommunication     | 0            | 16,311  | 24,467  | 40,778    | 81,556    |
| Foreign Portion       | 0            | 6,851   | 10,276  | 17,127    | 34,254    |
| Domestic Portion      | 0            | 9,460   | 14,191  | 23,651    | 47,302    |
| Maintenance equipment | 0            | 0       | 0       | 0         | 0         |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 0       | 0       | 0         | 0         |
| Electric Loco.        | 0            | 0       | 0       | 106,400   | 106,400   |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 0       | 0       | 106,400   | 106,400   |
| Passenger car         | 0            | 0       | 0       | 668,800   | 668,800   |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 0       | 0       | 668,800   | 668,800   |
| Subtotal              | 0            | 298,113 | 288,820 | 1,136,434 | 1,723,367 |
| Foreign Portion       | 0            | 6,851   | 14,316  | 41,183    | 62,350    |
| Domestic Portion      | 0            | 291,262 | 274,504 | 1,095,251 | 1,661,017 |
| Engineering Fee       | 47,408       | 14,905  | 14,441  | 18,062    | 94,816    |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 47,408       | 14,905  | 14,441  | 18,062    | 94,816    |
| Contingency           | 4,741        | 31,302  | 30,326  | 115,450   | 181,818   |
| Foreign Portion       | 0            | 685     | 1,432   | 4,118     | 6,235     |
| Domestic Portion      | 4,705        | 30,617  | 28,894  | 111,332   | 175,584   |
| Total                 | 52,149       | 344,320 | 333,587 | 1,269,946 | 2,000,001 |
| Foreign Portion       | 0            | 7,536   | 15,748  | 45,301    | 68,584    |
| Domestic Portion      | 52,149       | 336,784 | 317,839 | 1,224,645 | 1,931,417 |

**Table 11 Initial Investment Cost (Option 2 : Economic)**

|                       | (Million ZI) |         |         |           |           |
|-----------------------|--------------|---------|---------|-----------|-----------|
| Investment / Year     | 1994         | 1995    | 1996    | 1997      | Total     |
| Track and structure   | 0            | 253,900 | 299,500 | 537,700   | 1,091,100 |
| Foreign Portion       | 0            | 0       | 40,133  | 284,981   | 325,114   |
| Domestic Portion      | 0            | 253,900 | 259,367 | 252,719   | 765,986   |
| OH equipment          | 0            | 0       | 0       | 0         | 0         |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 0       | 0       | 0         | 0         |
| Substation            | 0            | 4,000   | 6,000   | 10,000    | 20,000    |
| Foreign Portion       | 0            | 2,000   | 3,000   | 5,000     | 10,000    |
| Domestic Portion      | 0            | 2,000   | 3,000   | 5,000     | 10,000    |
| Signalling            | 0            | 18,804  | 28,205  | 47,009    | 94,018    |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 18,804  | 28,205  | 47,009    | 94,018    |
| Telecommunication     | 0            | 16,311  | 24,467  | 40,778    | 81,556    |
| Foreign Portion       | 0            | 6,851   | 10,276  | 17,127    | 34,254    |
| Domestic Portion      | 0            | 9,460   | 14,191  | 23,651    | 47,302    |
| Maintenance equipment | 0            | 0       | 0       | 8,000     | 8,000     |
| Foreign Portion       | 0            | 0       | 0       | 6,400     | 6,400     |
| Domestic Portion      | 0            | 0       | 0       | 1,600     | 1,600     |
| Electric Loco.        | 0            | 37,490  | 0       | 524,860   | 562,350   |
| Foreign Portion       | 0            | 18,745  | 0       | 262,430   | 281,175   |
| Domestic Portion      | 0            | 18,745  | 0       | 262,430   | 281,175   |
| Passenger car         | 0            | 74,000  | 0       | 1,036,000 | 1,110,000 |
| Foreign Portion       | 0            | 14,800  | 0       | 207,200   | 222,000   |
| Domestic Portion      | 0            | 59,200  | 0       | 828,800   | 888,000   |
| Subtotal              | 0            | 404,505 | 358,172 | 2,204,347 | 2,967,024 |
| Foreign Portion       | 0            | 42,396  | 53,409  | 783,138   | 878,943   |
| Domestic Portion      | 0            | 362,109 | 304,763 | 1,421,209 | 2,088,081 |
| Engineering Fee       | 64,734       | 14,651  | 17,909  | 32,174    | 129,467   |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 64,734       | 14,651  | 17,909  | 32,174    | 129,467   |
| Contingency           | 6,473        | 41,916  | 37,608  | 223,652   | 309,649   |
| Foreign Portion       | 0            | 4,240   | 5,341   | 89,314    | 87,894    |
| Domestic Portion      | 6,473        | 37,676  | 32,267  | 145,338   | 221,755   |
| Total                 | 71,207       | 461,071 | 413,689 | 2,460,173 | 3,406,141 |
| Foreign Portion       | 0            | 46,635  | 58,750  | 861,452   | 966,837   |
| Domestic Portion      | 71,207       | 414,436 | 354,939 | 1,598,722 | 2,439,304 |

**Table 12 Initial Investment Cost (Option 3 : Economic)**

|                       | (Million ZI) |         |         |           |           |
|-----------------------|--------------|---------|---------|-----------|-----------|
| Investment / Year     | 1994         | 1995    | 1996    | 1997      | Total     |
| Track and structure   | 0            | 253,900 | 310,500 | 474,700   | 1,039,100 |
| Foreign Portion       | 0            | 0       | 40,055  | 212,191   | 252,245   |
| Domestic Portion      | 0            | 253,900 | 270,446 | 262,509   | 786,855   |
| OH equipment          | 0            | 66,528  | 99,792  | 166,320   | 332,640   |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 66,528  | 99,792  | 166,320   | 332,640   |
| Substation            | 0            | 10,600  | 15,900  | 26,500    | 53,000    |
| Foreign Portion       | 0            | 2,014   | 3,021   | 5,035     | 10,070    |
| Domestic Portion      | 0            | 8,586   | 12,879  | 21,465    | 42,930    |
| Signalling            | 0            | 102,238 | 153,357 | 255,595   | 511,190   |
| Foreign Portion       | 0            | 60,320  | 90,481  | 150,801   | 301,602   |
| Domestic Portion      | 0            | 41,918  | 62,876  | 104,794   | 209,588   |
| Telecommunication     | 0            | 16,311  | 24,467  | 40,778    | 81,556    |
| Foreign Portion       | 0            | 6,851   | 10,276  | 17,127    | 34,254    |
| Domestic Portion      | 0            | 9,460   | 14,191  | 23,651    | 47,302    |
| Maintenance equipment | 0            | 0       | 0       | 12,000    | 12,000    |
| Foreign Portion       | 0            | 0       | 0       | 9,600     | 9,600     |
| Domestic Portion      | 0            | 0       | 0       | 2,400     | 2,400     |
| Electric Loco.        | 0            | 0       | 0       | 0         | 0         |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 0       | 0       | 0         | 0         |
| Passenger car         | 0            | 235,000 | 0       | 3,290,000 | 3,525,000 |
| Foreign Portion       | 0            | 211,500 | 0       | 2,961,000 | 3,172,500 |
| Domestic Portion      | 0            | 23,500  | 0       | 329,000   | 352,500   |
| Subtotal              | 0            | 684,577 | 604,016 | 4,265,893 | 5,554,486 |
| Foreign Portion       | 0            | 280,685 | 143,832 | 3,355,754 | 3,780,271 |
| Domestic Portion      | 0            | 403,892 | 460,184 | 910,139   | 1,774,215 |
| Engineering Fee       | 101,474      | 22,479  | 30,201  | 48,795    | 202,949   |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 101,474      | 22,479  | 30,201  | 48,795    | 202,949   |
| Contingency           | 10,147       | 70,706  | 63,422  | 431,469   | 575,743   |
| Foreign Portion       | 0            | 28,069  | 14,383  | 335,575   | 378,027   |
| Domestic Portion      | 10,147       | 42,637  | 49,038  | 95,893    | 197,716   |
| Total                 | 111,622      | 777,761 | 697,638 | 4,746,156 | 6,333,178 |
| Foreign Portion       | 0            | 308,754 | 158,215 | 3,691,239 | 4,158,298 |
| Domestic Portion      | 11,622       | 469,008 | 539,423 | 1,054,827 | 2,174,880 |

Table 13 Initial Investment Cost (Option 4 : Economic)

|                       | (Million ZI) |         |         |           |           |
|-----------------------|--------------|---------|---------|-----------|-----------|
| Investment / Year     | 1994         | 1995    | 1996    | 1997      | Total     |
| Track and structure   | 0            | 253,900 | 299,500 | 537,700   | 1,091,100 |
| Foreign Portion       | 0            | 0       | 40,133  | 284,981   | 325,114   |
| Domestic Portion      | 0            | 253,900 | 259,367 | 252,719   | 765,986   |
| OH equipment          | 0            | 0       | 0       | 0         | 0         |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 0       | 0       | 0         | 0         |
| Substation            | 0            | 4,000   | 6,000   | 10,000    | 20,000    |
| Foreign Portion       | 0            | 2,000   | 3,000   | 5,000     | 10,000    |
| Domestic Portion      | 0            | 2,000   | 3,000   | 5,000     | 10,000    |
| Signalling            | 0            | 18,804  | 29,205  | 47,009    | 94,018    |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 0            | 18,804  | 28,205  | 47,009    | 94,018    |
| Telecommunication     | 0            | 16,311  | 24,467  | 40,778    | 81,556    |
| Foreign Portion       | 0            | 6,851   | 10,276  | 17,127    | 34,254    |
| Domestic Portion      | 0            | 9,460   | 14,191  | 23,651    | 47,302    |
| Maintenance equipment | 0            | 0       | 0       | 8,000     | 8,000     |
| Foreign Portion       | 0            | 0       | 0       | 6,400     | 6,400     |
| Domestic Portion      | 0            | 0       | 0       | 1,600     | 1,600     |
| Electric Loco.        | 0            | 49,010  | 0       | 686,140   | 735,150   |
| Foreign Portion       | 0            | 44,109  | 0       | 617,526   | 661,635   |
| Domestic Portion      | 0            | 4,901   | 0       | 68,614    | 73,515    |
| Passenger car         | 0            | 120,000 | 0       | 1,680,000 | 1,800,000 |
| Foreign Portion       | 0            | 108,000 | 0       | 1,512,000 | 1,620,000 |
| Domestic Portion      | 0            | 12,000  | 0       | 168,000   | 180,000   |
| Subtotal              | 0            | 462,025 | 358,172 | 3,009,627 | 3,829,824 |
| Foreign Portion       | 0            | 160,960 | 53,409  | 2,443,034 | 2,657,403 |
| Domestic Portion      | 0            | 301,065 | 304,763 | 566,593   | 1,172,421 |
| Engineering Fee       | 64,734       | 14,651  | 17,909  | 32,174    | 129,467   |
| Foreign Portion       | 0            | 0       | 0       | 0         | 0         |
| Domestic Portion      | 64,734       | 14,651  | 17,909  | 32,174    | 129,467   |
| Contingency           | 6,473        | 47,668  | 37,608  | 304,180   | 395,929   |
| Foreign Portion       | 0            | 16,096  | 5,341   | 244,303   | 265,740   |
| Domestic Portion      | 6,473        | 31,572  | 32,267  | 59,877    | 130,189   |
| Total                 | 71,207       | 524,343 | 413,689 | 3,345,981 | 4,355,221 |
| Foreign Portion       | 0            | 177,056 | 58,750  | 2,687,337 | 2,923,143 |
| Domestic Portion      | 71,207       | 347,288 | 354,939 | 658,644   | 1,432,078 |

**Table 14 Economic Analysis of CMK Line Improvement Project (Option 2)**

|                       | 1994         | 1995    | 1996   | 1997    | 1998   | 1999   | 2000   | 2001   | 2002   | 2003   | 2004   | 2005   |
|-----------------------|--------------|---------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|
| Option:               | 2            |         |        |         |        |        |        |        |        |        |        |        |
| EIRR (%):             | 18.8         |         |        |         |        |        |        |        |        |        |        |        |
| Cost:                 | 1.00         |         |        |         |        |        |        |        |        |        |        |        |
| Benefit:              | 1.00         |         |        |         |        |        |        |        |        |        |        |        |
| NPV:                  | 469846       |         |        |         |        |        |        |        |        |        |        |        |
| B/C:                  | 1.63         |         |        |         |        |        |        |        |        |        |        |        |
|                       | (Million Zl) |         |        |         |        |        |        |        |        |        |        |        |
| Cost                  | 23667        | 123888  | 94620  | 924800  | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| Initial Investment    | 23667        | 123888  | 94620  | 924800  | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| Additional Investment | 0            | 0       | 0      | 0       | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| Residual Value        | 0            | 0       | 0      | 0       | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| Benefit               | 0            | 0       | 0      | 0       | 187728 | 199308 | 210887 | 222467 | 234047 | 245627 | 257206 | 268786 |
| Time Saving           | 0            | 0       | 0      | 0       | 118727 | 126244 | 133761 | 141278 | 148794 | 156311 | 163828 | 171345 |
| Railway Passenger     |              |         |        |         | -7631  | -8070  | -8509  | -8948  | -9386  | -9825  | -10264 | -10703 |
| Bus Passenger         |              |         |        |         | 97288  | 101592 | 105897 | 110201 | 114506 | 118810 | 123115 | 127419 |
| Sedan User            |              |         |        |         | 29070  | 32721  | 36373  | 40024  | 43675  | 47326  | 50978  | 54629  |
| Generated Passenger   |              |         |        |         | 1422   | 1505   | 1588   | 1671   | 1754   | 1837   | 1920   | 2003   |
| Cost Saving           | 0            | 0       | 0      | 0       | 69001  | 73064  | 77127  | 81190  | 85252  | 89315  | 93378  | 97441  |
| Railway               |              |         |        |         | -26358 | -26792 | -27227 | -27661 | -28095 | -28529 | -28964 | -29398 |
| Bus                   |              |         |        |         | 33974  | 34156  | 34338  | 34520  | 34703  | 34885  | 35067  | 35249  |
| Sedan                 |              |         |        |         | 61385  | 65700  | 70015  | 74330  | 78645  | 82960  | 87275  | 91590  |
| Net Benefit           | -23667       | -123888 | -94620 | -924800 | 187728 | 199308 | 210887 | 222467 | 234047 | 245627 | 250456 | 268786 |

  

|                       | 2006   | 2007   | 2008   | 2009   | 2010   | 2011   | 2012   | 2013   | 2014   | 2015   | 2016   | 2017    |
|-----------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|
| Cost                  | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 145500 | 0      | 0      | -586472 |
| Initial Investment    | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0       |
| Additional Investment | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 145500 | 0      | 0      | 0       |
| Residual Value        | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | -586472 |
| Benefit               | 280603 | 292419 | 304236 | 316052 | 327869 | 339686 | 351502 | 363319 | 375135 | 386952 | 386952 | 386952  |
| Time Saving           | 181416 | 191487 | 201558 | 211629 | 221700 | 231770 | 241841 | 251912 | 261983 | 272054 | 272054 | 272054  |
| Railway Passenger     | -11410 | -12118 | -12825 | -13533 | -14240 | -14947 | -15655 | -16362 | -17070 | -17777 | -17777 | -17777  |
| Bus Passenger         | 133362 | 139304 | 145247 | 151190 | 157133 | 163075 | 169018 | 174961 | 180903 | 186846 | 186846 | 186846  |
| Sedan User            | 59465  | 64300  | 69136  | 73971  | 78807  | 83643  | 88478  | 93314  | 98149  | 102985 | 102985 | 102985  |
| Generated Passenger   | 2134   | 2265   | 2396   | 2527   | 2658   | 2789   | 2920   | 3051   | 3182   | 3313   | 3313   | 3313    |
| Cost Saving           | 99187  | 100932 | 102678 | 104424 | 106170 | 107915 | 109661 | 111407 | 113152 | 114898 | 114898 | 114898  |
| Railway               | -30742 | -32086 | -33431 | -34775 | -36119 | -37463 | -38807 | -40152 | -41496 | -42840 | -42840 | -42840  |
| Bus                   | 35363  | 35478  | 35592  | 35707  | 35821  | 35935  | 36050  | 36164  | 36279  | 36393  | 36393  | 36393   |
| Sedan                 | 94566  | 97541  | 100517 | 103492 | 106468 | 109443 | 112419 | 115394 | 118370 | 121345 | 121345 | 121345  |
| Net Benefit           | 280603 | 292419 | 304236 | 316052 | 327869 | 339686 | 351502 | 363319 | 375135 | 386952 | 386952 | 386952  |

**Table 15 Economic Analysis of CMK Line Improvement Project (Option 3)**

|                       | 1994         | 1995    | 1996    | 1997     | 1998   | 1999   | 2000   | 2001   | 2002   | 2003   | 2004   | 2005   |
|-----------------------|--------------|---------|---------|----------|--------|--------|--------|--------|--------|--------|--------|--------|
| Option:               | 3            |         |         |          |        |        |        |        |        |        |        |        |
| EIRR (%):             | 5.8          |         |         |          |        |        |        |        |        |        |        |        |
| Cost:                 | 1.00         |         |         |          |        |        |        |        |        |        |        |        |
| Benefit:              | 1.00         |         |         |          |        |        |        |        |        |        |        |        |
| NPV:                  | -1206607     |         |         |          |        |        |        |        |        |        |        |        |
| B/C:                  | 0.54         |         |         |          |        |        |        |        |        |        |        |        |
|                       | (Million ZL) |         |         |          |        |        |        |        |        |        |        |        |
| Cost                  | 64082        | 440578  | 378569  | 3210783  | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| Initial Investment    | 64082        | 440578  | 378569  | 3210783  | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| Additional Investment | 0            | 0       | 0       | 0        | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| Residual Value        | 0            | 0       | 0       | 0        | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| Benefit               | 0            | 0       | 0       | 0        | 202676 | 219128 | 235581 | 252033 | 268486 | 284938 | 301390 | 317843 |
| Time Saving           | 0            | 0       | 0       | 0        | 154576 | 164334 | 174092 | 183850 | 193608 | 203366 | 213124 | 222882 |
| Railway Passenger     | 0            | 0       | 0       | 0        | -9558  | -10108 | -10658 | -11208 | -11757 | -12307 | -12857 | -13407 |
| Bus Passenger         | 0            | 0       | 0       | 0        | 126383 | 131954 | 137524 | 143095 | 148666 | 154237 | 159807 | 165378 |
| Sedan User            | 0            | 0       | 0       | 0        | 37751  | 42488  | 47225  | 51962  | 56700  | 61437  | 66174  | 70911  |
| Generated Passenger   | 0            | 0       | 0       | 0        | 2319   | 2454   | 2589   | 2724   | 2859   | 2994   | 3129   | 3264   |
| Cost Saving           | 0            | 0       | 0       | 0        | 48100  | 54794  | 61489  | 68183  | 74878  | 81572  | 88266  | 94961  |
| Railway               | 0            | 0       | 0       | 0        | -75775 | -74906 | -74036 | -73167 | -72297 | -71428 | -70559 | -69689 |
| Bus                   | 0            | 0       | 0       | 0        | 44137  | 44368  | 44599  | 44830  | 45062  | 45293  | 45524  | 45755  |
| Sedan                 | 0            | 0       | 0       | 0        | 79738  | 85332  | 90926  | 96520  | 102113 | 107707 | 113301 | 118895 |
| Net Benefit           | -64082       | -440578 | -378569 | -3210783 | 202676 | 219128 | 235581 | 252033 | 268486 | 284938 | 301390 | 317843 |

  

|                       | 2006   | 2007   | 2008   | 2009   | 2010   | 2011   | 2012   | 2013   | 2014   | 2015   | 2016   | 2017   |
|-----------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Cost                  | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 573000 | 0      | 0      | 0      |
| Initial Investment    | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| Additional Investment | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 573000 | 0      | 0      | 0      |
| Residual Value        | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| Benefit               | 332593 | 347343 | 362092 | 376842 | 391592 | 406342 | 421092 | 435842 | 450592 | 465342 | 480092 | 494842 |
| Time Saving           | 235965 | 249048 | 262132 | 275215 | 288298 | 301381 | 314464 | 327548 | 340631 | 353714 | 366797 | 380000 |
| Railway Passenger     | -14302 | -15196 | -16091 | -16985 | -17880 | -18775 | -19669 | -20564 | -21458 | -22353 | -23247 | -24142 |
| Bus Passenger         | 173089 | 180801 | 188512 | 196223 | 203935 | 211646 | 219357 | 227068 | 234780 | 242491 | 250202 | 257913 |
| Sedan User            | 77178  | 83444  | 89711  | 95977  | 102244 | 108510 | 114777 | 121043 | 127310 | 133576 | 139842 | 146108 |
| Generated Passenger   | 3477   | 3689   | 3902   | 4114   | 4327   | 4540   | 4752   | 4965   | 5177   | 5390   | 5602   | 5815   |
| Cost Saving           | 96628  | 98294  | 99961  | 101628 | 103294 | 104961 | 106628 | 108294 | 109961 | 111628 | 113294 | 114961 |
| Railway               | -72018 | -74347 | -76677 | -79006 | -81335 | -83664 | -85993 | -88322 | -90651 | -92981 | -95310 | -97639 |
| Bus                   | 45903  | 46050  | 46198  | 46346  | 46494  | 46642  | 46790  | 46938  | 47086  | 47234  | 47382  | 47530  |
| Sedan                 | 122743 | 126591 | 130439 | 134287 | 138136 | 141984 | 145832 | 149680 | 153528 | 157376 | 161224 | 165072 |
| Net Benefit           | 332593 | 347343 | 362092 | 376842 | 391592 | 406342 | 421092 | 435842 | 450592 | 465342 | 480092 | 494842 |

**Table 16 Economic Analysis of CMK Line Improvement Project (Option 4)**

|                       | 1994         | 1995    | 1996   | 1997     | 1998   | 1999   | 2000   | 2001   | 2002   | 2003   | 2004   | 2005   |
|-----------------------|--------------|---------|--------|----------|--------|--------|--------|--------|--------|--------|--------|--------|
| Option:               | 4            |         |        |          |        |        |        |        |        |        |        |        |
| EIRR (%):             | 10.6         |         |        |          |        |        |        |        |        |        |        |        |
| NPV:                  | -151906      |         |        |          |        |        |        |        |        |        |        |        |
| a/c:                  | 0.89         |         |        |          |        |        |        |        |        |        |        |        |
| Cost:                 | 1.00         |         |        |          |        |        |        |        |        |        |        |        |
| Benefit:              | 1.00         |         |        |          |        |        |        |        |        |        |        |        |
|                       | (Million ZL) |         |        |          |        |        |        |        |        |        |        |        |
| Cost                  | 23667        | 187160  | 94620  | 1810608  | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| Initial Investment    | 23667        | 187160  | 94620  | 1810608  | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| Additional Investment | 0            | 0       | 0      | 0        | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| Residual Value        | 0            | 0       | 0      | 0        | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| Benefit               | 0            | 0       | 0      | 0        | 187728 | 199308 | 210887 | 222467 | 234047 | 245627 | 257206 | 268786 |
| Time Saving           | 0            | 0       | 0      | 0        | 118727 | 126244 | 133761 | 141278 | 148794 | 156311 | 163828 | 171345 |
| Railway Passenger     | 0            | 0       | 0      | 0        | -7631  | -8070  | -8509  | -8948  | -9386  | -9825  | -10264 | -10703 |
| Bus Passenger         | 0            | 0       | 0      | 0        | 97288  | 101592 | 105897 | 110201 | 114506 | 118810 | 123115 | 127419 |
| Sedan User            | 0            | 0       | 0      | 0        | 29070  | 32721  | 36373  | 40024  | 43675  | 47326  | 50978  | 54629  |
| Generated Passenger   | 0            | 0       | 0      | 0        | 1422   | 1505   | 1588   | 1671   | 1754   | 1837   | 1920   | 2003   |
| Cost Saving           | 0            | 0       | 0      | 0        | 69001  | 73064  | 77127  | 81190  | 85252  | 89315  | 93378  | 97441  |
| Railway               | 0            | 0       | 0      | 0        | -26358 | -26792 | -27227 | -27661 | -28095 | -28529 | -28964 | -29398 |
| Bus                   | 0            | 0       | 0      | 0        | 33974  | 34156  | 34338  | 34520  | 34703  | 34885  | 35067  | 35249  |
| Sedan                 | 0            | 0       | 0      | 0        | 61385  | 65700  | 70015  | 74330  | 78645  | 82960  | 87275  | 91590  |
| Net Benefit           | -23667       | -187160 | -94620 | -1810608 | 187728 | 199308 | 210887 | 222467 | 234047 | 245627 | 257206 | 268786 |
|                       | 280603       | 292419  | 304236 | 316052   | 327869 | 339686 | 351502 | 363319 | 375135 | 386952 | 398769 | 410586 |
| Cost                  | 0            | 0       | 0      | 0        | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| Initial Investment    | 0            | 0       | 0      | 0        | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| Additional Investment | 0            | 0       | 0      | 0        | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| Residual Value        | 0            | 0       | 0      | 0        | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| Benefit               | 280603       | 292419  | 304236 | 316052   | 327869 | 339686 | 351502 | 363319 | 375135 | 386952 | 398769 | 410586 |
| Time Saving           | 181416       | 191487  | 201558 | 211629   | 221700 | 231770 | 241841 | 251912 | 261983 | 272054 | 282125 | 292196 |
| Railway Passenger     | -11410       | -12118  | -12825 | -13533   | -14240 | -14947 | -15655 | -16362 | -17070 | -17777 | -18484 | -19191 |
| Bus Passenger         | 133362       | 139304  | 145247 | 151190   | 157133 | 163075 | 169018 | 174961 | 180903 | 186846 | 192789 | 198732 |
| Sedan User            | 59465        | 64300   | 69136  | 73971    | 78807  | 83643  | 88478  | 93314  | 98149  | 102985 | 107821 | 112657 |
| Generated Passenger   | 2134         | 2265    | 2396   | 2527     | 2658   | 2789   | 2920   | 3051   | 3182   | 3313   | 3444   | 3575   |
| Cost Saving           | 99187        | 100932  | 102678 | 104424   | 106170 | 107915 | 109661 | 111407 | 113152 | 114898 | 116644 | 118389 |
| Railway               | -30742       | -32086  | -33431 | -34775   | -36119 | -37463 | -38807 | -40152 | -41496 | -42840 | -44184 | -45528 |
| Bus                   | 35363        | 35478   | 35592  | 35707    | 35821  | 35935  | 36050  | 36164  | 36279  | 36393  | 36507  | 36621  |
| Sedan                 | 94566        | 97541   | 100517 | 103492   | 106468 | 109443 | 112419 | 115394 | 118370 | 121345 | 124321 | 127296 |
| Net Benefit           | 280603       | 292419  | 304236 | 316052   | 327869 | 339686 | 351502 | 363319 | 375135 | 386952 | 398769 | 410586 |





**CHAPTER 4   PKP MANAGEMENT TRAINING  
PROGRAM**



## CHAPTER 4 PKP MANAGEMENT TRAINING PROGRAM

### Summary

PKP is in an urgent necessity of restructuring its systems established in the centrally planned system toward those adaptable in a market economy. Human resources are the most important factor for the successful restructuring of PKP. However, since the introduction of the Economic Transformation Program in January 1990, almost no action has been initiated in this regard. Quick and steady action should be inaugurated to reform the human resource development systems.

First, the existing human resource department needs to be reformed in concert with the total PKP restructuring program toward a market economy where productivity improvement is a crucial key for future prosperity of PKP. The department should be reorganized with a view to making significant contributions to human resource development. In this regard, special importance needs to be placed on the new systems to create a built-in mechanism to stimulate self-development effort of employees. This includes a close link of:

- (a) career development;
- (b) education and training;
- (c) efficiency rating; and
- (d) wages and incentive systems.

Equal remuneration irrespective of the contribution to the organization needs to be abandoned.

Second, the existing training system needs to be reviewed and revised in the light of the management policy and strategies of PKP as well as in connection with the human resource development scheme. A focal objective of the training in a short term perspective is to train chief executive officers who should be capable of making proper policy decisions based on the comprehensive understanding of market demand, competitors and resources available. A series of training programs need to be developed to this end. An emphasis should be placed on the management training in terms of:

- (a) orientation to the principles of a market economy;
- (b) acquaintance with management tools and know-how in the market economy;  
and
- (c) preparation for internationalization of PKP operations.

Third, a close cooperation with other organizations is needed to effectively develop the management training program including MTME, Productivity Movement in Poland, Polish UN Experts (OPUNE), and European Federation of Productivity Councils.

### 4.1 Present Situation of Human Resource Management of PKP

#### 4.1.1 Quality of PKP Human Resources

"Centrally planned economy" was introduced into Poland at the end of 1940s. The distinctive feature of this type of economic system has been the ownership of the material means of production by the state. These include land, all natural resources, all medium and large scale enterprises and farms, and their production assets.

The need to control the collective, state owned production units naturally led to an enlarged, prolific and fragmented government structure. Under this highly centralized, authoritative, and hierarchical regime, each office or firm and each level of management within the vertically organized structures protected their own interests at the expense of others. Information feedback from the production sites to the central planning unit of the government was extremely limited, and this naturally affected the efficiency of overall economic activities. It resulted in a chronic shortage of available information on which to base decision making and detailed planning.

Goods and services were produced based on the programmed supply of input at a given degree of technological standards. Their prices were predetermined by the government, functioning just as a means for settling transactions without any particular contribution to desirable allocation of resources which is an important function of prices in a market economy. There was almost no built-in stabilizer to adjust possible discrepancies between production and consumption. Facilities, machines and labor necessary for incremental production were supplied by the government just in accordance with the program which was not flexible in adjustment.

PKP, as an important component of the national economic system, was centrally controlled by the government as well. Due to the economic system as outlined in the above, the utmost interest of PKP was to achieve the yearly transport quotas instructed by the government. Fares and tariffs were decided by the government irrespective of the costs incurred by the services. Consequently, it was a matter of course that the government subsidize the shortage of income. Investment budget was allocated by the government to PKP through the negotiations between both parties based on the proposals prepared by the expansion-oriented approach of PKP.

It is assumed that the average level of education of PKP employees was considerably high. However, under the centrally planned system, management staff of PKP had indulged themselves in writing reports, drafting rules, and repeating discussions and negotiations with the government without almost no autonomy to make decisions by themselves. Due to the warranted subsidies from the government, PKP had no need to pay attention to productivity improvement. In general, they did not pay any attention to the transport market as well because PKP was duly positioned by the government in a mainstream of delivery chain from production to consumption sites.

In the centrally planned system, on the other hand, it was an important government responsibility to secure job opportunities for every citizen. PKP, as a state owned enterprise with a large number of employment, was required to follow the national employment policy. In consequence, PKP kept a large number of employment irrespective of their productivity. It is generally said that the number of management staff in the Central and East Europe was as large as twice that of the Western countries. The situation would have been exacerbated in the level of laborers. According to some statistics ("Organization Review" June 1992), a percentage share of employees directly involved in production was as low as 34% while 21% was office workers and the remaining 45% was those engaged in related activities including maintenance, warehousing, transport and research.

In addition to the above characteristics, the closed system of the CMEA had segregated a large number of Polish people from the western world. Because of this, around 90% of management staff reportedly do not understand English which is the essential language to access the latest technologies and management methodologies in the world. Thus, most of the PKP management has been segregated from these technologies and methodologies.

In summary, general characteristics of PKP human resources fostered in the centrally planned system can be enumerated as follows: