COMPARATIVE COAL TRANSPORTATION COSTS: AN ECONOMIC AND ENGINEERING ANALYSIS OF TRUCK, BELT, RAIL, BARGE AND COAL SLURRY AND PNEUMATIC PIPELINES

VOLUME 6

TRUCK HAULAGE

Prepared for

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF MINES
and the
FEDERAL ENERGY ADMINISTRATION

by

Center for Advanced Computation
University of Illinois
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Urbana, Illinois 61801

FINAL REPORT

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FOREWARD

This report was prepared by the Center for Advanced Computation of the University of Illinois at Urbana-Champaign under USBM Contract No. J0166163. The contract was initiated under the Office of University Relations. It was administered under the technical direction of the Division of Interindustry Analysis with Mr. Ronald Balazik acting as the Technical Project Officer. Mr. Robert Carpenter was the contract specialist for the Bureau of Mines.

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Subject Inventions

This is to certify that, to the best of my knowledge and belief, there were no Subject Inventions made or have resulted from the performance of this contract.

August 1977

Michael Rieber
Principal Investigator

CAC Document No. 223

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6. TRUCK HAULAGE

6.1 INTRODUCTION

Among the principal gathering/distribution systems for coal is over-the-road trucking. Where alternative trunk line modes such as barge or rail links are weak or nonexistent, trucks may, particularly for relatively short line hauls, act as substitutes. Their major application, however, appears to be in connection with smaller mines or coal users particularly where terrain problems are significant.

Truck use has increased as rail lines have been abandoned or suffered neglect. For example, in 1956 about 38 percent of the coal transported in eastern Kentucky and about 8 percent of the coal moved in western Kentucky went by truck. By 1975, the percentages were almost 77 percent and 28 percent, respectively [4,U-11]. While rail route limitations and deterioration played a part in the change, increased emphasis on road building, particularly during the 1950's and 1960's, and improved truck load capacity and efficiency were also important.

Coal haulage costs by truck are relatively high. Other things being equal, variations in these costs are largely a function of road conditions, terrain and weather. In this study estimates are made of capital and operating costs of truck haulage. These include a separable estimate of road use costs. Rather than attempt to determine road deterioration due to coal movements which, at best, would be highly dependent on region, weather, original road type, other users, and maintenance conditions, an alternative was chosen. This involved an estimation of the cost of building and maintaining a road capable of sustaining the traffic, annualizing the costs, and allocating a portion to the coal traffic. The procedure is presented in Section 6.4. A computer model is presented which will enable users to generate their own cost data tailored to their specific needs.

A word of caution is in order. Hard data were found to be sketchy. However, there have been no significant technological advances in recent years. In many cases a simple updating of older material appeared to be adequate.

The data problem arises because most large coal trucking operations appear to be exempt from ICC regulation and rate making. Therefore, cost data presented in support of administered rates are lacking. The exemptions arise because the operations tend to be owned by the mine or receiver, or because they are handled by a for-hire carrier hauling an exempt commodity.

Because of the size of the trucks, industry trends, and the increasing cost of gasoline and, possibly, associated taxes, the cost calculations have been made in terms of diesel fuel rather than gasoline. The analysis excludes all taxes. Fuel taxes differ by state while property taxes differ by state and locality. Both also depend on the size of the operation which is determined only after an optimization calculation. Users may wish to add taxes as a lump, or distributed, sum after completing the costing model. Finally, it will be found that the program assumes that time for hauling coal has been set equal to the time required for the empty return (TR=TH in Section 6.3.8.1). In relatively flat regions this is reportedly true. Where topography makes this convenient assumption untenable, the model can be easily altered either by using TH, with altered values of the components, to substitute for a new TR, or by reestimating with a simple empirically derived factor for TH (e.g. TH=aTR; a>1).

6.2 OPERATING COSTS - DISCUSSION

Line-haul trucking costs for various vehicle gross weights were based on the procedure used by Stevens [2,5,6] and the Highway Research Bulletin [1]. Figure 6.1 indicates the cost breakdown. (Note: all tables and figures are collected at the end of each major section.) To indicate the trends in vehicle - mile cost, it was expedient to group and accumulate the individual expense accounts under the seven headings: shown in the figure. Because engine oil consumption is primarily for lubricants, engine oil costs were included with repair and servicing costs. The Stevens study was adjusted for price inflation as follows.

In compiling repair and service costs the principal components are mechanics and repair parts. About 33 percent of repair servicing costs accrue to mechanics; repair parts represent 60 percent. Therefore, to update the Stevens' study, and its supplement, the 33 percent due mechanics was adjusted by the ratio of indexes for 1976/1970 (5.92/3.85 = 1.55), given by the wholesale price index for the annual wage of mechanics. The 67 percent due to parts was adjusted by the ratio of the wholesale price index, 1976/1970 (151.7/111.6 = 1.36), for transportation equipment. Ownership of shop and garage facilities is covered under the cost of depreciation and interest. The cost of tires and tubes was adjusted by using the ratio of the wholesale price index, 1976/1970 (157.1/107.2 = 1.47) published in the Monthly Labor Review. Fuel costs were adjusted in the same way. They were further adjusted for speed and terrain. This is discussed below. Indirect and overhead costs include the subcategories shown in Figure 6.1. Because indirect and overhead costs are broad items, adjustments to indirect and overhead costs were simplified by using percentage of the overhead and indirect cost to total per-mile operating costs excluding overhead and indirect. Therefore, adjustments were first made to the total of the first five items, excluding overhead and indirect cost.

Depreciation and investment costs include those subcategories found in Figure 6.1. As the fleet model garage facility was assumed to be located on industrial property, no separate depreciation was calculated on land investment. Furthermore, as the vehicles are assumed to run out their useful line-haul life, they are salvagable only at scrap values. This is estimated at approximately one percent of original price, and here considered to be zero. From the Stevens' study, it is estimated that 80 percent of the depreciation value and interest charges for

line-haul operating costs accrues to the line-haul truck itself. As depreciation and interest are essentially directly related to the cost of the new vehicle equipment, the ratio of the wholesale price index for trucks for 1976/1970 was used (151.7/111.6 = 1.36). To the 1.36 was added a factor to account for the increase in interest rates from 6.5 percent to 8.5 percent, or 0.095. The total adjustment factor used was 1.455.

6.2.1 Operating Cost Adjusted by Running Speed

Vehicle speed is an important factor in running costs. Therefore adjustment due to running speed is necessary if more precise cost data are required. In practice, total elapsed time, or trip time, is more important than simply driving time. Dividing the trip mileage by driving time gives average running speed. The operating cost as modified by different running speeds was based on the Stevens' investigation [5,6].

6.2.2 Operating Cost Adjusted by Elements of Highway Design

The operating cost of a truck is affected by highway design elements such as distance, grades, curves, speed changes, roadway surfaces, lane width, number of lanes, shoulder width, and traffic control. Therefore some adjustments are necessary to produce a more reliable cost analysis. However, except for grades none of the above factors appeared to be highly significant with respect to costs. Here, an attempt has been made to classify different truck operations for terrain that can be crudely classified as flat and mountainous. A percentage factor is used in our cost analysis program instead of real mileage estimates for each type of terrain. For example, if the total mileage between a plant location and a mine location is 100 miles and includes a mountain section of 10 miles, the percentage factor for grades would be 10%.

6.2.3 Reserve Truck Requirements

In the calculation of truck transport costs, it is also necessary to know the total number of trucks needed with respect to mine output capacity. This depends on total tonnage and truck cycle time. The truck cycle calculation includes waiting time (to load), loading time, hauling time (loaded), waiting time (to dump), dumping time, and return time (unloaded).

After the cycle time estimate has been completed for a given truck, the supply estimate is made and the number of trucks required is determined. Because the number of productive minutes per hour varies, the average minutes per shift hour is used.

Truck down-time for service and repairs is also included when making an estimate of the total fleet required. The availability factor is included in order to determine the actual fleet size needed. There are different ways to determine truck availability. In this study we use a probability factor associated with truck downtime. It can be shown that the probability of having exactly n units available is:

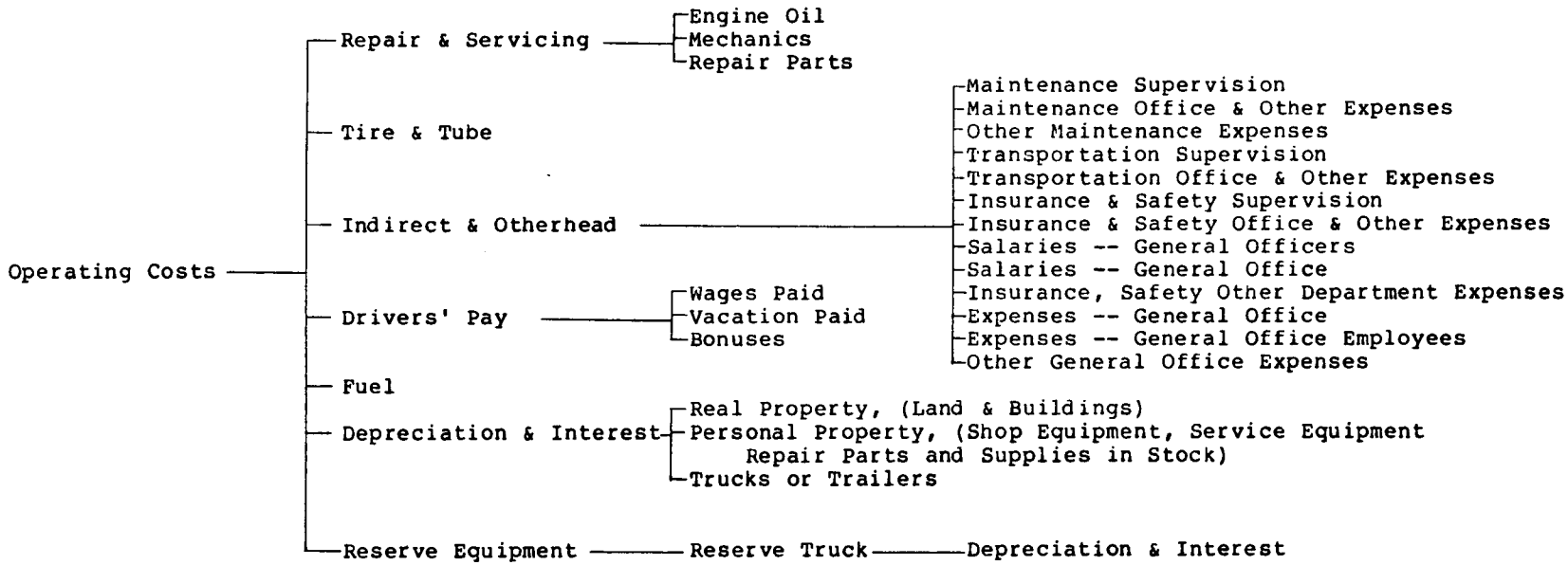
$$Pn = Pnr * Pmnr * C_r^n$$

where Pn is the probability of n units being available, Pnr is the probability of a single unit being available, Pmnr is the probability of a single unit not being available, and C_r^n is the combinations of n things taken r at a time. Therefore the total fleet size can be calculated as follows:

$$\text{Fleet size} = \frac{\text{Trucks required}}{Pn}$$

Since the fleet size is always greater than the theoretical number of trucks required, the cost of reserve trucks is an important factor and is included with operating costs.

FIGURE 6.1: Truck Cost Elements



6.3 OPERATING COSTS - MODEL

A generalized description of the costing model is found in Figure 2. The specific relationship, adjustments and sources are described below.

6.3.1 Maintenance Cost

6.3.1.1 Cost adjusted by gross weight. The regressions are based on data derived from [1, pages 121-2].

$$Y_1 = 7.15 - 0.048X_A + 0.0012\ X_A^2$$

$$Y_{11} = 7.15 - 0.048X_B + 0.0012\ X_B^2$$

X_A = gross weight of truck loaded

X_B = gross weight of unloaded truck

Y_1 = $/vehicle mile for repair and service of loaded truck

Y_{11} = Cost per vehicle mile for repair and service of unloaded truck

6.3.1.2 Data adjusted by wholesale price indexes.

$$Y1M = 0.33 * FR1 * Y_1 + 0.67 * FR11 * Y_1$$

$$Y11M = 0.33 * FR1 * Y_{11} + 0.67 * FR11 * Y_{11}$$

Y1M = adjusted maintenance cost of PTM for loaded truck

Y11M = adjusted maintenance cost of PTM for unloaded truck

FR1 = adjustment factor for mechanics

FR11 = adjustment factor for repair parts

PTM = per truck-mile

Sources are found in the Monthly Labor Review.

6.3.2 Tires and Tubes Cost

6.3.2.1 Cost adjusted by gross weight.

$Y_2 = 1.74 - 0.01X_A + 0.0004X_A^2$

$Y_{22} = 1.74 - 0.01X_B + 0.0004X_B^2$

Y_2 = Cost per vehicle-mile for tires of loaded truck

Y_{22} = Cost per vehicle-mile for tires of unloaded truck

Regressions based on data derived from [1, pages 121-2].

6.3.2.2 Data adjusted by wholesale price indexes.

YM = FR2 * Y_2

Y22M = FR2 * Y_{22}

Y2M = adjusted cost per vehicle-mile for loaded truck

Y22M = adjusted cost per vehicle-mile for unloaded truck

FR2 = adjustment factor for tires and tubes

FR2 = 157.1/107.2 = 1.47

Sources are found in the Monthly Labor Review.

6.3.3 Cost of Fuel (Diesel)

6.3.3.1 Cost adjusted by gross weight.

$$Y_3 = 2.77 - 0.004X_A + 0.00012X_A^2$$

$$Y_{33} = 2.77 - 0.004X_B + 0.00012X_B^2$$

Y_3 = Cost per vehicle-mile for fuel, loaded truck

Y_{33} = Cost per vehicle-mile for fuel, unloaded truck

Regression based on data derived from [1, pages 121-2].

6.3.3.2 Data adjusted by wholesale price index.

$Y3M = FR3 * Y_3$

$Y33M = FR3 * Y_{33}$

Y3M = adjusted cost per vehicle mile, loaded truck

Y33M = adjusted cost per vehicle mile, unloaded truck

FR3 = adjustment factor for fuel consumption

Sources are found in the Monthly Labor Review.

6.3.4 Depreciation and Interest

6.3.4.1 Cost adjusted by gross weight.

$$Y_4 = 0.28 + 0.155X_A - 0.00027X_A^2$$

$$Y_{44} = 0.28 + 0.155X_B - 0.00027X_B^2$$

Y_4 = Cost per vehicle-mile for depreciation of loaded truck

Y_{44} = Cost per vehicle-mile for depreciation of unloaded truck

Regression based on data derived from [1, pages 121-2].

6.3.4.2 Data adjusted by current wholesale price.

Y4M = FR4 * Y_4

Y44M = FR4 * Y_{44}

Y4M = adjusted cost per vehicle-mile for loaded truck

Y4MM = adjusted cost per vehicle-mile for unloaded truck

FR4 = adjustment factor for depreciation and interest

Sources are found in the Monthly Labor Review.

6.3.5 Driver Costs

6.3.5.1 Cost adjusted by gross weight.

$Y_5 = 14.1 + 0.027X_A + 0.00005X_A^2$

$Y_{55} = Y_5$

Y_5 = Cost per vehicle-mile for drivers' wages and subsistence, loaded truck

Y_{55} = Cost per vehicle-mile for drivers' wages and subsistence, unloaded truck

Regression based on data derived from [1, pages 121-2].

6.3.5.2 Data adjusted by current wholesale price.

$Y5M = FR5 * Y_5$

$Y55M = FR5 * Y_{55}$

Y5M = adjusted cost per vehicle-mile for loaded truck

Y55M = adjusted cost per vehicle-mile for unloaded truck

FR5 = adjustment factor for drivers' wages and subsistence

Sources are found in the Monthly Labor Review.

6.3.6 Indirect and Overhead Costs Adjusted by Gross Weight

$Y15M = Y1M + Y2M + Y3M + Y4M + Y5M$

$Y115M = Y11M + Y22M + Y33M + Y44M + Y55M$

$Y6M = Y15M * (0.35 - 0.0012X_A)$

$Y66M = Y115M * (0.35 - 0.0012X_B)$

Y15M = adjusted operating cost per vehicle-mile for loaded truck excluding indirect and overhead costs

Y115M = adjusted operating cost per vehicle-mile for unloaded truck excluding indirect and overhead costs

Y6M = adjusted indirect and overhead costs for loaded truck

Y66M = adjusted indirect and overhead costs for unloaded truck

Regression equations are based on [1, pages 121-2], see Figure 6.3.

Price adjustments were already included in the previous sections.

6.3.7 Operating Cost Adjusted by Running Speed and Grades

Figure 6.4 indicates the cost flow through the model. Tables 6.1 and 6.2 provide the specific factors.

Y16M = Y1M + Y2M + Y3M + Y4M + Y5M + Y6M

Y116M = Y11M + Y22M + Y33M + Y44M + Y55M + Y66M

Y16M = total updated operating cost per vehicle-mile for loaded truck

Y116M = total updated operating cost per vehicle-mile for unloaded truck

COPL = operating cost on level road

COPB = operating cost under bottle-neck conditions

COPU = operating cost on up-grade

COPD = operating cost on down-grade

FV = speed adjustment factor

FB = speed adjustment factor for bottle-necks (FB = FV)

FU = cost adjustment factor for up-grade

FD = cost adjustment factor for down-grade

COPTM = operating cost per ton per mile

COPT = operating cost per ton

YOP = average operating cost per truck-mile for round trip

PL = percentage of total mileage on level

PB = percentage of total mileage at bottle-neck

PU = percentage of total mileage on up-grade

PD = percentage of total mileage on down-grade

CPT = capacity per truck

MT = mileage between mine and plant

YOP = $\frac{1}{2}$ (Y16M + Y116M)

COPL = PL * FV * YOP

COPB = PB * FB * YOP

COPU = PU * YOP * FU

COPD = PD * YOP * FD

COPTM = (COPL + COPB + COPU + COPD)/CPT

6.3.8 Number of Reserve Trucks Required

6.3.8.1 Calculation of truck cycle time. Figure 6.5 indicates the calculation flow for reserve trucks. Figure 6.6 indicates the flow of the cost calculations.

TH = MT * (PL/VL + PU/VU + PD/VD)

TB = MT * PB/VB

TR = TH

CY = 2TH + TB + TWL + TWD + TL + TD

TH = time for hauling

TR = time for return

PL = percentage of total mileage on level

PU = percentage of total mileage on up-grades

PD = percentage of total mileage on down-grades

VL = level speed (regular speed)

VU = speed on rising grades

VD = speed on down-grades

MT = mileage between mine and plant

TB = time during bottle-neck

PB = percentage of total mileage at bottle-neck

VB = bottle-neck speed

CY = total cycle time

6.3.8.2 Number of trucks.

$$NOTE = \frac{CPY * CY}{OD * OH * CPT}$$

NOTE = number of trucks

CPY = demand capacity per year

OD = operating days per year

OH = operating time per day

CPT = capacity per truck

6.3.8.3 Real truck number.

$$NOT = \frac{NOTE}{PY}$$

NOT = size of fleet

PY = (P_n) the probability of hauling exactly n units

6.3.9 Cost of Reserved Trucks

6.3.9.1 Depreciation and interest.

$$CTTK = (NOTE-NOT) * PT \left(\frac{1}{LOT} * \frac{INT * (LOT+1)}{LOT}\right)$$

CTTK = total reserved truck cost per year

PT = truck price

LOT = service life of trucks

6.3.9.2 Unit cost ($/ton).

$$CTT = \frac{CTTK}{CPY}$$

$$CTTM = \frac{CTTK}{MT}$$

CTT = cost of reserved truck per ton

CTTM = cost of reserved truck per ton per mile

TABLE 6.1: Adjusted Speed Factors

GROSS WEIGHT (Kips)	SPEED (mph)	FACTOR
80	15-20	1.245
	20-25	1.117
	25-30	1.064
	30-35	1.000
	35-45	0.979
	45-55	1.000
70	15-20	1.200
	20-25	1.130
	25-30	1.060
	30-35	1.000
	35-45	1.000
	45-55	1.000
50	15-20	1.000
	20-25	1.138
	25-30	1.064
	30-35	1.064
	35-45	1.064
	45-55	1.000
40	15-20	1.021
	20-25	1.125
	25-30	1.042
	30-35	1.063
	35-45	1.042
	45-55	1.000

Source: [5]

TABLE 6.2: Grade Adjustment Factors

Diesel Engine

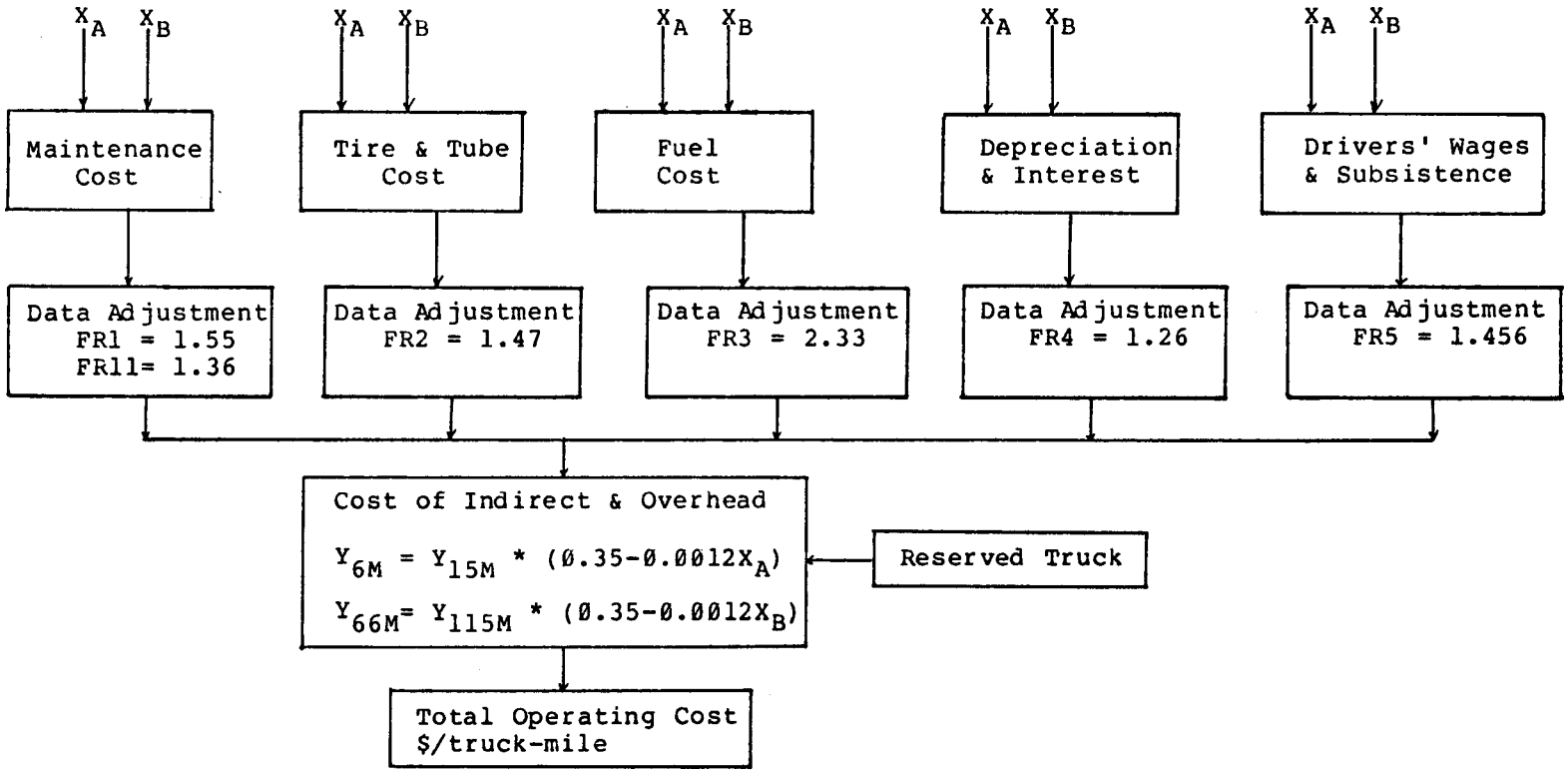
Gross Weight (Kips)	Terrain Level	Rolling	Rising
80	1	1.06	1.10
70	1	1.05	1.11
50	1	1.00	1.00
40	1	1.00	1.00

Gas Engine

Gross Weight (Kips)	Terrain Level	Rolling	Rising
80	-	-	-
70	1	1	1.29
50	1	1	1.00
40	1	1	1.05

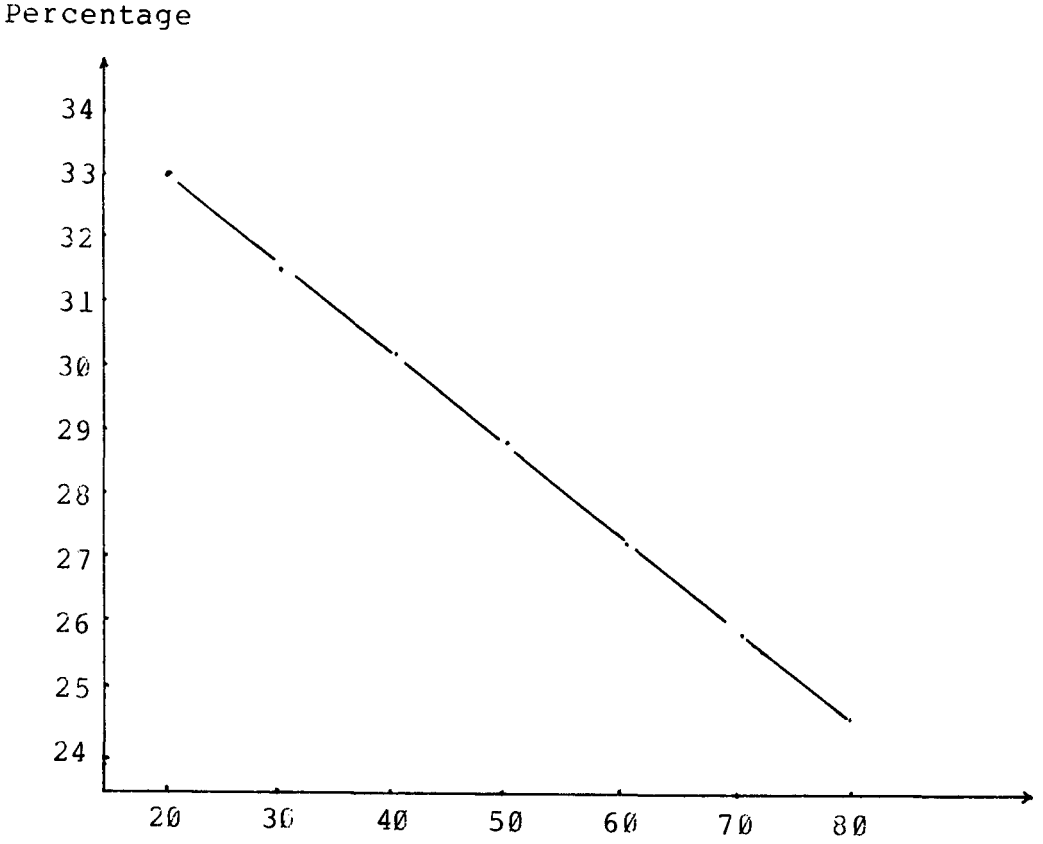
Source: [5]

FIGURE 6.2: Operating Cost Model Flow Chart



Source: Reference [1]
Note: Regression coefficients derived from data in [1]

FIGURE 6.3: Ratio of Indirect to Operating Costs: Percent Change by Gross Weight



Source: [1]

Note: One Kip equals 1000 pounds.

FIGURE 6.4: Adjusted Operating Cost Flow Model

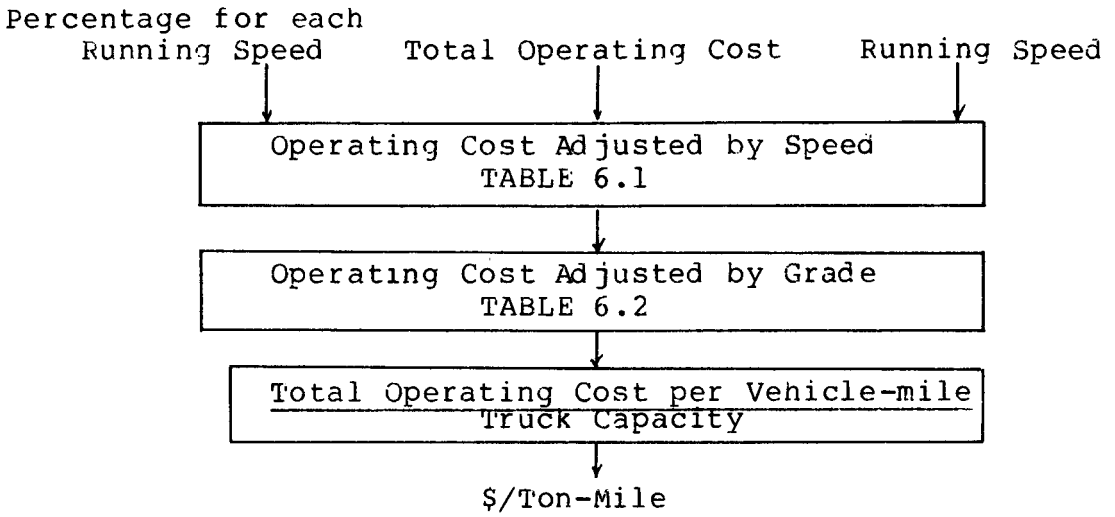


FIGURE 6.5: Reserve Truck Quantity Calculation

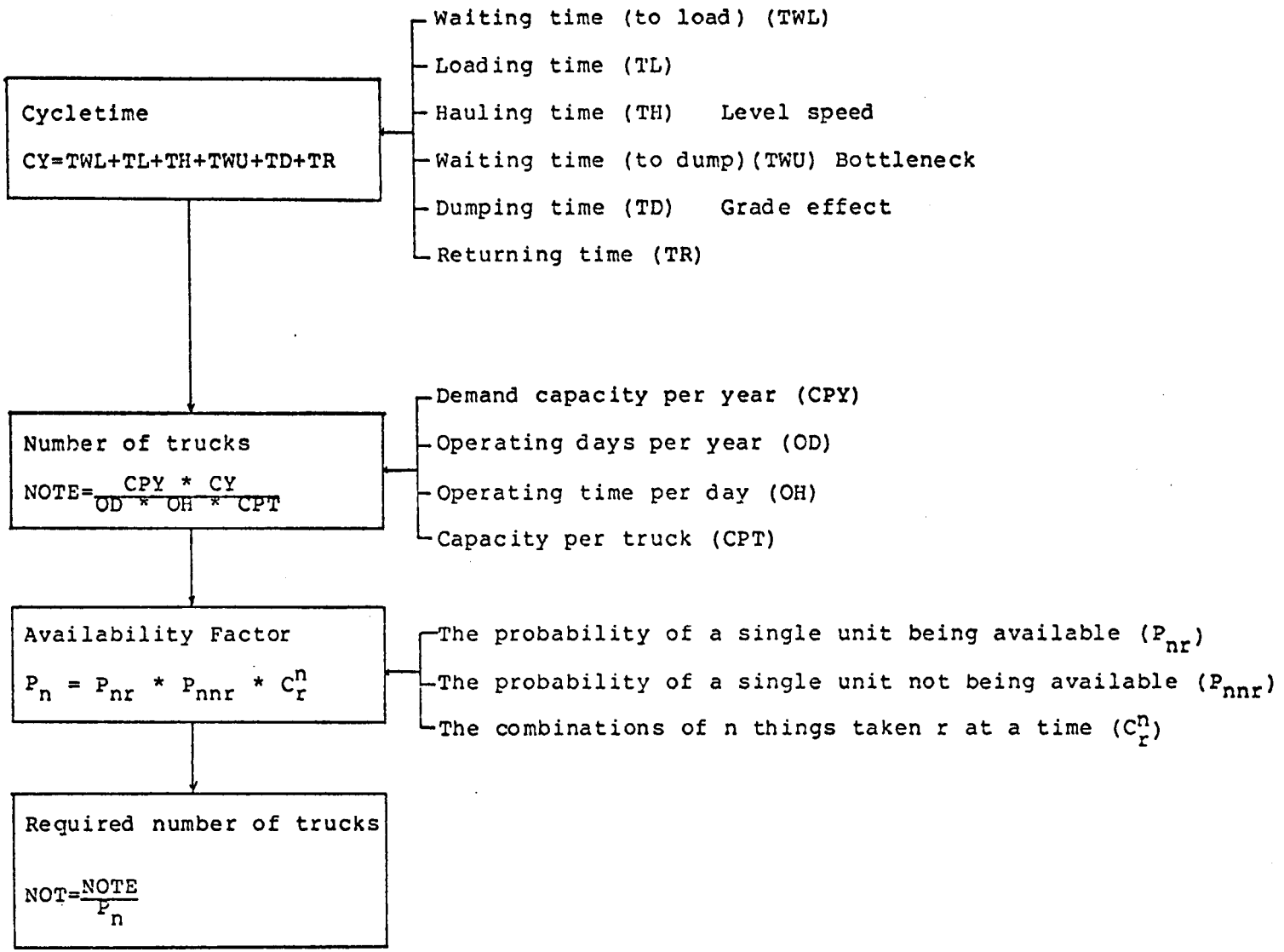
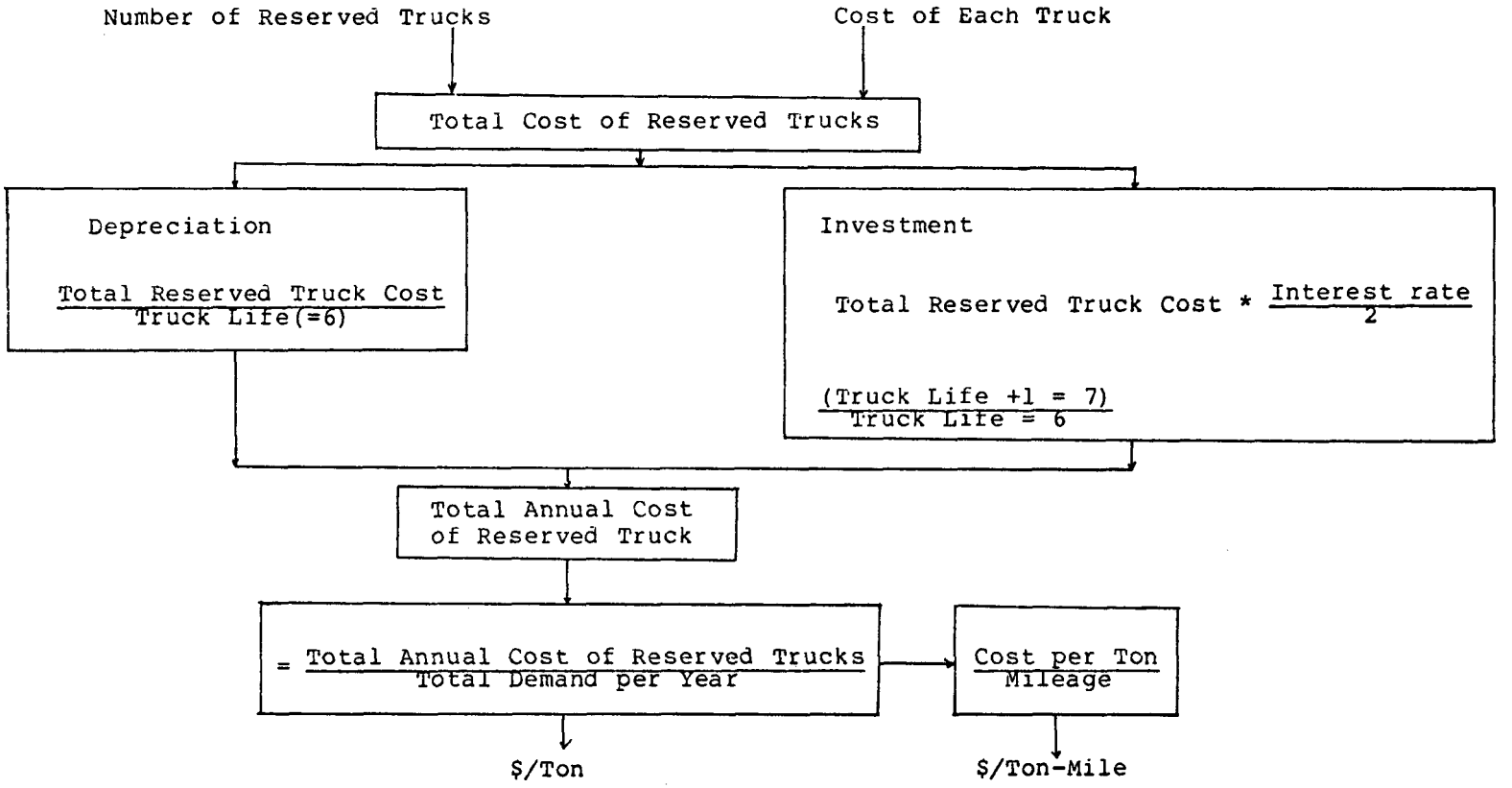


FIGURE 6.6: Reserved Truck Cost Calculations



6.4. CAPITAL COST - DISCUSSION

As used here, capital costs refer to road construction and maintenance including total construction costs, engineering, right of way, earth works and drainage, structures and flexible pavement. Figure 6.7 provides an outline of the principle components. Figure 6.8 shows the costing model.

There have been no great technological changes in road construction, therefore, cost data for road construction taken from Federal-Aid projects for 1964 have been used. These include six different types of roads and ten geographic divisions. The cost data were adjusted for inflation. Road maintenance data are based on the same source.

FIGURE 6.7: Capital Cost Components

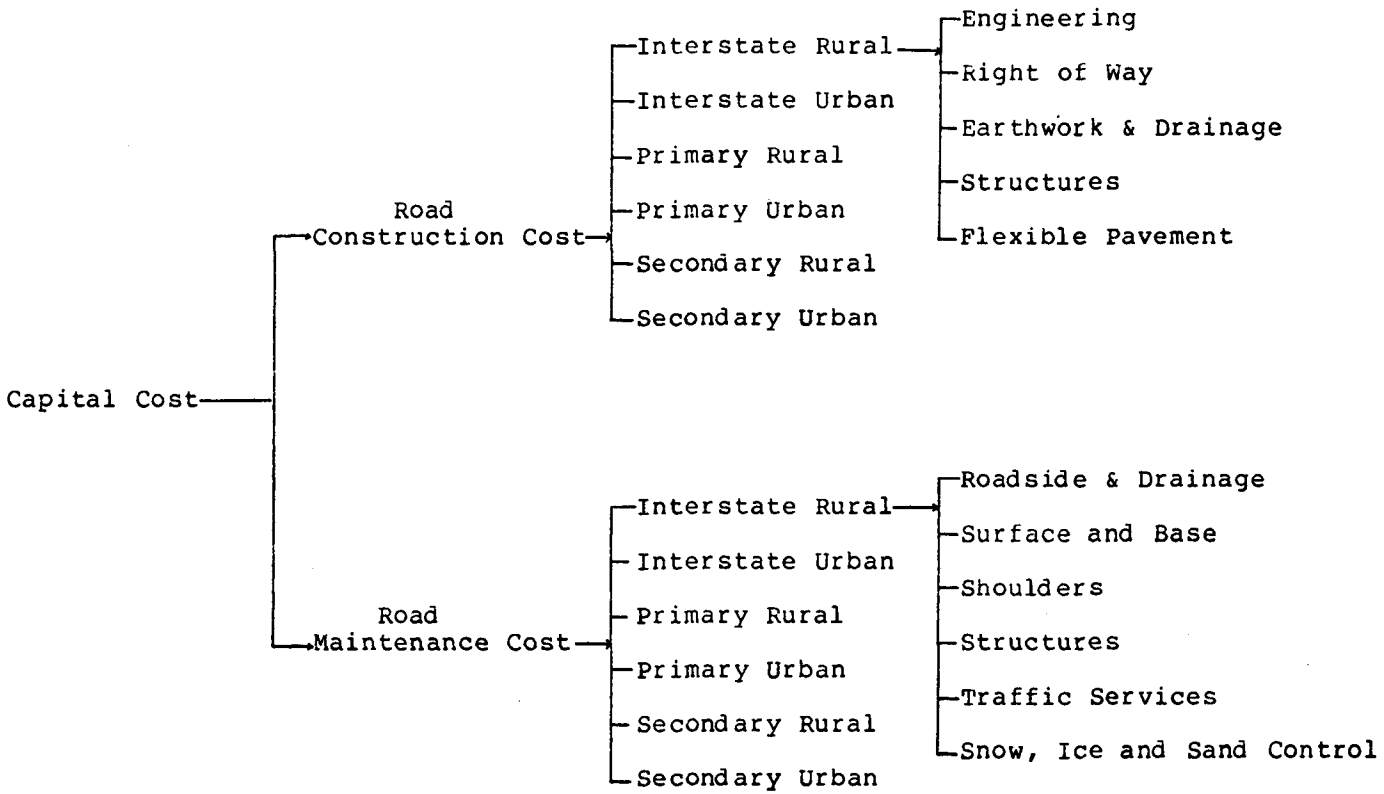
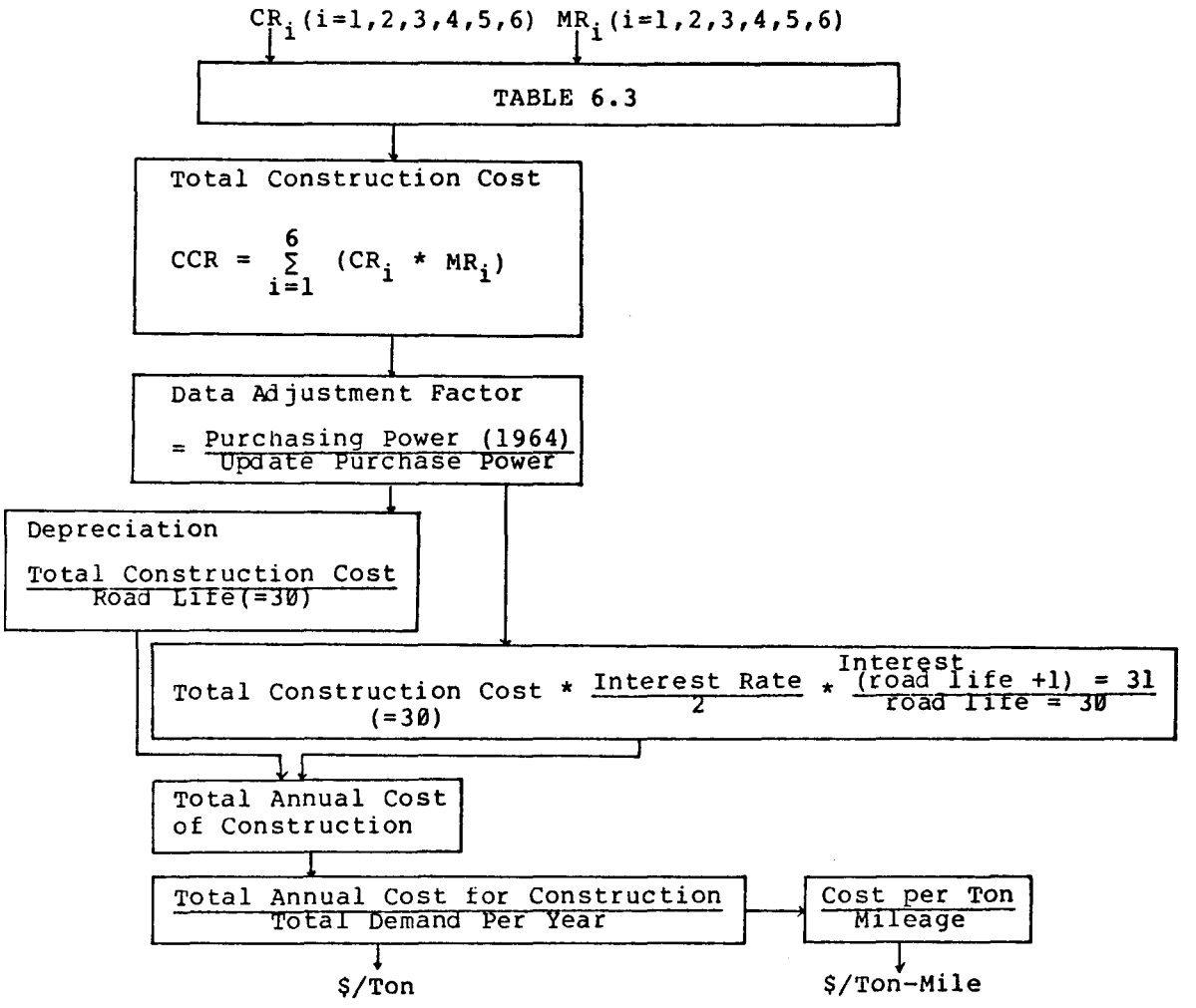


FIGURE 6.8: Construction Cost Flow Chart



6.5 CAPITAL COST - MODEL

6.5.1 Road Construction Cost

6.5.1.1 Total construction cost. This follows the pattern indicated below.

Type of Road ⟶ TABLE 6.3 ⟶ Cost/Mile

$$CCR = \sum_{i=1}^{6} (CR_i * MR_1)$$

(CR1 * MR1 + CR2 * MR2 + ... + CR6 * MR6)

CR = cost of each type of road per mile

CCR = total construction cost of road

CR = cost of each type of road per mile

MR = mileage of each type of road

xx1 = interstate rural highway

xx2 = interstate urban highway

xx3 = primary rural highway

xx4 = primary urban highway

xx5 = secondary rural highway

xx6 = secondary urban highway

6.5.1.2 Data adjustment factors. This inflation adjustment is based on the relative wholesale prices found in the Survey of Curent Business.

$$FR = \frac{1}{DV}$$

FR = adjustment factor

DV = current dollar value compared to base value

6.5.1.3 Annual depreciation and interest on road construction.

$$CARC = \frac{CCR * FR}{LOR} + \frac{INT * (LOR + 1)}{2 * LOR} * CCR * FR$$

CACR = total construction cost per year

INT = interest

LOR = average life of road

6.5.1.4 Unit Cost ($/ton):

$$CTI = \frac{CARC}{CPY}$$

$$CTMR = \frac{CTR}{MT}$$

CTR = cost of road construction per ton

CTMR = cost of road construction per ton per mile

MT = mileage between plant and mine

6.5.2 Road Maintenance Cost

Figure 6.9 shows the flow necessary for these calculations.

6.5.2.1 Model of road maintenance costs.

6.5.2.1.1 Total maintenance cost:

The flow of these maintenance costs is seen directly below.

Type of Road ⟶ TABLE 6.4 ⟶ Cost/Mile

$$CCM = \sum_{i=1}^{6} CM_i * MR_i$$

CCM = total maintenance cost of road

CM = cost of each type of road per mile

MR = mileage of each type of road

i=1 = interstate rural highway

i=2 = interstate urban highway

i=3 = primary rural highway

i=4 = primary urban highway

i=5 = secondary rural highway

i=6 = secondary urban highway

6.5.2.1.2 Data adjustment factors:

$$FR = \frac{1}{DV}$$

FR = adjustment factor

DV = current dollar value compared to base value

6.5.2.1.3 Unit costs:

$$CTRM = \frac{CCM * FR}{CPY}$$

$$CTRMM = \frac{CTM}{MT}$$

CTRM = cost of road maintenance per ton

CTRMM = cost of road maintenance per ton-mile

MT = mileage between plant and mine

TABLE 6.3: Cost of Road Construction

Type of Road	Dollars per Mile
Interstate Rural	$ 751,000
Interstate Urban	$3,198,000
Primary Rural	$ 318,000
Primary Urban	$ 600,000
Secondary Rural	$ 136,000
Secondary Urban	$ 175,000

Source: [9]

Includes: engineering, right of way, earthwork and drainage, structures, flexible pavement

Note that dollars/ton/mile are simple averages of the ten geographic areas. For more detailed work, the original source should be used.

TABLE 6.4: Road Maintenance Costs

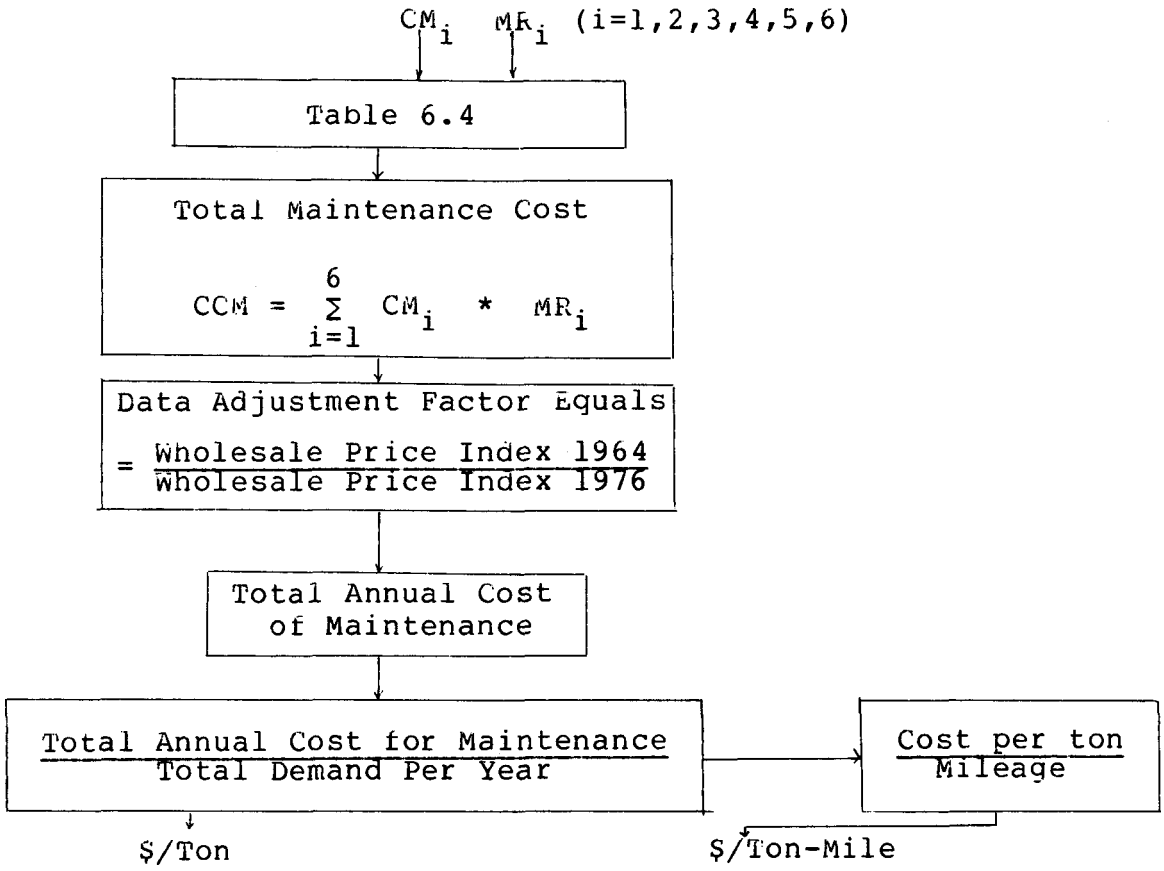
Type of Road	Dollars per mile
Interstate Rural	$3,233
Interstate Urban	$6,677
Primary Road	$2,358
Primary Urban	$4,484
Secondary Rural	$ 850
Secondary Urban	$1,979

Source: [9]

Includes: Roadside and drainage, surface and base, shoulder, structures, traffic services, snow, ice and sand control.

Note that dollars/ton/mile are simple averages of the ten geographic areas. For more detailed work, the original source should be used.

FIGURE 6.9: Road Maintenance Flow Chart



6.6 TOTAL COST MODEL

The total cost model is the aggregation of each of the parts described above. The flow chart (Figure 6.10) indicates the procedure.

Total capital investment cost (CTCI)

CFC1 = (Y44M + Y4M)/2 * MT * 2. *NOTE * OH/CY * OD/100

CTCI1 = CFC1 / (1./OY + INT * (OY + 1.)/2./OY) + (NOT - NOTE) * PT * OY/LOT + CCR * FR * PC

CTCI = 1.1 * CTCI1

CWCA = CTCI1 * 0.1 * INT * (OY + 1)/OY/2

CFC = CFC1 + CWCA

CWCA = annual working capital cost

CFC = annual depreciation and interest

OY = number of years of operation

Annual operating costs (Section 6.3)

COPT = COPYM * MT + CTT + CWCA/CPY

COPY = COPT * CPY

Annual road costs (Section 6.4, 6.5)

CRY = (CTRM + CTR) * CPY

Annual reserved truck costs (Section 6.3.9)

CTTY = CTT * CPY

Total cost per ton

CT = COPT + (CTR + CTRM) * PC

Total cost per ton per mile

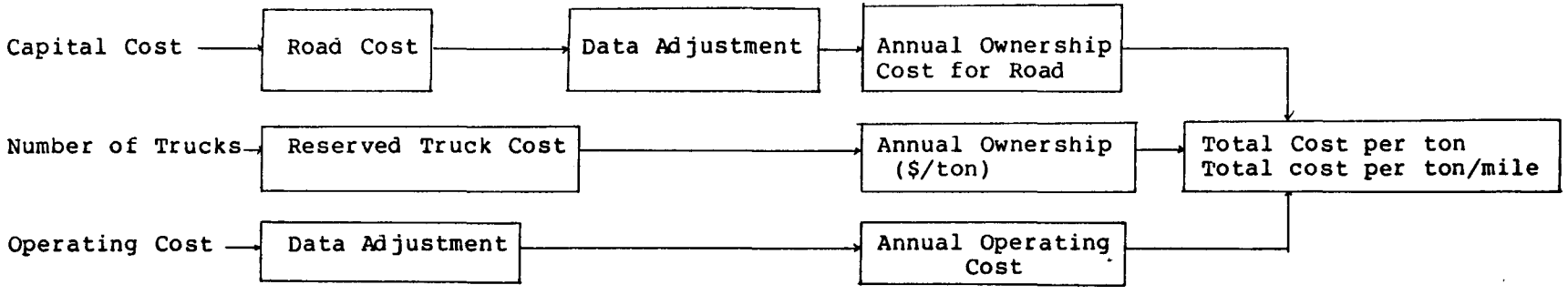
CTM = CT/MT

Annual total cost per year

CTY = CT * CPY

Note that PC equals the percentage of road cost which is included in total cost. This percentage will vary with the relative use of the road by coal trucks compared with all other traffic. If no user cost is desired, it can be set equal to zero. Alternatively, a road use study can be made for the specific routes in question.

FIGURE 6.1Ø: Total Cost Flow



6.7 COMPUTER MODEL FOR TRUCK COST ESTIMATION - SPECIFIC EXAMPLE

This computer truck cost model was formulated for general use. Costs as well as other parameters are included in the attached table. The reader can substitute his own values by changing the values in the data file. If any item is not to be included a zero can be inserted to eliminate it. For example, if road cost and maintenance are to be omitted, a zero must be put in the data file. In addition, this model can be easily adjusted to represent any particular year by changing the inflation factor. The particular case presented here was run with data obtained from a private truck company.

The most common type of rear dump over the road truck used for coal hauling was a five axle, diesel engine type. It cost about $50,000, and had an average life of eight years. Its loaded capacity was 23 tons with an unloaded weight of 12 tons.

In the mine area, loading time was estimated at 0.015 hours. The unloading time was 0.01 hours. The waiting time for loading and the waiting time for unloading were about the same: 0.05 hours. Normal road speed was estimated to be 45 miles per hour. A ten percent bottle-neck condition was assumed with the bottle-neck speed assumed to be 10 miles per hour. Other values are estimated in the model. The specific parameters are as follows.

	3 axles	5 axles
Truck Price ($)	25,000-30,000	50,000-55,000
Life (yrs)	6-8	8-10
Rear Dump	x	x
Engine	gas or diesel	diesel
Transmission	manual	manual
Tire (type)	10-120	10-120
Capacity	12 ton(24 Kips)	23 ton(46 Kips)
Loading time (hrs)	0.009~0.017	
Unloading time (hrs)	0.009~0.017	
Waiting Time load (hrs)	0.03~0.05	
Waiting time unload (hrs)	0.03~0.05	

*Private Company

Input data file - FORTRAN IV

*The Number of Trucks Required

Input Data for Cycle Time

*	ITEM	UNIT	FORMAT
MT	Mileage between mine and plant	mile	F
PL	% of total mileage on level	*	F
VL	Level speed (regular speed)	mile/hr	F
PU	% of total mileage on up-grades	*	F
VU	Up-grade speed	mile/hr	F
PD	% of total mileage on down-grade	*	F
VD	Down-grade speed	mile/hr	F
PB	% of total mileage at bottle-neck	*	F
VB	Bottle-neck speed	mile/hr	F
TWL	Waiting time (loading)	hr	F
TWD	Waiting time (dumping)	hr	F
TL	Loading time	hr	F
TD	Dumping time	hr	F

Input Data for Operating Capacity

*	ITEM	UNIT	FORMAT
CPY	Demand capacity per year	tons/year	F
CPT	Truck capacity	tons/truck	F
OH	Operating time per day	hrs/day	F
OD	Operating days per year	days/year	F
PY	Probability of hauling exactly n units	*	F

Input Data for Capital Cost

*	ITEM	UNIT	FORMAT
CR1	Road construction cost for interstate rural highway	$/Mile	F
CR2	Road construction cost for interstate urban highway	$/Mile	F
CR3	Road construction cost for primary rural highway	$/Mile	F
CR4	Road construction cost for primary urban highway	$/Mile	F
CR5	Road construction cost for secondary rural highway	$/Mile	F
CR6	Road construction cost for secondary urban highway	$/Mile	F
MR1	Mileage of interstate rural highway	Mile	F
MR2	Mileage of interstate urban highway	Mile	F
MR3	Mileage of primary rural highway	Mile	F
MR4	Mileage of primary urban highway	Mile	F
MR5	Mileage of secondary rural highway	Mile	F
MR6	Mileage of secondary urban highway	Mile	F
DV	Current dollar value compared with base value (1967)	*	F
INT	Interest	*	F
LOR	Road life	Year	F
CM1	Maintenance cost of interstate rural highway per mile	$/Mile	F
CM2	Maintenance cost of inter-state urban highway per mile	$/Mile	F

CM3	Maintenance cost of primary rural highway per mile	$/Mile	F
CM4	Maintenance cost of primary urban highway per mile	$/Mile	F
CM5	Maintenance cost of secondary rural highway per mile	$/Mile	F
CM6	Maintenance cost of secondary urban highway per mile	$/Mile	F

Input Data Operating Cost

*	ITEM	UNIT	FORMAT
XA	Gross weight of loaded truck	KP	F
XB	Gross weight of unloaded truck	KP	F
FR1	Adjustment factor for mechanics	*	F
FR11	Adjustment factor for repair parts	*	F
FR2	Adjustment factor for tire cost	*	F
FR3	Adjustment factor for fuel consumption	*	F
FR4	Adjustment factor for depreciation and interest	*	F
FR5	Adjustment factor for drivers' wage	*	F
PT	Truck price	$/each	F
LOT	Service life of truck	year	F
FV	Speed adjustment factor	*	F
FB	Speed adjustment factor for bottle-neck	*	F
FU	Cost adjustment factor for upgrade	*	F
FD	Cost adjustment factor for downgrade	*	F
PC	% of road cost included in total cost	*	F
OY	Number of years of operation	*	F

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SPECIFICATION FOR TRUCK TRANSPORTATION

DEMAND CAPACITY PER YEAR = 100000.0
MILEAGE BETWEEN MINE AND PLANT = 50.0
REGULAR SPEED = 45.0
BOTTLE-NECK SPEED = 10.0
TRUCK CAPACITY = 23.0
PERCENTAGE OF ROAD COST INCLUDED IN TOTAL COST = 0.0

COST ANALYSIS FOR TRUCK TRANSPORTION

THE TOTAL COST PER TON = 1.711
TOTAL COST PER TON PER MILE = 0.034
ANNUAL COST FOR TOTAL OPERATING COST = 171050.5
ANNUAL COST FOR ROAD = 2455951.5
ANNUAL RESERVED TRUCK COST= 6099.6
TOTAL ANNUAL COST = 171050.5
TOTAL CAPITAL INVESTMENT COST= 708138.2
TOTAL NUMBER OF TRUCK= 5.7

SPECIFICATION FOR TRUCK TRANSPORTATION

DEMAND CAPACITY PER YEAR = 250000.0
MILEAGE BETWEEN MINE AND PLANT = 50.0
REGULAR SPEED = 45.0
BOTTLE-NECK SPEED = 10.0
TRUCK CAPACITY = 23.0
PERCENTAGE OF ROAD COST INCLUDED IN TOTAL COST = 0.0

COST ANALYSIS FOR TRUCK TRANSPORTION

THE TOTAL COST PER TON = 1.711
TOTAL COST PER TON PER MILE = 0.034
ANNUAL COST FOR TOTAL OPERATING COST = 427626.2
ANNUAL COST FOR ROAD = 2455951.5
ANNUAL RESERVED TRUCK COST= 15249.1
TOTAL ANNUAL COST = 427626.2
TOTAL CAPITAL INVESTMENT COST= 1770345.4
TOTAL NUMBER OF TRUCK= 14.3

SPECIFICATION FOR TRUCK TRANSPORTATION

DEMAND CAPACITY PER YEAR = 500000.0
MILEAGE BETWEEN MINE AND PLANT = 50.0
REGULAR SPEED = 45.0
BOTTLE-NECK SPEED = 10.0
TRUCK CAPACITY = 23.0
PERCENTAGE OF ROAD COST INCLUDED IN TOTAL COST = 0.0

COST ANALYSIS FOR TRUCK TRANSPORTION

THE TOTAL COST PER TON = 1.711
TOTAL COST PER TON PER MILE = 0.034
ANNUAL COST FOR TOTAL OPERATING COST = 855252.4
ANNUAL COST FOR ROAD = 2455951.5
ANNUAL RESERVED TRUCK COST= 30498.2
TOTAL ANNUAL COST = 855252.4
TOTAL CAPITAL INVESTMENT COST= 3540690.9
TOTAL NUMBER OF TRUCK= 28.6

SPECIFICATION FOR TRUCK TRANSPORTATION

DEMAND CAPACITY PER YEAR = 750000.0
MILEAGE BETWEEN MINE AND PLANT = 50.0
REGULAR SPEED = 45.0
BOTTLE-NECK SPEED = 10.0
TRUCK CAPACITY = 23.0
PERCENTAGE OF ROAD COST INCLUDED IN TOTAL COST = 0.0

COST ANALYSIS FOR TRUCK TRANSPORTION

THE TOTAL COST PER TON = 1.711
TOTAL COST PER TON PER MILE = 0.034
ANNUAL COST FOR TOTAL OPERATING COST = 1282878.5
ANNUAL COST FOR ROAD = 0.0
ANNUAL RESERVED TRUCK COST= 45747.3
TOTAL ANNUAL COST = 1282878.5
TOTAL CAPITAL INVESTMENT COST= 5311036.4
TOTAL NUMBER OF TRUCK= 42.9

SPECIFICATION FOR TRUCK TRANSPORTATION

DEMAND CAPACITY PER YEAR = 1000000.0
MILEAGE BETWEEN MINE AND PLANT = 50.0
REGULAR SPEED = 45.0
BOTTLE-NECK SPEED = 10.0
TRUCK CAPACITY = 23.0
PERCENTAGE OF ROAD COST INCLUDED IN TOTAL COST = 0.0

COST ANALYSTS FOR TRUCK TRANSPORTION

THE TOTAL COST PER TON = 1.711
TOTAL COST PER TON PER MILE = 0.034
ANNUAL COST FOR TOTAL OPERATING COST = 1710504.7
ANNUAL COST FOR ROAD = 0.0
ANNUAL RESERVED TRUCK COST= 60996.4
TOTAL ANNUAL COST = 1710504.7
TOTAL CAPITAL INVESTMENT COST= 7081381.8

TOTAL NUMBER OF TRUCK= 57.2

Mileage

SPECIFICATION FOR TRUCK TRANSPORTATION

DEMAND CAPACITY PER YEAR = 500000.0
MILEAGE BETWEEN MINE AND PLANT = 50.0
REGULAR SPEED = 45.0
BOTTLE-NECK SPEED = 10.0
TRUCK CAPACITY = 23.0
PERCENTAGE OF ROAD COST INCLUDED IN TOTAL COST = 0.0

COST ANALYSIS FOR TRUCK TRANSPORTION

THE TOTAL COST PER TON = 1.711
TOTAL COST PER TON PER MILE = 0.034
ANNUAL COST FOR TOTAL OPERATING COST = 855252.4
ANNUAL COST FOR ROAD = 2455951.5
ANNUAL RESERVED TRUCK COST= 30498.2
TOTAL ANNUAL COST = 855252.4
TOTAL CAPITAL INVESTMENT COST= 3540690.9
TOTAL NUMBER OF TRUCK= 28.6

SPECIFICATION FOR TRUCK TRANSPORTATION

DEMAND CAPACITY PER YEAR = 500000.0
MILEAGE BETWEEN MINE AND PLANT = 25.0
REGULAR SPEED = 45.0
BOTTLE-NECK SPEED = 10.0
TRUCK CAPACITY = 23.0
PERCENTAGE OF ROAD COST INCLUDED IN TOTAL COST = 0.0

COST ANALYSIS FOR TRUCK TRANSPORTION

THE TOTAL COST PER TON = 0.857
TOTAL COST PER TON PER MILE = 0.034
ANNUAL COST FOR TOTAL OPERATING COST = 428295.2
ANNUAL COST FOR ROAD = 2455951.5
ANNUAL RESERVED TRUCK COST= 15859.1
TOTAL ANNUAL COST = 428295.2
TOTAL CAPITAL INVESTMENT COST= 1786071.1
TOTAL NUMBER OF TRUCK= 14.9

SPECIFICATION FOR TRUCK TRANSPORTATION

DEMAND CAPACITY PER YEAR = 500000.0
MILEAGE BETWEEN MINE AND PLANT = 10.0
REGULAR SPEED = 45.0
BOTTLE-NECK SPEED = 10.0
TRUCK CAPACITY = 23.0
PERCENTAGE OF ROAD COST INCLUDED IN TOTAL COST = 0.0

COST ANALYSIS FOR TRUCK TRANSPORTION

THE TOTAL COST PER TON = 0.344
TOTAL COST PER TON PER MILE = 0.034
ANNUAL COST FOR TOTAL OPERATING COST = 172121.0
ANNUAL COST FOR ROAD = 2455951.5
ANNUAL RESERVED TRUCK COST= 7075.6
TOTAL ANNUAL COST = 172121.0
TOTAL CAPITAL INVESTMENT COST= 733299.2
TOTAL NUMBER OF TRUCK= 6.6

Road cost

SPECIFICATION FOR TRUCK TRANSPORTATION

DEMAND CAPACITY PER YEAR = 500000.0
MILEAGE BETWEEN MINE AND PLANT = 50.0
REGULAR SPEED = 45.0
BOTTLE-NECK SPEED = 10.0
TRUCK CAPACITY = 23.0
PERCENTAGE OF ROAD COST INCLUDED IN TOTAL COST = 0.0

COST ANALYSIS FOR TRUCK TRANSPORTION

THE TOTAL COST PER TON = 1.711
TOTAL COST PER TON PER MILE = 0.034
ANNUAL COST FOR TOTAL OPERATING COST = 855252.4
ANNUAL COST FOR ROAD = 2455951.5
ANNUAL RESERVED TRUCK COST= 30498.2
TOTAL ANNUAL COST = 855252.4
TOTAL CAPITAL INVESTMENT COST= 3540690.9
TOTAL NUMBER OF TRUCK= 28.6

SPECIFICATION FOR TRUCK TRANSPORTATION

DEMAND CAPACITY PER YEAR = 500000.0
MILEAGE BETWEEN MINE AND PLANT = 50.0
REGULAR SPEED = 45.0
BOTTLE-NECK SPEED = 10.0
TRUCK CAPACITY = 23.0
PERCENTAGE OF ROAD COST INCLUDED IN TOTAL COST = 0.1

COST ANALYSIS FOR TRUCK TRANSPORTION

THE TOTAL COST PER TON = 2.227
TOTAL COST PER TON PER MILE = 0.045
ANNUAL COST FOR TOTAL OPERATING COST = 867881.6
ANNUAL COST FOR ROAD = 2455951.5
ANNUAL RESERVED TRUCK COST= 30498.2
TOTAL ANNUAL COST = 1113476.7
TOTAL CAPITAL INVESTMENT COST= 6901690.9
TOTAL NUMBER OF TRUCK= 28.6

SPECIFICATION FOR TRUCK TRANSPORTATION

DEMAND CAPACITY PER YEAR = 500000.0
MILEAGE BETWEEN MINE AND PLANT = 50.0
REGULAR SPEED = 45.0
BOTTLE-NECK SPEED = 10.0
TRUCK CAPACITY = 23.0
PERCENTAGE OF ROAD COST INCLUDED IN TOTAL COST = 0.2

COST ANALYSIS FOR TRUCK TRANSPORTION

THE TOTAL COST PER TON = 2.743
TOTAL COST PER TON PER MILE = 0.055
ANNUAL COST FOR TOTAL OPERATING COST = 880510.8
ANNUAL COST FOR ROAD = 2455951.5
ANNUAL RESERVED TRUCK COST= 30498.2
TOTAL ANNUAL COST = 1371701.1
TOTAL CAPITAL INVESTMENT COST= 10262690.9
TOTAL NUMBER OF TRUCK= 28.6

SPECIFICATION FOR TRUCK TRANSPORTATION

DEMAND CAPACITY PER YEAR = 500000.0
MILEAGE BETWEEN MINE AND PLANT = 50.0
REGULAR SPEED = 45.0
BOTTLE-NECK SPEED = 10.0
TRUCK CAPACITY = 23.0
PERCENTAGE OF ROAD COST INCLUDED IN TOTAL COST = 2.0

COST ANALYSIS FOR TRUCK TRANSPORTION

THE TOTAL COST PER TON = 1.711
TOTAL COST PER TON PER MILE = 0.034
ANNUAL COST FOR TOTAL OPERATING COST = 855252.4
ANNUAL COST FOR ROAD = 3132024.3
ANNUAL RESERVED TRUCK COST= 30498.2
TOTAL ANNUAL COST = 855252.4
TOTAL CAPITAL INVESTMENT COST= 3540690.9
TOTAL NUMBER OF TRUCK= 28.6

SPECIFICATION FOR TRUCK TRANSPORTATION

DEMAND CAPACITY PER YEAR = 500000.0
MILEAGE BETWEEN MINE AND PLANT = 50.0
REGULAR SPEED = 45.0
BOTTLE-NECK SPEED = 10.0
TRUCK CAPACITY = 23.0
PERCENTAGE OF ROAD COST INCLUDED IN TOTAL COST = 0.1

COST ANALYSIS FOR TRUCK TRANSPORTION

THE TOTAL COST PER TON = 2.370
TOTAL COST PER TON PER MILE = 0.047
ANNUAL COST FOR TOTAL OPERATING COST = 871624.1
ANNUAL COST FOR ROAD = 3132024.3
ANNUAL RESERVED TRUCK COST= 30498.2
TOTAL ANNUAL COST = 1184826.5
TOTAL CAPITAL INVESTMENT COST= 7897690.9
TOTAL NUMBER OF TRUCK= 28.6

SPECIFICATION FOR TRUCK TRANSPORTATION

DEMAND CAPACITY PER YEAR = 500000.0
MILEAGE BETWEEN MINE AND PLANT = 50.0
REGULAR SPEED = 45.0
BOTTLE-NECK SPEED = 10.0
TRUCK CAPACITY = 23.0
PERCENTAGE OF ROAD COST INCLUDED IN TOTAL COST = 0.2

COST ANALYSIS FOR TRUCK TRANSPORTION

THE TOTAL COST PER TON = 3.029
TOTAL COST PER TON PER MILE = 0.061
ANNUAL COST FOR TOTAL OPERATING COST = 887995.9
ANNUAL COST FOR ROAD = 313024.3
ANNUAL RESERVED TRUCK COST= 30498.2
TOTAL ANNUAL COST = 1514400.7
TOTAL CAPITAL INVESTMENT COST= 12254690.9
TOTAL NUMBER OF TRUCK= 28.6

SPECIFICATION FOR TRUCK TRANSPORTATION

DEMAND CAPACITY PER YEAR = 500000.0
MILEAGE BETWEEN MINE AND PLANT = 50.0
REGULAR SPEED = 45.0
BOTTLE-NECK SPEED = 10.0
TRUCK CAPACITY = 23.0
PERCENTAGE OF ROAD COST INCLUDED IN TOTAL COST = 0.0

COST ANALYSIS FOR TRUCK TRANSPORTION

THE TOTAL COST PER TON = 1.711
TOTAL COST PER TON PER MILE = 0.034
ANNUAL COST FOR TOTAL OPERATING COST = 855252.4
ANNUAL COST FOR ROAD = 2455951.5
ANNUAL RESERVED TRUCK COST= 30498.2
TOTAL ANNUAL COST = 855252.4
TOTAL CAPITAL INVESTMENT COST= 3540690.9
TOTAL NUMBER OF TRUCK= 28.6

SPECIFICATION FOR TRUCK TRANSPORTATION

DEMAND CAPACITY PER YEAR = 500000.0
MILEAGE BETWEEN MINE AND PLANT = 50.0
REGULAR SPEED = 45.0
BOTTLE-NECK SPEED = 10.0
TRUCK CAPACITY = 23.0
PERCENTAGE OF ROAD COST INCLUDED IN TOTAL COST = 0.0

COST ANALYSIS FOR TRUCK TRANSPORTION

THE TOTAL COST PER TON = 1.718
TOTAL COST PER TON PER MILE = 0.034
ANNUAL COST FOR TOTAL OPERATING COST = 859145.0
ANNUAL COST FOR ROAD = 2455951.5
ANNUAL RESERVED TRUCK COST= 34047.1
TOTAL ANNUAL COST = 859145.0
TOTAL CAPITAL INVESTMENT COST= 3632185.5
TOTAL NUMBER OF TRUCK= 31.9

SPECIFICATION FOR TRUCK TRANSPORTATION

DEMAND CAPACITY PER YEAR = 500000.0
MILEAGE BETWEEN MINE AND PLANT = 50.0
REGULAR SPEED = 45.0
BOTTLE-NECK SPEED = 10.0
TRUCK CAPACITY = 23.0
PERCENTAGE OF ROAD COST INCLUDED IN TOTAL COST = 0.0

COST ANALYSIS FOR TRUCK TRANSPORTION

THE TOTAL COST PER TON = 1.737
TOTAL COST PER TON PER MILE = 0.035
ANNUAL COST FOR TOTAL OPERATING COST = 868633.5
ANNUAL COST FOR ROAD = 2455951.5
ANNUAL RESERVED TRUCK COST= 42697.5
TOTAL ANNUAL COST = 868633.5
TOTAL CAPITAL INVESTMENT COST= 3855203.8
TOTAL NUMBER OF TRUCK= 40.0

SPECIFICATION FOR TRUCK TRANSPORTATION

DEMAND CAPACITY PER YEAR = 500000.0
MILEAGE BETWEEN MINE AND PLANT = 50.0
REGULAR SPEED = 45.0
BOTTLE-NECK SPEED = 10.0
TRUCK CAPACITY = 23.0
PERCENTAGE OF ROAD COST INCLUDED IN TOTAL COST = 0.0

COST ANALYSIS FOR TRUCK TRANSPORTION

THE TOTAL COST PER TON = 1.673
TOTAL COST PER TON PER MILE = 0.033
ANNUAL COST FOR TOTAL OPERATING COST = 836512.9
ANNUAL COST FOR ROAD = 2455951.5
ANNUAL RESERVED TRUCK COST= 22907.6
TOTAL ANNUAL COST = 836512.9
TOTAL CAPITAL INVESTMENT COST= 3344994.0
TOTAL NUMBER OF TRUCK= 21.5

SPECIFICATION FOR TRUCK TRANSPORTATION

DEMAND CAPACITY PER YEAR = 500000.0
MILEAGE BETWEEN MINE AND PLANT = 50.0
REGULAR SPEED = 45.0
BOTTLE-NECK SPEED = 10.0
TRUCK CAPACITY = 23.0
PERCENTAGE OF ROAD COST INCLUDED IN TOTAL COST = 0.0

COST ANALYSIS FOR TRUCK TRANSPORTION

THE TOTAL COST PER TON = 1.711
TOTAL COST PER TON PER MILE = 0.034
ANNUAL COST FOR TOTAL OPERATING COST = 855252.4
ANNUAL COST FOR ROAD = 2455951.5
ANNUAL RESERVED TRUCK COST= 30498.2
TOTAL ANNUAL COST = 855252.4
TOTAL CAPITAL INVESTMENT COST= 3540690.9
TOTAL NUMBER OF TRUCK= 28.6

SPECIFICATION FOR TRUCK TRANSPORTATION

DEMAND CAPACITY PER YEAR = 500000.0
MILEAGE BETWEEN MINE AND PLANT = 50.0
REGULAR SPEED = 45.0
BOTTLE-NECK SPEED = 10.0
TRUCK CAPACITY = 23.0
PERCENTAGE OF ROAD COST INCLUDED IN TOTAL COST = 0.0

COST ANALYSIS FOR TRUCK TRANSPORTION

THE TOTAL COST PER TON = 1.748
TOTAL COST PER TON PER MILE = 0.035
ANNUAL COST FOR TOTAL OPERATING COST = 873991.8
ANNUAL COST FOR ROAD = 2455951.5
ANNUAL RESERVED TRUCK COST= 38088.9
TOTAL ANNUAL COST = 873991.8
TOTAL CAPITAL INVESTMENT COST= 3736387.8
TOTAL NUMBER OF TRUCK= 35.7

SPECIFICATION FOR TRUCK TRANSPORTATION

DEMAND CAPACITY PER YEAR = 500000.0
MILEAGE BETWEEN MINE AND PLANT = 50.0
REGULAR SPEED = 45.0
BOTTLE-NECK SPEED = 10.0
TRUCK CAPACITY = 23.0
PERCENTAGE OF ROAD COST INCLUDED IN TOTAL COST = 0.0

COST ANALYSIS FOR TRUCK TRANSPORTION

THE TOTAL COST PER TON = 1.711
TOTAL COST PER TON PER MILE = 0.034
ANNUAL COST FOR TOTAL OPERATING COST = 855252.4
ANNUAL COST FOR ROAD = 2455951.5
ANNUAL RESERVED TRUCK COST= 30498.2
TOTAL ANNUAL COST = 855252.4
TOTAL CAPITAL INVESTMENT COST= 3540690.9
TOTAL NUMBER OF TRUCK= 28.6

SPECIFICATION FOR TRUCK TRANSPORTATION

DEMAND CAPACITY PER YEAR = 500000.0
MILEAGE BETWEEN MINE AND PLANT = 50.0
REGULAR SPEED = 45.0
BOTTLE-NECK SPEED = 10.0
TRUCK CAPACITY = 12.0
PERCENTAGE OF ROAD COST INCLUDED IN TOTAL COST = 0.0

COST ANALYSIS FOR TRUCK TRANSPORTION

THE TOTAL COST PER TON = 2.927
TOTAL COST PER TON PER MILE = 0.059
ANNUAL COST FOR TOTAL OPERATING COST = 1463297.9
ANNUAL COST FOR ROAD = 2455951.5
ANNUAL RESERVED TRUCK COST= 35073.0
TOTAL ANNUAL COST = 1463297.9
TOTAL CAPITAL INVESTMENT COST= 4713125.8
TOTAL NUMBER OF TRUCK= 54.8