Part 3

PROJECT EVALUATION

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ABBREVIATIONS

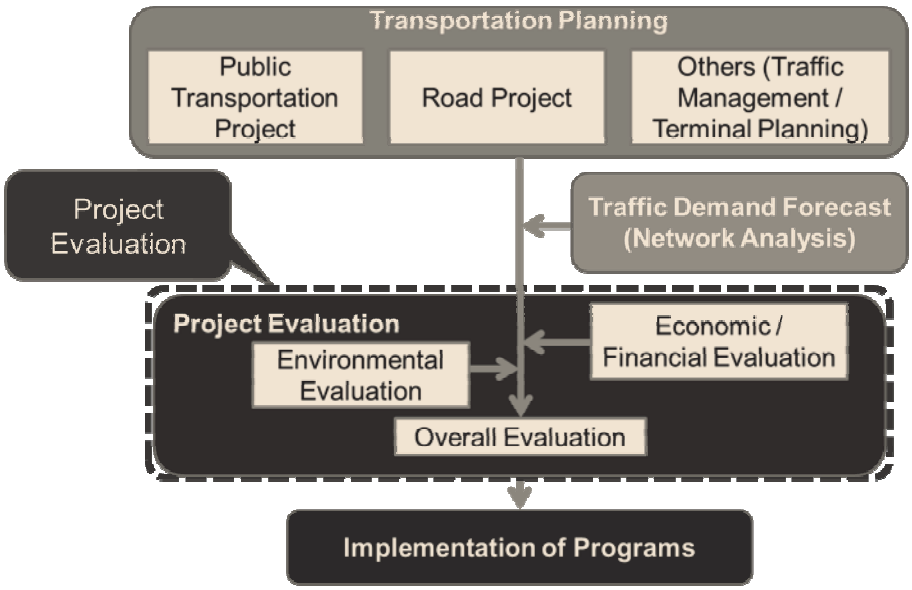
ADB	Asian Development Bank
BCR	benefit cost ratio
BRT	Bus Rapid Transit
CVM	conjoint value method
DOTC	Department of Transportation and communications
DPWH	Department of Public Works and Highways
EIRR	economic internal rate of return
FIRR	financial internal rate of return
GDP	gross domestic products
GHG	greenhouse gas
JICA	Japan International Cooperation Agency
NEDA	National Economic Development Authority
NPV	net present value
OD	origin-destination
SCF	standard conversion factor
SP	standard preference
SP Survey	stated preference survey
STEP	Special Term for Economic Partnership
TTC	travel time cost
WTP	willingness-to-pay
VOC	vehicle operation cost

1 PROJECT EVALUATION

Figure 1.1 shows the development procedure of the project evaluation. Candidate projects are initially identified on each sector such as public transportation, road project, traffic management measures, terminal planning, and others. The traffic demand forecast is done by focusing on candidate projects and analyzing their effect on the current traffic situation; the project evaluation is done thereafter. This evaluation is composed of economic or financial, environmental such as social and natural environment consideration, and the overall. Candidate projects are prioritized during this step. The implementation program will then be formulated in the master plan after project evaluation.

This manual focuses on the economic and financial evaluations.

Figure 1.1 Development Procedure on Urban Transport



Source: JICA Project Team

2 PROJECT EFFECTS

1) Classification of Project Effects

(a) **Facility and Implementation Effects:** Facility effects occur during construction and planning stage while implementation effects occur in the operation of the transport project or infrastructure.

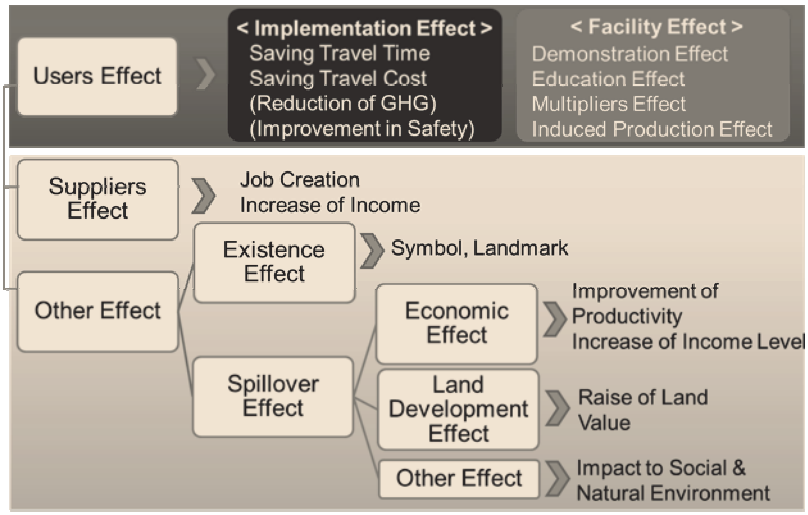
(b) **Direct and Indirect Effects:** Direct effects are the result of using transport project/infrastructure. Indirect effects occur as an improvement of productivity or income.

(c) **Classification of Project Effects:** Project effects are divided into users, suppliers and other effects.

The most significant is users effect, which is composed of implementation and facility effects. The implementation effect includes saving travel time and cost, reduction of GHG, and improvement in safety while the facility effect includes demonstration, education, multipliers, and induced production effects. The suppliers effect is during the construction stage and includes job creation and increase of income. The other effect is indirect and from the viewpoint of the beneficiary. This is divided into existence that is, for example, a large seaport or long-distance bridge project that could be a landmark for the project location; the spillover effects comprises of economic, land development, and other effects.

The evaluation of the project during the planning stage will focus on implementation effect.

Figure 2.1 Classification of Project Effects



Source: JICA Project Team

2) With and Without Case Project Comparison

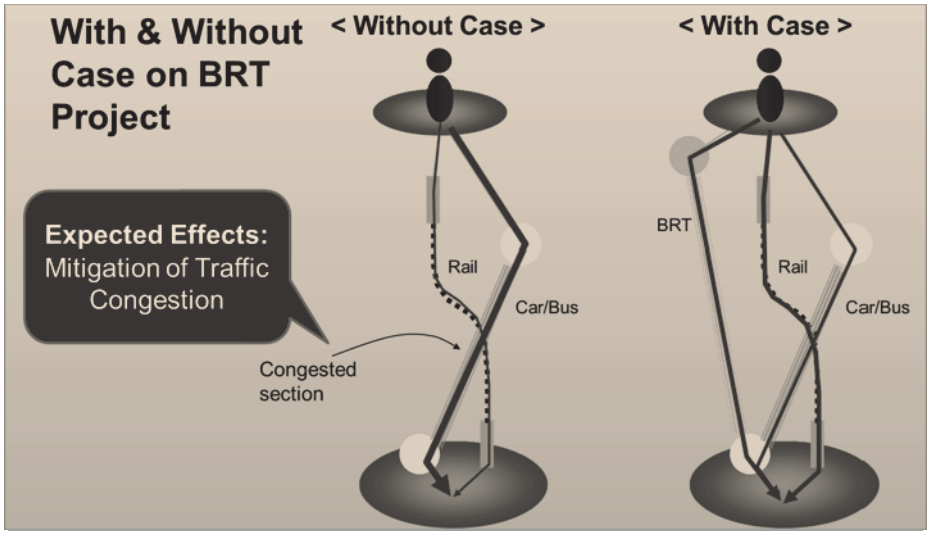
Project evaluation is based on the principle of comparing situations through 'with' and 'without' cases. The comparison is the basic concept in evaluating the viability of the project.

Figure 2.2 is an example of with and without case of a BRT project. The 'without' case is before the BRT construction, having only railway or car/bus as transportation modes and there having a traffic congestion between two points. Traffic congestion is shown to be

mitigated upon BRT project completion in the 'with' case.

The project evaluation uses comparisons to clarify project effects including traffic congestion mitigation.

Figure 2.2 Example of With and Without Case on Transport Project



Source: JICA Project Team

3 ECONOMIC EVALUATION

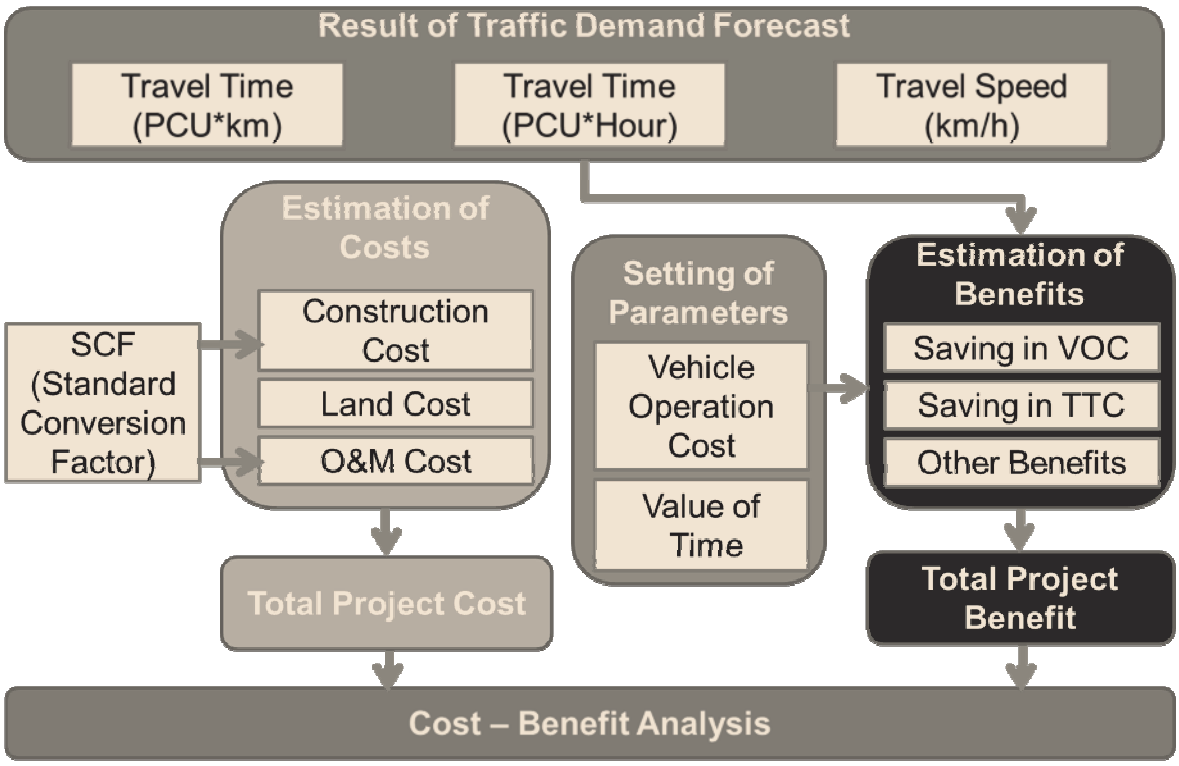
A traditional and generally accepted method for determining whether a proposed public infrastructure project deserves investment of public funds is economic evaluation. The viewpoint is that of the country and the government, and the yardstick is the Economic Internal Rate of Return (or EIRR).

3.1 Cost-Benefit Analysis

1) Outline of Cost-Benefit Analysis

Cost-benefit analysis is where project costs and benefits are measured by economic costs and compared throughout the project life. The process of cost-benefit analysis is shown in Figure 3.1. When benefits are estimated, the parameters that require money conversion especially vehicle operation cost and value of time are indispensable in economic evaluation. Cost estimation will correspondingly be required. The economic cost is simply estimated by multiplying SCF to the financial cost. The previous projects by JICA or ADB adopted this method using 0.83 as the value of SCF. Excluding land acquisition, project costs are converted using SCF.

Figure 3.1 Flow Chart of Cost-Benefit Analysis



Source: JICA Project Team

2) Economic Benefits to be Accounted

Table 3.1 shows the accounted and occasionally accounted economic benefits of the transportation sector. The parameter needed to estimate benefits will be required if for the reduction of traffic accident or exhaust gas, however, this is not often applicable to developing countries. Saving operation and travel time costs are particularly the main benefits of the transportation sector.

Table 3.1 Economic Benefits to Account

No.	Transportation Sector	Accounted	Occasionally Accounted
1	Urban Transportation	・Savings in Operating Cost ・Saving in TTC	・Reduction of Accidents ・Reduction of Exhaust Gas
2	Road Project	・Savings in VOC ・Savings in TTC	・Reduction of Accidents ・Reduction of Exhaust Gas
3	Railway Project	・Cost reduction from Alternative Travel Cost ・Savings in TTC ・Savings in Freight Transp. Cost	・Reduction of Accidents ・Reduction of Exhaust Gas
4	Port Project	・Reduction of T. Cost (on land) ・Reduction of T. Cost (at sea) ・Reduction of waiting time	・Reduction of Accidents ・Reduction of Exhaust Gas
5	Airport Project	・Cost reduction from Alternatives ・Reduction of TTC ・Reduction of waiting time (Freight)	・Reduction of Accidents ・Reduction of Exhaust Gas

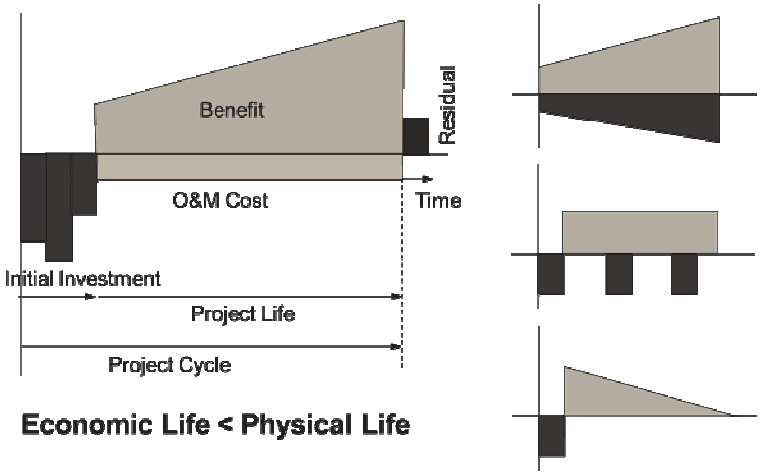
Source: JICA Project Team

3) Project Life on Cost-Benefit Analysis

The project life will be assumed on cost-benefit analysis. The durable life of a transportation project is usually long, at 50 to 60 years, if properly maintained. The economic project life is considered 30 years shorter than physical life because facilities become outdated and uneconomical due to rapid innovation. Generally, project life is composed of construction period and 30 years.

Social discount rate is decided corresponding to the country's economic situation. The social discount rate is assumed at 15%, which is also the opportunity cost of capital.

Figure 3.2 Benefit and Cost Flows in Project Life



Source: JICA Project Team

4) Economic Indicators

The three (3) major economic indicators are net present value, benefit cost ratio, and economic internal rate of return.

(a) **Net Present Value (NPV):** Net present value is calculated by project benefit and project cost, which are discounted by social discount rate. This indicator presents the magnitude of net benefits from the project directly, by Benefit –cost.

$$NPV= \Sigma\_(t=0)\text{^}T\ ((Bt-Ct)/(1+i)t)$$

(b) **Benefit Cost Ration (BCR):** BCR is also calculated by project benefit and cost. This is represented by benefit divided by cost. If the value is more than 1, this means that project is effective.

$$BCR = \Sigma_{(t=0)}^{T} [Bt/(1+i)t / \Sigma_{(t=0)}^{T} Ct/(1+i)t]$$

(c) **Economic Internal Rate of Return (EIRR):** EIRR is the discount rate that equates to the present values of the project's benefits and costs so that NPV is zero and BCR is one. If this indicator will be more than 15%, as in the case of the Philippine project, this will produce a net benefit from the social viewpoint.

$$EIRR: i \text{ which satisfies: } \Sigma_{(t=0)}^{T} (Bt-Ct)/(1+i)t = 0$$

5) Sensitivity Analysis

Changing the projected cost upward and the benefit downward creates a sensitivity analysis. The analysis is done using the "ICC Project Evaluation Procedures and Guidelines" of National Economic and Development Authority (NEDA).

3.2 Vehicle Operation Cost (VOC)

Vehicle Operation Cost (VOC) by vehicle type is required to evaluate the transportation project from an economical viewpoint. Vehicle classification should be consistent with those adopted in traffic surveys.

1) Components of VOC

VOC is composed of:

(i) Fuel Cost;
(ii) Oil Cost;
(iii) Tire Cost;
(iv) Repair Cost;
(v) Depreciation Cost;
(vi) Capital Opportunity Cost;
(vii) Crew Cost (personal expenses or commercial vehicles); and
(viii) Others, such as insurance tax and so on.

With these components, the VOC may be estimated by vehicle type and travel speed.

There are eight (8) vehicle classifications as shown in Table 3.2, each with representative models chosen for the study. Table 3.3 indicates prices and characteristics for each classification.

2) Fuel Cost

Based on the official website of the Department of Energy of the Philippines, gasoline and diesel costs in Metro Manila are 37.65 Peso/liter and 25.00 Peso/liter, respectively, as of September 2015. Using the assumed ratio of fuel type, the average fuel costs for each type of vehicle are calculated and presented in Table 3.4 below.

Table 3.2 Representative Models for Each Vehicle Classification

Vehicle Classification	Representative Models
Motorcycle	• Kawasaki HD III • Honda TMX 125 • Yamaha GS 125
Car	• Nissan Sentra • Honda City • Toyata Corolla • Toyata RAV4 sv 5Door 4x2 • Honda CR-V M/T 4x2 • Nissan Cefiro • Mitsubishi (Pajero)
HOV	• Toyota HI ACE Super Grandia • Mitsubishi Adventure • Nissan Urban • Isuzu Crosswind
Van	• Toyota HI ACE Super Grandia • L 300 Exceed DX • D-Max Pick Up 4x2 MT • L400 Space Gear • L200 Strada 4x4 • Mitsubishi Canter FE 639 • Isuzu NKR 4.3 MT GVW 4000
Jeepney (inc. franchise fee)	• Jeepney (Galvanized Iron Body) • Jeepney (Stainless Steel Body
Standard Bus	• CMC SP215NSB • Nissan RB46SXL • Hino FF1J
Small Truck	• Isuzu FSR • Isuzu FTR
Big Truck	• Hino SHEEVG TT & chassis BN b/ • Recon TT & chassis 20 ft.

Table 3.3 Price and Characteristics for Each Vehicle Classification

		Motorcycle	Car	HOV	Van	Jeepney	Standard Bus	Small Truck	Big Truck
Vehicle Price	Financial Price (USD)	79,695	1,082,206	1,092,617	1,812,710	1,054,250	972,000	5,500,000	1,825,781
	Tax Rate (%)	15	42-59	43-59	37-57	46	37	37	47
	Economic Price (USD)	69,300	631,024	633,401	1,095,293	637,009	665,753	4,014,599	1,332,687
Characteristics	No. of Tires	2	4	4	4	4	6	6	14
	Main Fuel	Gasoline	Gasoline	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
	Annual Operation (km)	7,500	17,500	60,000	25,000	70,000	80,000	50,000	50,000
	Average Speed (km/h)	30.0	35.0	25.0	16.7	38.9	36.4	33.3	33.3
	Annual Usage Hours (h)	250	500	2,400	1,500	1,800	2,200	1,500	1,500

Source: JICA Project Team based on the data on DPWH, 2010 and Hearing to Dealer in 2015

Table 3.4 Composition of Fuel Consumption and Average Fuel Cost by Type of Vehicle

	Motorcycle	Car	HOV	Van	Jeepney	Standard Bus	Small Truck	Big Truck
Fuel Type	Gasoline	Gasoline	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Average Financial Cost (Peso/liter)	37.65	37.65	25.00	25.00	25.00	25.00	25.00	25.00
Average Economic Cost (Peso/liter)	33.13	33.13	22.00	22.00	22.00	22.00	22.00	22.00

Source: JICA Project Team based on the fuel cost data as of 2015

The data of fuel consumption cost per vehicle classification are taken from previous studies. Fuel consumption rate for each operation speed may be calculated with this data. The difference in fuel consumption rates by speed is assumed based on past studies. Consequently, the financial and economic fuel costs for each speed level are also calculated as seen in Table 3.5.

Table 3.5 Fuel Consumption Rate and Cost by Type of Vehicle

	Speed (km/hr)	Motorcycle[1]	Car	HOV	Van	Jeepney	Standard Bus	Small Truck	Big Truck
Fuel Consumption Rate (Litter/1000Km)	5	67.8	212.6	337.2	337.2	487.2	672.7	605.2	1210.4
	10	44.2	138.6	215.8	215.8	311.7	430.4	387.3	774.5
	20	32.0	100.2	156.0	156.0	225.4	311.2	280.0	560.0
	30	27.7	87.0	122.2	122.2	205.8	284.2	235.0	412.0
	40	25.6	80.2	107.9	107.9	191.6	264.5	225.0	342.0
	50	25.0	78.4	101.4	101.4	205.8	284.2	220.0	314.0
	60	25.8	81.0	97.5	97.5	236.2	326.1	225.0	303.0
	70	27.3	85.7	98.2	98.2	275.9	380.9	230.0	314.0
	80	29.6	92.7	102.0	102.0	317.3	438.1	250.0	340.0
	90	32.7	102.4	112.7	112.7	350.5	483.9	276.2	375.6
Financial Fuel Cost (USD/1000km)	5	2,552	8,004	8,430	8,430	12,181	16,818	15,130	30,260
	10	1,664	5,218	5,395	5,395	7,793	10,760	9,683	19,363
	20	1,203	3,773	3,900	3,900	5,635	7,780	7,000	14,000
	30	1,044	3,276	3,055	3,055	5,146	7,105	5,875	10,300
	40	963	3,020	2,698	2,698	4,789	6,613	5,625	8,550
	50	941	2,952	2,535	2,535	5,146	7,105	5,500	7,850
	60	972	3,050	2,438	2,438	5,905	8,153	5,625	7,575
	70	1,029	3,227	2,455	2,455	6,897	9,523	5,750	7,850
	80	1,113	3,490	2,550	2,550	7,933	10,953	6,250	8,500
	90	1,229	3,855	2,818	2,818	8,762	12,098	6,905	9,390
Economic Fuel Cost (USD/1000km)	5	2,246	7,044	7,418	7,418	10,719	14,799	13,314	26,629
	10	1,464	4,592	4,748	4,748	6,858	9,469	8,521	17,039
	20	1,059	3,320	3,432	3,432	4,959	6,846	6,160	12,320
	30	919	2,882	2,688	2,688	4,528	6,252	5,170	9,064
	40	847	2,657	2,374	2,374	4,215	5,819	4,950	7,524
	50	828	2,598	2,231	2,231	4,528	6,252	4,840	6,908
	60	856	2,684	2,145	2,145	5,196	7,174	4,950	6,666
	70	905	2,839	2,160	2,160	6,069	8,380	5,060	6,908
	80	979	3,071	2,244	2,244	6,981	9,638	5,500	7,480
	90	1,082	3,393	2,479	2,479	7,710	10,646	6,076	8,263

Source: JICA Project Team based on the fuel cost data as of September, 2015; JICA Project Team based on MMUTIS Technical Report 1998, JICA
Note: [1] Based on the Study for the Formulation of High Speed Railway Projects on Hanoi – Ho Chi Minh -Nha Trang Sections
[2] Based on the Study on Energy Efficiency and Pollution Abatement by Replacement of the Jeepney Engines, 2007

3) Oil Cost

Oil consumption cost is also calculated. The unit cost of oil is obtained from the DOTC website and oil dealers. The financial and economic oil costs are calculated from the assumed oil consumption rates by speed based on past studies as shown below in Table 3.6.

Table 3.6 Oil Consumption Rate and Cost by Type of Vehicle

	Speed (km/hr)	Motorcycle	Car	HOV	Van	Jeepney	Standard Bus	Small Truck	Big Truck
Oil Consumption Rate (Liter/1000Km)	5	0.45	3.48	4.10	4.10	4.10	8.01	6.86	8.01
	10	0.29	2.24	2.63	2.63	2.63	5.14	4.40	5.14
	20	0.20	1.54	1.81	1.81	1.81	3.53	3.03	3.54
	30	0.16	1.27	1.49	1.49	1.49	2.92	2.50	2.92
	40	0.15	1.13	1.33	1.33	1.33	2.68	2.22	2.68
	50	0.14	1.10	1.29	1.29	1.29	2.58	2.08	2.58
	60	0.14	1.09	1.28	1.28	1.28	2.36	1.80	2.36
	70	0.14	1.07	1.26	1.26	1.26	2.14	1.68	2.14
	80	0.13	1.00	1.18	1.18	1.18	1.87	1.52	1.87
	90	0.12	0.90	1.06	1.06	1.06	1.68	1.37	1.68
Financial Oil Cost (Peso/1000km)	5	90	922	820	820	820	1,602	1,372	1,602
	10	58	594	526	526	526	1,028	880	1,028
	20	40	408	362	362	362	706	606	708
	30	33	337	298	298	298	584	500	584
	40	29	299	266	266	266	536	444	536
	50	29	292	258	258	258	516	416	516
	60	28	289	256	256	256	472	360	472
	70	28	284	252	252	252	428	336	428
	80	26	265	236	236	236	374	304	374
	90	23	239	212	212	212	336	274	336
Economic Oil Cost (Peso1000km)	5	76	802	705	705	705	1,378	1,180	1,378
	10	49	516	452	452	452	884	757	884
	20	34	355	311	311	311	607	521	609
	30	28	293	256	256	256	502	430	502
	40	25	261	229	229	229	461	382	461
	50	24	254	222	222	222	444	358	444
	60	24	251	220	220	220	406	310	406
	70	23	247	217	217	217	368	289	368
	80	22	231	203	203	203	322	261	322
	90	20	207	182	182	182	289	236	289

Source: JICA Project Team based on MMUTIS Technical Report 1998, JICA
Note: Oil prices by vehicle type are from hearing to dealer as of October, 2015.

4) Tire Cost

Tire cost data is also collected. Tire life is assumed based on DPWH data in 2010 and other previous studies.

Table 3.7 Financial and Economic Costs of Tires

	Motorcycle	Car	HOV	Van	Jeepney	Standard Bus	Small Truck	Big Truck
No. of Tires (no./set)	2	4	4	4	4	6	6	14
Unit Financial Cost (USD)	625	4,404	5,268	5,268	7,327	13,931	17,285	20,779
Financial Cost (USD/set)	1,250	17,615	21,072	21,072	29,309	83,583	103,712	290,904
Economic Cost (USD/set)[1]	1,136	16,013	19,157	19,157	26,645	75,985	94,284	264,458
Tire Life (km)	12,000	45,000	50,000	50,000	50,000	50,000	45,000	50,000

Source: JICA Project team based on DPWH data in 2010 and hearing to dealers, October 2015
Note: [1] 10% VAT is considered to calculate economic cost

5) Repair Cost

Vehicle repair cost is estimated by assuming the percentage of annual repair cost to the vehicle cost exclusive of tire cost (see Table 3.9). Additionally, assuming that vehicle repair cost per distance changes by speed, the cost for each speed is also calculated (see Table 3.10).

Table 3.8 Tire Consumption Rate and Cost by Type of Vehicle

	Speed (km/hr)	Motorcycle	Car	HOV	Van	Jeepney	Standard Bus	Small Truck	Big Truck
Tire Consumption Indices (56km/hr = 100 %)	5	53	53	53	53	53	53	53	53
	10	56	56	56	56	56	56	56	56
	20	60	60	60	60	60	60	60	60
	30	67.0	67.0	67	67	67.0	67.0	67.0	67.0
	40	78.0	78.0	78	78	78.0	78.0	78.0	78.0
	50	92	92	92	92	92	92	92	92
	56	100	100	100	100	100	100	100	100
	60	107	107	107	107	107	107	107	107
	70	125	125	125	125	125	125	125	125
	80	151	151	151	151	151	151	151	151
	90	180	180	180	180	180	180	180	180
Financial Tire Cost (USD/1000km)	5	55.2	207.5	223.4	223.4	310.7	886.0	1221.5	3083.6
	10	58.3	219.2	236.0	236.0	328.3	936.1	1290.6	3258.1
	20	62.5	234.9	252.9	252.9	351.7	1003.0	1382.8	3490.8
	30	69.8	262.3	282.4	282.4	392.7	1120.0	1544.2	3898.1
	40	81.2	305.3	328.7	328.7	457.2	1303.9	1797.7	4538.1
	50	95.8	360.1	387.7	387.7	539.3	1537.9	2120.3	5352.6
	60	111.4	418.8	450.9	450.9	627.2	1788.7	2466.1	6225.3
	70	130.2	489.3	526.8	526.8	732.7	2089.6	2880.9	7272.6
	80	157.3	591.1	636.4	636.4	885.1	2524.2	3480.1	8785.3
	90	187.5	704.6	758.6	758.6	1055.1	3009.0	4148.5	10472.5
Economic Tire Cost (USD/1000km)	5	50.2	188.6	203.1	203.1	282.4	805.4	1110.5	2803.3
	10	53.0	199.3	214.6	214.6	298.4	851.0	1173.3	2961.9
	20	56.8	213.5	229.9	229.9	319.7	911.8	1257.1	3173.5
	30	63.4	238.4	256.7	256.7	357.0	1018.2	1403.8	3543.7
	40	73.9	277.6	298.8	298.8	415.7	1185.4	1634.3	4125.5
	50	87.1	327.4	352.5	352.5	490.3	1398.1	1927.6	4866.0
	60	101.3	380.8	409.9	409.9	570.2	1626.1	2241.9	5659.4
	70	118.4	444.8	478.9	478.9	666.1	1899.6	2619.0	6611.5
	80	143.0	537.3	578.5	578.5	804.7	2294.7	3163.8	7986.6
	90	170.4	640.5	689.6	689.6	959.2	2735.5	3771.4	9520.5

Source: JICA Project team based on MMUTIS Technical Report 1998, JICA

Table 3.9 Repair Cost Estimation by Type of Vehicle

	Motorcycle	Car	HOV	Van	Jeepney	Standard Bus	Small Truck	Big Truck
Financial Vehicle Cost w/o Tire (USD)	78,445	1,064,591	1,071,545	1,791,638	942,691	5,416,417	1,722,069	2,084,096
Economic Vehicle Cost w/o Tire (USD)	68,164	615,010	614,245	1,076,137	639,109	3,938,614	1,238,403	1,351,188
Annual Repair Cost								
% of Vehicle Cost	4.0	4.0	8.0	8.0	8.0	8.0	8.0	8.0
Financial Cost (USD)	3,138	42,584	85,724	143,331	75,415	433,313	137,765	166,728
Economic Cost (USD)	2,727	24,600	49,140	86,091	51,129	315,089	99,072	108,095
Annual Operation (km)	7,500	17,500	60,000	25,000	70,000	80,000	50,000	50,000
Average Speed (km)	30	25	25	17	39	36	33	33
Financial Repair Cost (USD/1000km)	418.4	2433.4	1428.7	5733.2	1077.4	5416.4	2755.3	3334.6
Economic Repair Cost (USD/1000km)	363.5	1405.7	819.0	3443.6	730.4	3938.6	1981.4	2161.9

Source: JICA Project Team

Table 3.10 Repair Consumption Rate and Cost by Type of Vehicle

	Speed (km/hr)	Motorcycle	Car	HOV	Van	Jeepney	Standard Bus	Small Truck	Big Truck
Repair Cost Rate by Speed (%)	5	141	141	142	142	142	134	159	159
	10	133	133	131	131	131	126	147	147
	20	118	118	111	111	111	113	124	124
	30	105	105	89	89	89	100	100	100
	40	95	95	74	74	74	94	83	83
	50	94	94	72	72	72	93	81	81
	60	100	100	79	79	79	100	88	88
	70	108	108	88	88	88	107	98	98
	80	115	115	100	100	100	114	112	112
	90	122	122	112	112	112	120	125	125
Financial Tire Cost (USD/1000km)	5	589.9	3431.0	2032.0	8153.9	1532.2	7256.9	4385.5	5307.5
	10	556.4	3236.4	1873.2	7516.9	1412.5	6836.3	4041.1	4890.7
	20	493.7	2871.4	1587.5	6370.3	1197.1	6100.0	3421.2	4140.4
	30	439.3	2555.0	1270.0	5096.2	957.7	5416.4	2755.3	3334.6
	40	397.5	2311.7	1063.6	4268.1	802.0	5100.9	2296.1	2778.8
	50	393.3	2287.3	1031.9	4140.7	778.1	5048.3	2227.2	2695.4
	60	418.4	2433.4	1127.1	4522.9	849.9	5416.4	2410.9	2917.7
	70	451.8	2628.0	1254.1	5032.5	945.7	5784.5	2686.4	3251.2
	80	481.1	2798.4	1428.7	5733.2	1077.4	6152.6	3076.8	3723.6
	90	510.4	2968.7	1603.3	6434.0	1209.0	6520.7	3444.1	4168.2
Economic Tire Cost (USD/1000km)	5	512.6	1982.1	1164.8	4897.6	1038.8	5277.0	3153.8	3441.0
	10	483.5	1869.6	1073.8	4515.0	957.6	4971.1	2906.1	3170.8
	20	429.0	1658.8	910.0	3826.3	811.6	4435.7	2460.3	2684.4
	30	381.7	1476.0	728.0	3061.0	649.3	3938.6	1981.4	2161.9
	40	345.4	1335.5	609.7	2563.6	543.7	3709.2	1651.2	1801.6
	50	341.7	1321.4	591.5	2487.1	527.5	3670.9	1601.7	1747.5
	60	363.5	1405.7	646.1	2716.6	576.2	3938.6	1733.8	1891.7
	70	392.6	1518.2	718.9	3022.7	641.1	4206.3	1931.9	2107.9
	80	418.1	1616.6	819.0	3443.6	730.4	4474.0	2212.6	2414.1
	90	443.5	1715.0	919.1	3864.5	819.7	4741.6	2476.8	2702.4

Source: JICA Project Team

6) Depreciation Cost

Vehicle depreciation cost is calculated by assuming the percentage of salvage value to the vehicle cost and ratio of depreciation due to use and time. The results of this estimation are shown in Table 3.11.

In regards to depreciation cost, the cost per distance is calculated for each speed level assuming the fluctuation of cost by speed (see Table 3.12).

Table 3.11 Depreciation Cost Estimation by Type of Vehicle

	Motorcycle	Car	HOV	Van	Jeepney	Standard Bus	Small Truck	Big Truck
Vehicle Cost w/o Tire								
Financial	78,445	1,064,591	1,071,545	1,791,638	942,691	5,416,417	1,722,069	2,084,096
Economic	68,164	615,010	614,245	1,076,137	639,109	3,938,614	1,238,403	1,351,188
Salvage Value								
% of Vehicle Cost	25.0	25.0	20.0	20.0	20.0	20.0	15.0	15.0
Financial Cost (Peso)	19,611	266,148	214,309	358,328	188,538	1,083,283	258,310	312,614
Economic Cost (Peso)	17,041	153,753	122,849	215,227	127,822	787,723	185,760	202,678
% of Depreciation of Use & Time								
Subject to use (%)	50	50	70	70	70	70	70	70
Subject to time (%)	50	50	30	30	30	30	30	30
Depreciable Amount								
Financial								
Subject to use (Peso)	29,417	399,222	600,065	1,003,317	527,907	3,033,193	1,024,631	1,240,037
Subject to time (Peso)	29,417	399,222	257,171	429,993	226,246	1,299,940	439,128	531,444
Total (USD)	58,834	798,443	857,236	1,433,310	754,153	4,333,133	1,463,758	1,771,482
Economic								
Subject to use (Peso)	25,561	230,629	343,977	602,636	357,901	2,205,624	736,850	803,957
Subject to time (Peso)	25,561	230,629	147,419	258,273	153,386	945,267	315,793	344,553
Total (Peso)	51,123	461,258	491,396	860,909	511,287	3,150,891	1,052,643	1,148,510

Source: JICA Project Team
Note: Costs are calculated applying assumed annual operation distance, average speed and vehicle life.

Table 3.12 Capital Opportunity Cost by Type of Vehicle

	Motorcycle	Car	HOV	Van	Jeepney	Standard Bus	Small Truck	Big Truck
Vehicle Cost w/o Tire								
Financial	78,445	1,064,591	1,071,545	1,791,638	942,691	5,416,417	1,722,069	2,084,096
Economic	68,164	615,010	614,245	1,076,137	639,109	3,938,614	1,238,403	1,351,188
Salvage Value								
% of Vehicle Cost	25.0	25.0	20.0	20.0	20.0	20.0	15.0	15.0
Financial	19,611	266,148	214,309	358,328	188,538	1,083,283	258,310	312,614
Economic	17,041	153,753	122,849	215,227	127,822	787,723	185,760	202,678
Interest rate (i = 12%)	12%	12%	12%	12%	12%	12%	12%	12%
Operational Information								
Annual Operation (km)	7,500	17,500	60,000	25,000	70,000	80,000	50,000	50,000
Average Speed (km/hr)	30	35	2,400	1,500	39	36	33	33
Vehicle Life (year)	12	15	25	17	12	12	15	15
Financial Cost								
Daily Cost (USD/Day)	19.61	266.15	257.17	429.99	226.25	1299.94	396.08	479.34
Hourly Cost (USD/Hr)	23.53	159.69	32.15	86.00	37.71	177.26	79.22	95.87
Economic Cost								
Daily Cost (USD/Day)	21.30	192.19	184.27	322.84	191.73	1181.58	356.04	388.47
Hourly Cost (USD/Hr)	25.56	115.31	23.03	64.57	31.96	161.13	71.21	77.69

Source: JICA Project Team

7) Crew Cost and Others

The estimated costs of crew, overhead and others by type of vehicle are shown in Table 3.13. Data on driver wages were obtained through interviews with transport companies.

Table 3.13 Crew Cost, Overhead Cost, and Other Costs by Type of Vehicle

	Motorcycle	Car	HOV	Van	Jeepney	Standard Bus	Small Truck	Big Truck
Annual Crew Cost								
Financial (Peso/year)			135,960	135,960	135,960	279,816	736,368	736,368
Economic (Peso/year)			135,960	135,960	135,960	279,816	736,368	736,368
Annual Overhead and Other Costs								
Financial (Peso/year)	900	4,611			3,168	41,282	51,681	52,397
Economic (Peso/year)	600	1,011			1,168	38,282	49,381	49,397
Daily Total Cost								
Financial (Peso/day)	3.00	15.37	465.10	465.10	463.76	1,070.33	2,626.83	2,629.22
Economic (Peso/day)	2.00	3.37	457.94	457.94	457.09	1,060.33	2,619.16	2,619.22
Hourly Total Cost								
Financial (Peso/hour)	3.60	9.22	58.14	93.02	77.29	145.95	525.37	525.84
Economic (Peso/hour)	2.40	2.02	57.24	91.59	76.18	144.59	523.83	523.84

Source: JICA Project Team
Note: Annual crew cost is assumed based on DPWH Data in 2010.

8) Total Vehicle Operation Cost by Type of Vehicle

The total VOC is the sum of the estimated costs mentioned above. The VOC subject to use, which includes fuel cost, oil cost, tire cost, repair cost and depreciation cost, is shown in Table 3.14. The VOC subject to time, that includes depreciation cost, capital opportunity cost, and crew and overhead cost, is shown in Table 3.15. Table 3.16 shows the total VOC.

Table 3.14 VOC Subject to Use (Peso/1,000 km)

	Speed (km/hr)	Motorcycle	Car	HOV	Van	Jeepney	Standard Bus	Small Truck	Big Truck
Financial Cost	5	3,734	14,640	12,596	22,002	15,666	30,558	24,105	42,668
	10	2,726	11,077	9,057	17,796	10,835	23,370	17,759	30,797
	20	2,133	8,838	7,003	14,501	8,225	19,058	14,038	24,309
	30	1,913	7,950	5,739	12,076	7,423	17,385	12,041	19,770
	40	1,765	7,457	5,027	10,254	6,821	16,573	11,339	17,826
	50	1,737	7,183	4,879	9,997	7,224	17,212	11,428	17,823
	60	1,827	7,578	4,945	10,458	8,127	18,872	11,936	18,278
	70	1,953	8,108	5,169	11,228	9,293	20,869	12,581	19,379
	80	2,110	8,716	5,570	12,372	10,604	23,069	13,997	21,667
	90	2,315	9,491	6,179	13,752	11,754	25,134	15,743	24,664
Economic Cost	5	3,272	11,216	10,672	16,408	14,075	25,165	20,194	35,817
	10	2,388	8,223	7,066	12,394	9,076	18,946	14,698	25,519
	20	1,868	6,443	5,384	9,956	6,841	15,324	11,569	20,064
	30	1,676	5,768	4,380	8,244	6,180	14,009	9,968	16,344
	40	1,547	5,409	3,854	7,041	5,687	13,371	9,463	14,835
	50	1,523	5,247	3,725	6,846	6,034	13,950	9,564	14,879
	60	1,602	5,514	3,767	7,128	6,842	15,336	9,977	15,222
	70	1,712	5,881	3,913	7,607	7,847	17,013	10,488	16,097
	80	1,850	6,330	4,151	8,298	8,908	18,879	11,661	17,992
	90	2,031	6,914	4,581	9,199	9,844	20,629	13,132	20,528

Source: JICA Project Team

Table 3.15 VOC Subject to Time (Peso/Hour)

	Motorcycle	Car	HOV	Van	Jeepney	Standard Bus	Small Truck	Big Truck
Financial Cost								
Depreciation	9.8	53.2	8.9	23.9	10.5	49.2	19.5	23.6
Capital Opportunity Cost	23.5	159.7	32.1	86.0	177.3	37.7	177.3	79.2
Crew and Overhead Cost	3.6	9.2	58.1	93.0	146.0	77.3	146.0	525.4
Total	36.9	222.1	99.2	202.9	125.5	372.5	624.1	645.3
Economic Cost								
Depreciation	8.5	30.8	5.1	14.3	7.1	35.8	14.0	15.3
Capital Opportunity Cost	25.6	115.3	23.0	64.6	161.1	32.0	161.1	71.2
Crew and Overhead Cost	2.4	2.0	57.2	91.6	144.6	76.2	144.6	523.8
Total	36.5	148.1	85.4	170.5	115.2	341.5	609.1	616.9

Source: JICA Project Team

Table 3.16 Total VOC (Peso/1000 km)

	Speed (km/hr)	Motorcycle	Car	HOV	Van	Jeepney	Standard Bus	Small Truck	Big Truck
Financial Cost	5	11,122	59,068	32,438	62,584	40,761	105,050	148,924	171,735
	10	6,420	33,291	18,979	38,086	23,382	60,616	80,169	95,330
	20	3,980	19,945	11,964	24,646	14,499	37,681	45,242	56,576
	30	3,145	15,355	9,046	18,840	11,605	29,800	32,844	41,281
	40	2,689	13,010	7,507	15,327	9,958	25,885	26,941	33,960
	50	2,476	11,626	6,864	14,055	9,734	24,661	23,910	30,730
	60	2,443	11,280	6,598	13,840	10,218	25,080	22,338	29,034
	70	2,481	11,282	6,586	14,126	11,085	26,190	21,497	28,598
	80	2,572	11,492	6,811	14,909	12,172	27,725	21,798	29,734
	90	2,726	11,960	7,282	16,006	13,148	29,272	22,677	31,834
Economic Cost	5	10,569	40,833	27,751	50,508	37,123	93,469	142,009	159,187
	10	6,036	23,032	15,605	29,444	20,599	53,098	75,606	87,204
	20	3,692	13,848	9,654	18,481	12,603	32,400	42,023	50,906
	30	2,892	10,705	7,227	13,928	10,021	25,393	30,270	36,905
	40	2,459	9,111	5,989	11,303	8,568	21,909	24,690	30,256
	50	2,252	8,208	5,433	10,256	8,339	20,781	21,746	27,216
	60	2,210	7,982	5,190	9,970	8,763	21,028	20,128	25,503
	70	2,234	7,997	5,133	10,043	9,493	21,892	19,189	24,909
	80	2,306	8,181	5,219	10,430	10,349	23,148	19,274	25,703
	90	2,437	8,560	5,530	11,093	11,124	24,424	19,899	27,381

Source: JICA Project Team

3.3 Time Value

1) Methodology to Estimate Time Value

Below are the methodologies to estimate time value:

Economic Time Value:

- Value added to be produced in the time
- Income Approach

Behavioral Time Value;

- Preference Approach and Stated Preference Survey (SP Survey)
- Willingness to Pay or Conjoint Value Method (CVM)

(a) **Income Approach:** Income approach is the simplest method. Time values by

transportation mode are estimated using individual income and assuming certain working hours per month.

Time Value = Individual Income (PHP/Month) / Assumed Working Time

(b) **Preference Approach:**

$$\text{Logit Model} = \frac{1}{1 + Exp(aT + bM + d)}$$

$$\text{Time Value} = \frac{\text{Cost}}{\text{Time}} = \frac{\text{a (Parameter of Time)}}{\text{b(Parameter of Cost)}}$$

T: Travel Time, M: Travel Cost

(c) **Stated Preference Survey:** To obtain sufficient parameters to forecast future modal shares, results of the Stated Preference (SP) Survey are considered effective. Results can be used not only to construct the forecasting model, but also to know the current value of time for transportation users. The purpose of SP Surveys is to collect data to build the modal choice model (Logit Model) and data related to personnel income by mode.

(d) **Willingness to Pay:** In economics, the willingness-to-pay (WTP) level is the maximum amount a person would be willing to pay in exchange for good service, such as travel timesavings in the transportation sector.

$$WTP^* = \exp\left(-\frac{\beta_0 + \sum \beta_k x_k}{\beta_T}\right)$$

2) Estimation of Time Value

Time Values by transport mode are calculated by income approach using the trip information and individual income on MUCEP database.

(a) **Assumption of Working Time:** Monthly working hours was assumed at 167.69 (hours/month) based on the following information.

Table 3.17 Condition to Assume Working Hours/Month

Item		Unit	Remarks
Mean number of hours worked in a week	40.9*	Hours	
Working Hours	8.18	Hours/Day	5 working day/week
Day off on Saturday, Sunday, Holiday and Special Non-Working Day in 2014 (17 days (15 days on weekday))	119	Day	52 weeks * 2 weekend + 15 days on weekday
Working day/year	246	Day/Year	
Working day/month	20.5	Day/Month	
Monthly Working Hour	167.69	Hours/Month	

Source: JICA Project Team
*Philippine Statistics Authority, Annual Labor and Employment Estimates for 2014.

(b) **Result of Time Value by Transport Mode:** The results of estimated time value by transport mode are shown in the following table.

Table 3.18 Results of Time Value by Transport Mode

No.	Mode	(PHP/Min.)
1	MC	1.11
2	Car	1.80
3	Taxi	1.54
4	Jeepney	0.92
5	Bus	1.18
6	HOV	1.41
7	Truck	1.18
8	Pedicab	0.63
9	Walk	0.72
10	Other Land Transport	0.77
11	Railway	1.28
12	Water Transport	0.60
13	Air Transport	1.93
14	Others	1.00

Source: JICA Project Team

3) Examples on Previous Studies

Estimations of time value by various methods are shown below.

(a) **Income Approach in JICA Study in Pakistan:** Time values by transport mode were estimated using travel behavior survey as shown in the following table. Time value at the benchmark years were measured using the ratio among the estimated per-capita GDP in 2010, 2020 and 2030.

Table 3.19 Estimated Time Values by Income Approach in Previous Study

Estimates of Time Value by Income Approach

Mode	Ave. Income (Rs./Mon.)	Time of Value (Rs. /Min.)	Sample Size
(1) Car	38,836	3.68	525
(2) Rickshaw	19,104	1.81	461
(3) Qinggi	14,166	1.34	104
(4) Wagon	15,131	1.43	143
(5) Bus	15,011	1.42	304
(6) AC Bus	23,497	2.23	90

Time Value at Benchmark Years

Mode	2010	2020	2030
(1) Car	3.68	5.03	7.49
(2) Rickshaw	1.81	2.47	3.68
(3) Qinggi	1.34	1.83	2.73
(4) Wagon	1.43	1.96	2.91
(5) Bus	1.42	1.94	2.89
(6) AC Bus	2.23	3.05	4.54

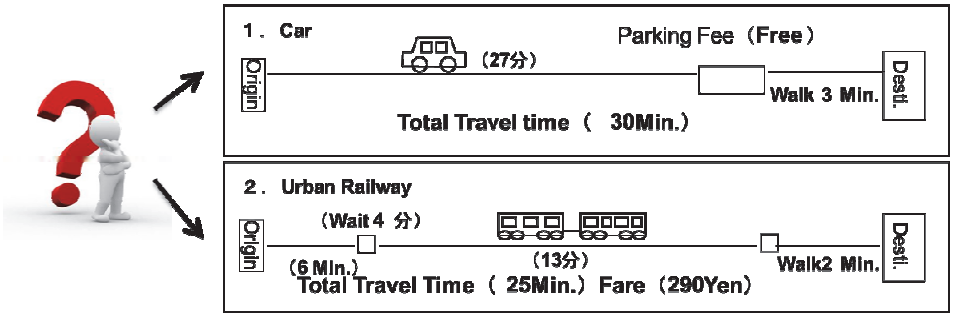
Using the ratio of the estimated per-capita GDP in 2020 & 2030 and per-capita GDP in 2010

Source: JICA Project Team

(b) **Preference Approach & SP Survey:** The preference approach is by formula of logit model. The design of SP survey form is the most important in the formula model. Figure 3.3 shows the design of SP survey, formulated logit mode, then the time value result as it is in the case of Japan.

Figure 3.3 Time Value Estimation by Preference Approach & SP Survey

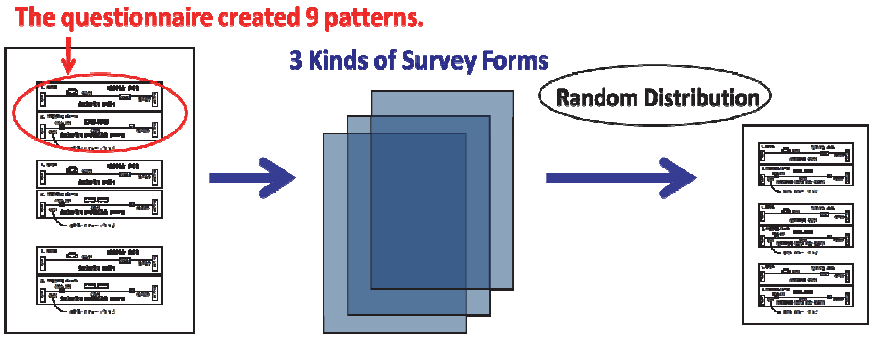
1. Design of Questionnaire



2. Setting of Level Service

Mode	Variable		Level 1	Level 2	Level 3
Car	Travel Time	(min.)	27	35	41
	Parking Fee	(JPY/day)	free	500	1,000
Bus	Travel Time	(min.)	33	43	50
	Waiting Time	(min.)	5	7	9
Railway	Access Time	(min.)	6	9	15
	Waiting Time	(min.)	4	6	8
	Fare	(JPY)	290	320	350
	Egress Time	(min.)	2	4	6

3. Procedure of SP Survey Implementation



4. Parameter Estimates in Modal Split Model

Explanatory Variable		Parameter	T-Value
Time (a)	Total Time	-0.0263	(-7.9)
Cost (b)	Total Cost	-0.000584	(-2.0)
Car Ownership	Car User	0.601	(8.4)
Dummy	Railway User	0.307	(2.6)
Constant	Car User	-0.274	(-2.0)
Constant	Bus User	-1.310	(-7.5)
Likelihood Ratio Index			0.226
Percent Correctly Predicted			70.0%
No. of Samples			2,033

5. Estimating Time Value

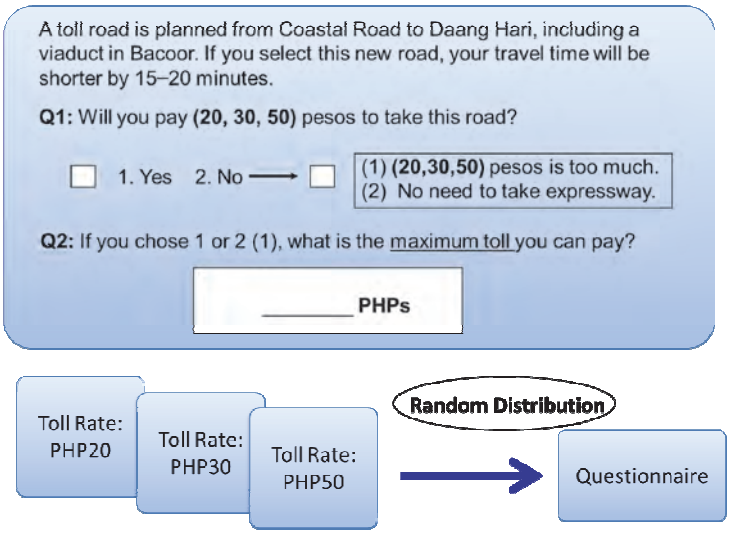
$$\text{Time Value} = \frac{Cost}{Time} = \frac{a}{b} = \frac{-0.0263}{-0.000584} = \text{JYN } 45.0$$

Source: JICA Project Team

(c) **Willingness-to-pay Survey for Expressway Service in CALA Study:** This SP Survey was conducted to obtain data on highway users' willingness to pay for expressway services. Survey results were analyzed using contingent valuation method (CVM).

Surveyors interviewed vehicle drivers at gas stations along Aguinaldo Highway. The purpose of the survey was explained initially before the interview. Following the single bound binary choice method, three kinds of survey sheets were used indicated with different toll rates.

Figure 3.4 Questionnaire about Willingness to Pay for Expressway Services

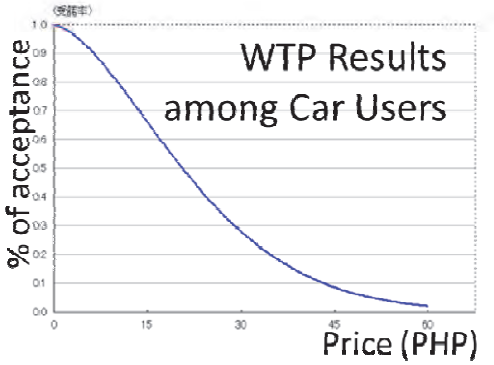


Source: JICA Project Team

Figure 3.5 Estimated Time Value by Willingness to Pay for Expressway Services

Results by Mode

Mode	Ave. (PHP)	Median (PHP)	Time Value (PHP/min.)	Sample
Car	23.01	20.64	1.31	766
Jeep/Van	18.21	15.76	1.04	336
Truck/ Cargo van	28.88	27.35	1.65	101
Total	22.28	19.86	1.27	1,203



Source: JICA Project Team

4 FINANCIAL EVALUATION

1) Financial Analysis

Financial analysis looks at the cash flows of a project with disregard to borrowings or capital leveraging. The focus is on the project itself, as though it is an enterprise that is debt-free and exempt from income taxes. The yardstick is the Financial Internal Rate of Return or FIRR that is calculated similarly as the EIRR, but with different cash flow streams.

2) Financial Indicators and Evaluation Criteria

There are different methods to compute FIRR based on the cash flow. Project IRR is normal FIRR; only compare investment and O&M cost with the revenue. This does not include loan, equity, interest, repayment, dividend, and depreciation in O&M Cost.

(a) **Project IRR:** Project IRR is defined as the discount rate that equates to the project's revenue and costs. If this discount rate is high, the project profitability will be high. If the FIRR will be more than 20% it will be an attractive business for private investor.

- Compare (Investment + O&M Cost) with (Revenue)
- Do not include Loan, Equity, Interest, Repayment and Dividend
- Do not include Depreciation in O&M Cost

(b) **Equity IRR:** Equity IRR is an indicator to check profitability for shareholders.

- Compare (Equity) with (Dividend + Residuals)

(c) **Financier's IRR:** Financier's IRR is another indicator from the financer's viewpoint.

- Compare (Loan) with (Interest + Repayment)

(d) **WACC (Weighted Average Cost of Capital):** Combination of the ODA loan interest rate and that in Philippines. This is applied to evaluate the financial viability of this project by ODA loan.

WACC is assumed as 1.37% in case of STEP loan under the following requirements:

Threshold Value 1 (STEP):

Japanese ODA Loan (STEP): Interest rate: 0.2%, 85% of finance source.
Philippines Local Fund: Interest rate: 8%, 15% of finance source.
WACC = 85% * 0.2% + 15% * 8% = 1.37%

Threshold Value 2 (Soft Loan):

Japanese ODA Loan (Soft Loan): Interest rate: 1.40%, 85% of finance source.
Philippines Local Fund: Interest rate: 8%, 15% of finance source.
WACC = 85% * 1.4% + 15% * 8% = 2.39%

STEP, or Special Term for Economic Partnership, is one of the ODA loans introduced by the Japanese Government in 2002. This is expected to raise the visibility of Japan's ODA to the citizens in recipient countries and Japan by utilizing and transferring good technologies and know-how of Japanese firms. WACC will be threshold value to evaluate applicability of ODA loan.

3) Sensitivity Analysis

Sensitivity analysis is made by changing the projected cost upward and revenue downward. This analysis is done using the scenarios in the "ICC Project Evaluation Procedures and Guidelines" of NEDA.

Scenario I: Increase in projected costs by 10% or 20%

Scenario II: Decrease in revenues by 10% or 20%

Scenario III: Combination of Scenario I and II

Table 4.1 Sensitive Analysis by Changing Cost and Revenue

Changing in Cost & Revenue		Cost Increase		
		Base Case	10% Up	20% Up
Revenue Decrease	Base Case			
	10% Down			
	20% Down			

Source: JICA Project Team

4) Financial Statements

(a) **Income Statement (Profit & Loss Statement):** Cost deduction from revenue, profit (or loss) in the fiscal period.

Income statement is a company's financial statement presenting how the revenue is transformed into net income. It shows the revenues for a specific period and the cost and expenses charged against these revenues, including write-offs and taxes. The purpose of the income statement is to show managers and investors whether the company made or lost funds on a given period. The structure of an income statement is shown below.

Table 4.2 Structure of Income Statement

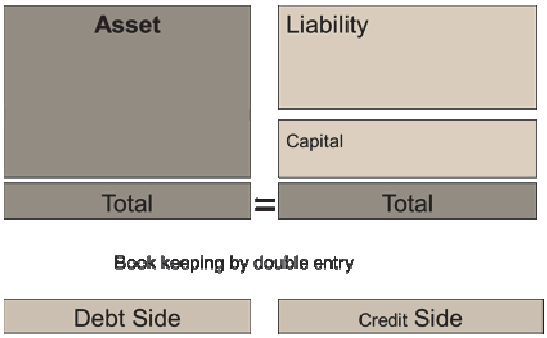
	Year		
	2013	2014	2015
Revenue			
Sales (Proceed)			
Other Revenue			
Interest received			
Expenditure (Cost)			
Operating Expense			
Depreciation			
Interest Paid			
Profit before Tax			
Tax			
Profit after tax			
Accumulated profit after tax			

Source: JICA Project Team

(b) **Balance Sheet:** Description of assets at the end of fiscal period

In financial accounting, a balance sheet is a summary of the financial balances. Assets, liabilities, and ownership equity are listed under a specific date such as the end of a financial year. A standard company balance sheet has three parts: Assets, liabilities and capital. The main categories of assets are usually listed first, and typically in order of liquidity. Assets are then followed by liabilities. The difference between the assets and liabilities is known as equity or net assets, or net worth or capital of the company. According to the accounting equation, the net worth must be the difference of assets minus liabilities. This sheet focuses on the in-flow and outflow of cash.

Figure 4.1 Structure of Balance Sheet



Source: JICA Project Team

(c) **Cash Flow:** Description of inflow and outflow in a fiscal period

Cash flow is the movement of money into or out of a project. This will be used to check whether procurement and operation method of the project body is appropriate or not.

Table 4.3 Structure of Cash Flow

	Year		
	2013	2014	2015
Cash Inflow			
Sales (Proceed)			
Depreciation			
Interest Received			
Other Revenue			
Cash Outflow			
Operating Expense			
Interest Paid			
Tax Paid			
Loan Repayment			
Dividend			
Cash Balance			
Accumulated Cash Balance			

Source: JICA Project Team

5 EXERCISE ON ECONOMIC EVALUATION

1) Outline of Exercise

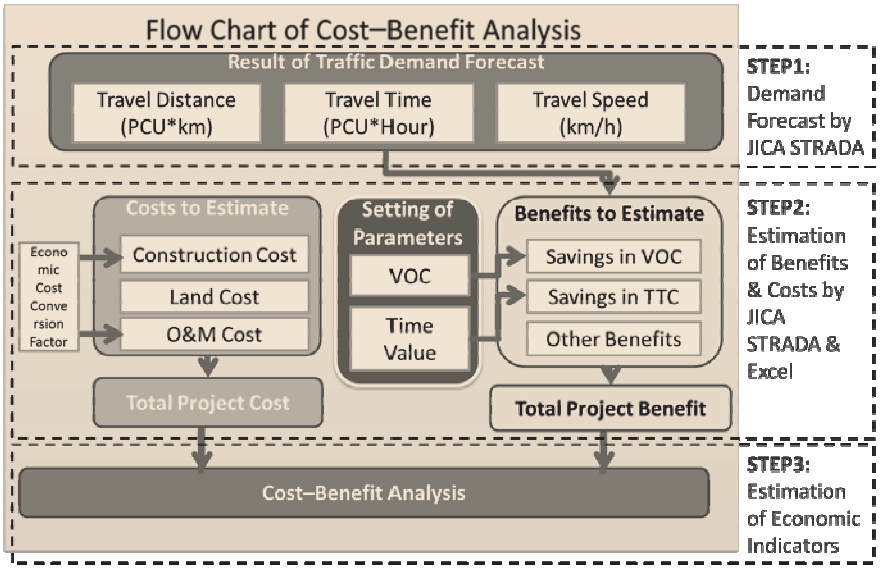
Exercise on economic evaluation is divided into 3 steps:

Step 1: Demand Forecast by JICA STRADA/Cube (Demand Forecast Software)

Step 2: Estimation of Benefit and Costs

Step 3: Estimation of Economic Indicators

Figure 5.1 Outline of Exercise on Economic Evaluation



Source: JICA Project Team

2) Pre-Condition of Exercise

Exercise:

> Traffic congestion is getting serious in the Model City as shown in the following figures. Road improvement project is planned in CBD of this city in order to mitigate traffic congestion. Please evaluate the economic feasibility of this project, based on the result of transport demand forecast.

3) Step 1: Traffic Demand Forecast by JICA STRADA/CUBE

(1) With- and Without-project Comparison

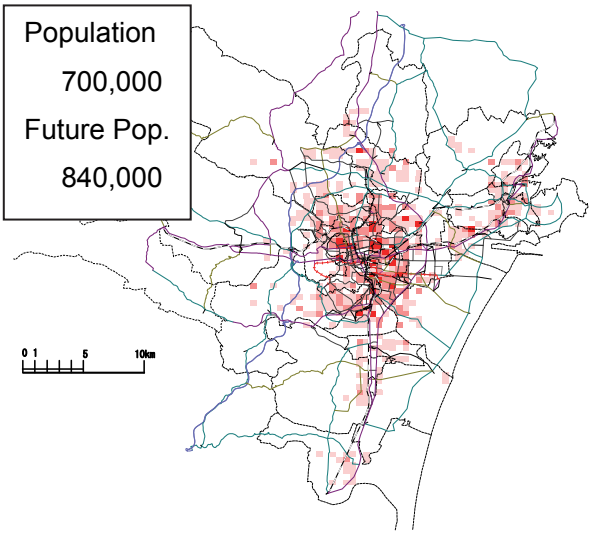
Project evaluation is based on the principle of comparing 'with' and 'without' a projects.

Table 5.1 Required Traffic Demand Result (Traffic Assignment Result)

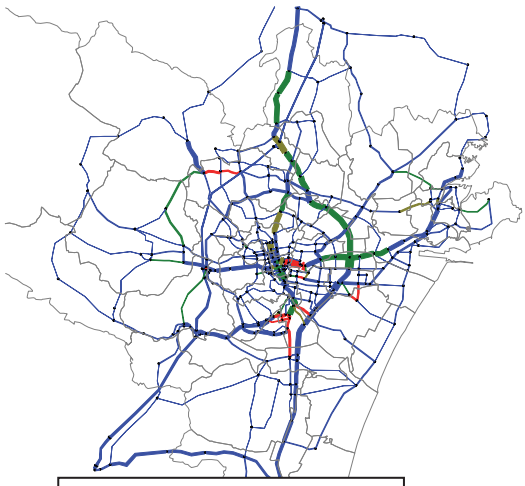
Indices	Do Nothing Case (Without-Case)	Project Case (With-Case)
Total PCU Km (pcu-km)	6,112,329	
Total PCU Hours (pcu-hour)	133,897	
Average Congestion (Traffic Volume/Capacity)	0.37	
Average Speed (km/h)	45.6	

Figure 5.2 Model City on Exercise

[Population]



[Road Traffics]

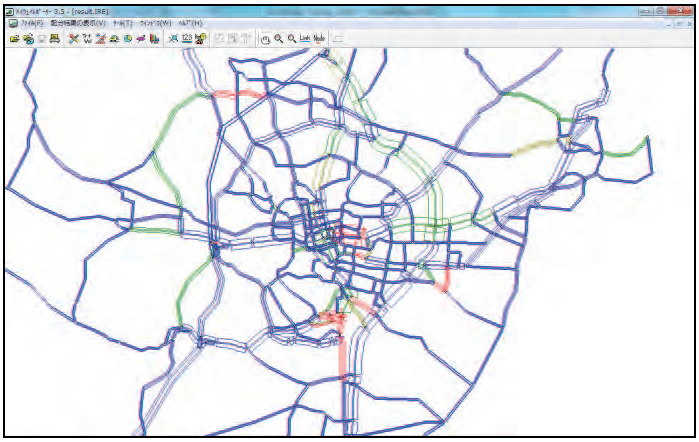


OD table: 1 OD table only (Car)

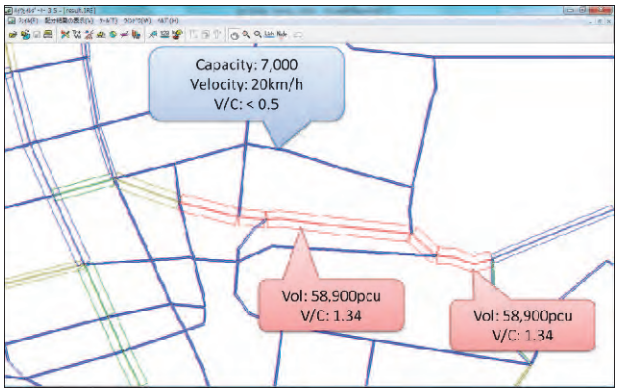
[Zoning Divisions]

50 Zones (48 zones and 2 outside zones)

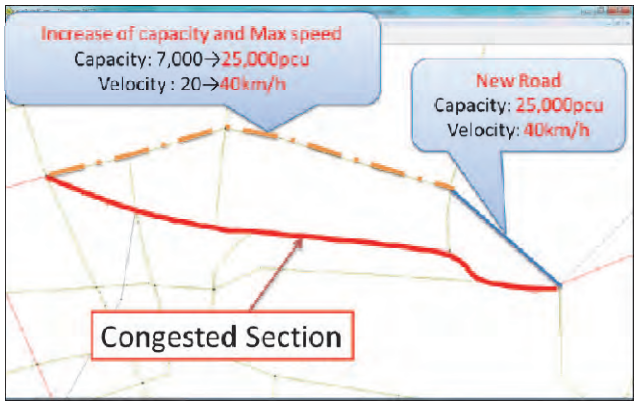
[Traffic Situation]



[Congested Situation in CBD]



[Road Improvement Project]

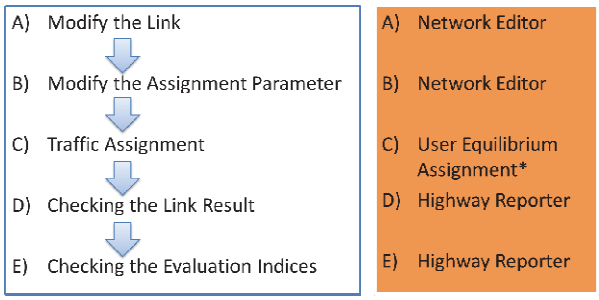


Source: JICA Project Team

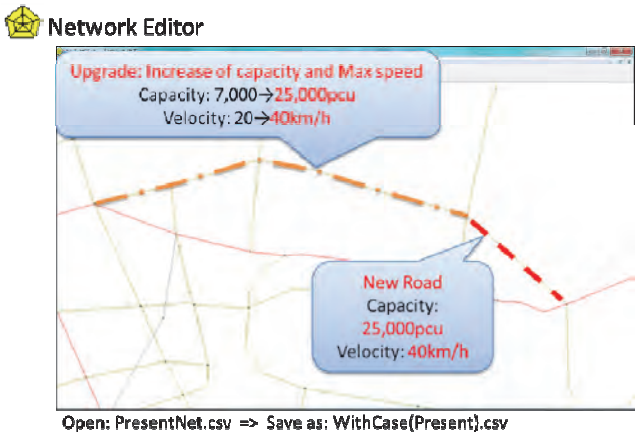
(2) Traffic Demand Forecast for Project Case (With Case)

Steps on demand forecast for "with case"using JICA STRADA are shown in the following figure.

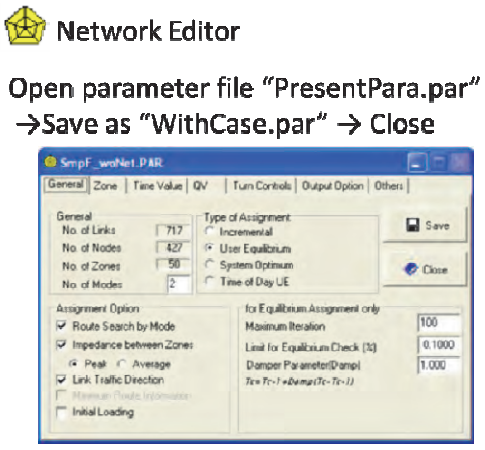
Figure 5.3 Steps on Traffic Demand Forecast for Project Case



A) Modify the Link

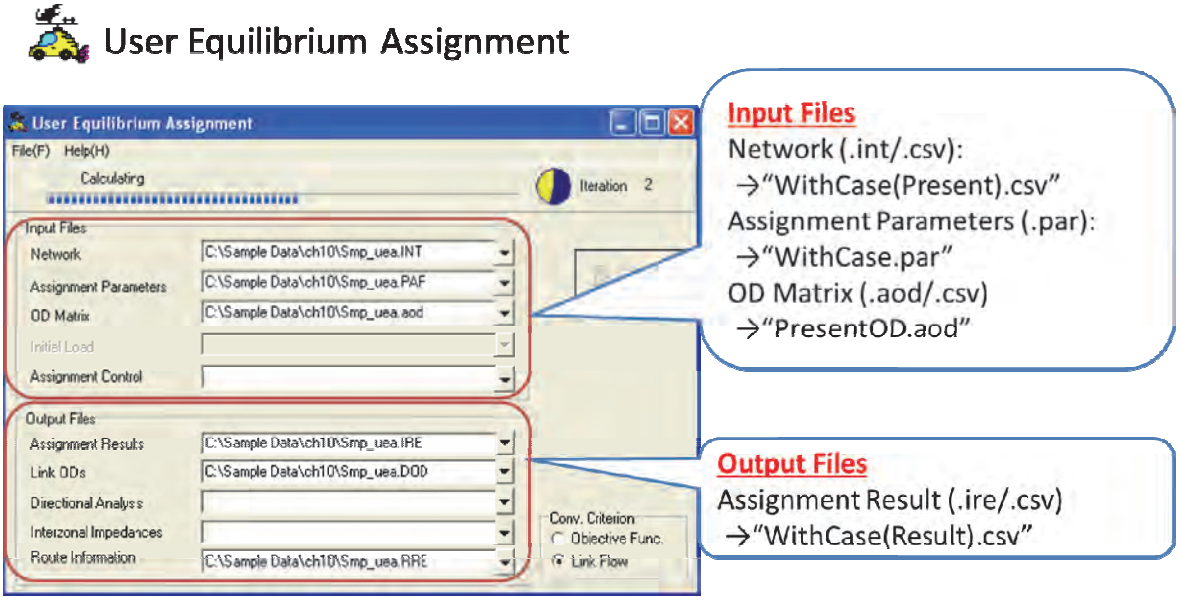


B) Modify the assignment parameter

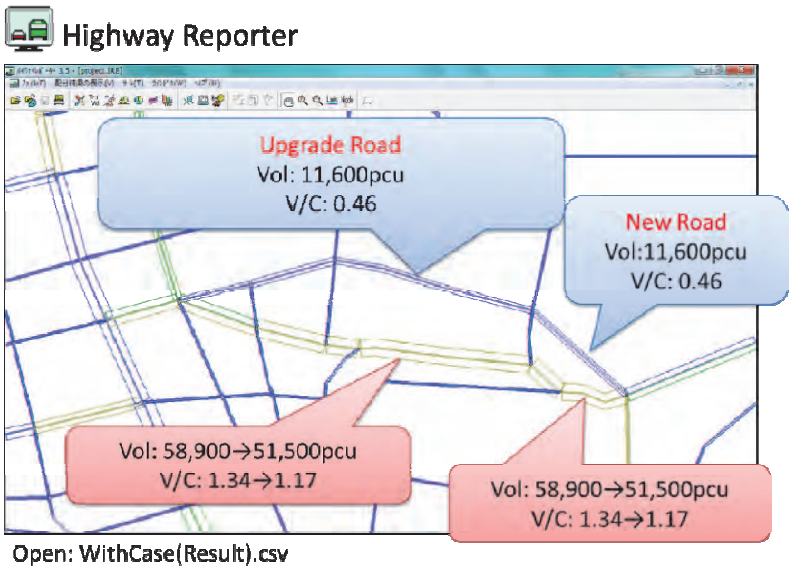


Source: JICA Project Team

C) Traffic assignment



D) Checking the Link Result



E) Evaluation Indices

Indices	Do nothing Case (Without-Case)	Project Case (With-Case)
Total PCU Kilometers (pcu-km)	6,112,329	6,110,507
Total PCU Hours (pcu-hour)	133,897	133,714
Average Congestion (Vol/Cap)	0.37	0.37
Average Speed (km/h)	45.6	45.7

Source: JICA Project Team

4) Step 2: Estimation of Benefits & Costs

(1) Methodology of Benefit Estimation:

User benefits are calculated as a consumer surplus by subtracting the generalized costs to all road users with project implementation from those without the implementation.

(a) Economic Benefits to be analyzed in the exercise

- Fixed demand is assumed to estimate generalized cost, the cost is calculated per link and then multiplied by the respective link traffic volume to aggregate total costs.
- Economic benefits of the project are defined as the savings in VOC (Vehicle Operation Costs) and TTC (Travel Time Costs) attributable to the Project.
- The benefits are determined through “with-“ and “without-” comparison of traffic demand analysis.

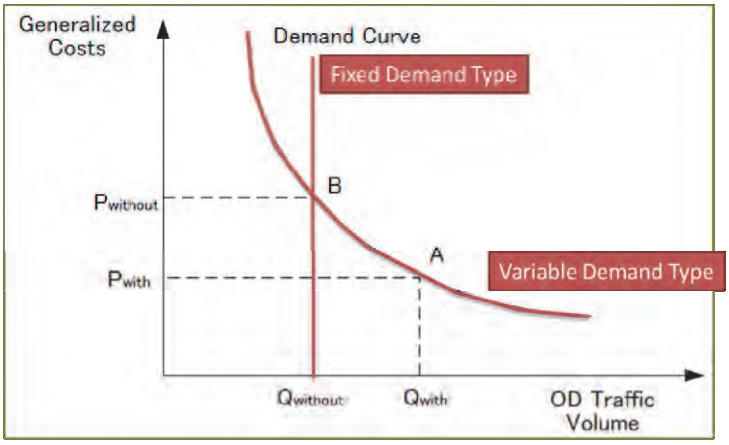
(b) VOC (Vehicle Operation Costs)

- VOC (GR) is obtained per link by multiplying the link distance by velocity and vehicle type.

$$GR = \sum_m \sum_l (Q_{ml} \cdot L_l \cdot \beta_m)$$

where, Q_{ml} : Traffic volume of the mode m on the link l (vehicles/day)
L_l : Distance of the link l (km)
β_m : Cost unit per road type and velocity rank for the mode m (currency units/vehicle km)

Figure 5.4 Methodology of Benefit Estimation



Source: JICA Project Team

(c) TTC (Travel Time Costs):

- Time cost (GT) is determined by multiplying the link travel time by link traffic volume and by time value.

$$GT = \sum_m \sum_l Q_l^m \cdot T_l \cdot \alpha_m$$

where, Q_l^m : Traffic volume of the mode m on the link l (vehicles/day)
T_l : Travel time on the link l (minutes)
α_m : Time value unit for the mode m (currency units/vehicle minute)

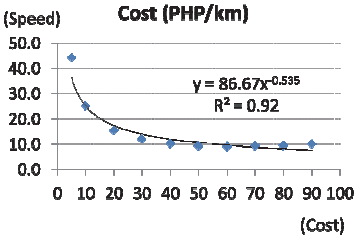
(d) Using VOC and Time Value on Exercise:

- Assumptions of VOC and Time Value in the exercise are shown in Figure 5.5.

Figure 5.5 VOC and Time Value on Exercise

- VOC:

	Speed (km/h)	Cost (PHP/km)
Economic Cost	5	44.4
	10	25.3
	20	15.4
	30	12.0
	40	10.3
	50	9.4
	60	9.2
	70	9.2
	80	9.5
	90	10.0



- Time Value: 1.00 (Peso/min.), 60.0 (Peso/Hour)

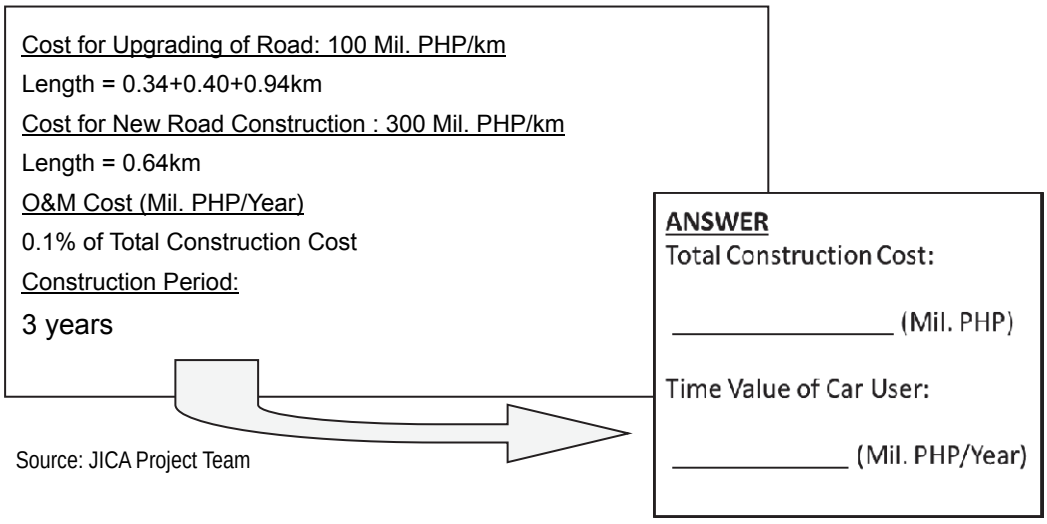
Source: JICA Project Team

(2) **Estimation of Benefit**

Total TTC and VOC in both "without case" and "with case" can be calculated using Evaluator software by JICA STRADA (see Figure 5.6).

(3) **Estimation of Cost**

Assumption of project cost in the exercise.



Source: JICA Project Team

5) Step 3: Estimation of Economic Indicators

(1) **Outline of Cost Benefit Analysis**

Cost-Benefit analysis is a systematic process for calculating and comparing benefits and costs in the project life.

(2) **Pre-Condition on Exercise:**

(i) Project Life: Durable life of a transportation project is usually very long, that is, 50 to 60 years if properly maintained. On the other hand, economic project life is considered much shorter than the physical life of about 30 years. This project life is defined as 33 years including the 3-year construction period.

(ii) Social Discount Ratio: As the opportunity cost of capital, 15% per annum is assumed as the social discount rate.

(iii) Traffic Demand: In this exercise, the traffic demand is assumed as fixed during the project life. However, when we evaluate the actual project, a forecast traffic demand will be required and estimate of benefits each year.

The exercise sheet to calculate economic indices is shown in Figure 5.9.

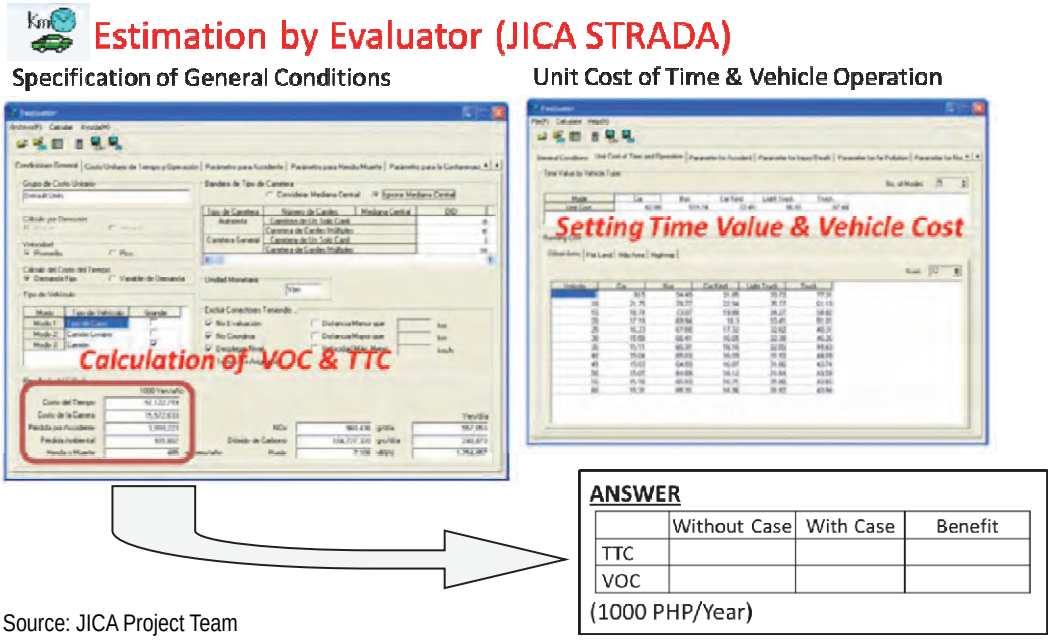
(3) **Exercise on Excel (Sensitive Analysis):**

Sensitive analysis is made by changing the projected cost upward and the benefit downward. This analysis is done using the scenarios in the "ICC Project Evaluation Procedures and Guidelines" of NEDA.

(4) **Calculation of Economic Indices**

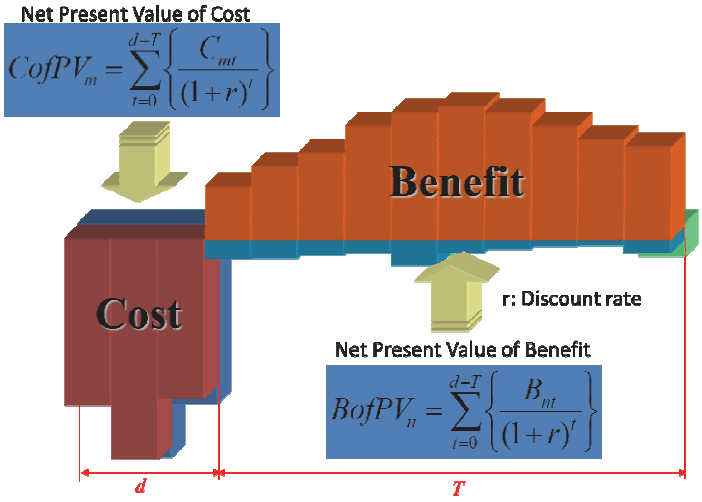
Economic indices can be calculated using the formula in Figure 5.8.

Figure 5.6 Estimation of Benefit using JICA STRADA



Source: JICA Project Team

Figure 5.7 Cost Benefit Analysis



Source: JICA Project Team

Figure 5.8 Formula of Economic Indices

- **NPV(Net Present Value)**

$$NPV = \sum_{t=0}^{T}\left(\frac{B_t - Ct}{(1+i)^t}\right)$$

- **BCR (Benefit Cost Ratio (or B/C Ratio))**

$$BCR = \sum_{t=0}^{T}\frac{B_t}{(1+i)^t} \Big/ \sum_{t=0}^{T}\frac{C_t}{(1+i)^t}$$

- **EIRR (Economic Internal Rate of Return)**

$$EIRR: \text{i which satisfies:} \quad \sum_{t=0}^{T}\frac{B_t - Ct}{(1+i)^t} = 0$$

Source: JICA Project Team

Figure 5.9 Exercise Sheet to calculate Economic Indices

		Year	Cost (Mil. PHP)	Total Benefit (Mil. PHP)	Saving TTC (Mil. PHP)	Saving VOC (Mil. PHP)	Benefit-Cost
Standard Conversion Factor (SCF):			83%				
Construction Period		-3	89.6	0	0	0	-89.64
		-2	149.4	0	0	0	-149.40
		-1	59.8	0	0	0	-59.76
Project Life		1	0.36	91.0	4.3	86.7	90.59
		2	0.36	91.0	4.3	86.7	90.59
		3	0.36	91.0	4.3	86.7	90.59
		4	0.36	91.0	4.3	86.7	90.59
		5	0.36	91.0	4.3	86.7	90.59
		6	0.36	91.0	4.3	86.7	90.59
		7	0.36	91.0	4.3	86.7	90.59
		8	0.36	91.0	4.3	86.7	90.59
		9	0.36	91.0	4.3	86.7	90.59
		10	0.36	91.0	4.3	86.7	90.59
		11	0.36	91.0	4.3	86.7	90.59
		12	0.36	91.0	4.3	86.7	90.59
		13	0.36	91.0	4.3	86.7	90.59
		14	0.36	91.0	4.3	86.7	90.59
		15	0.36	91.0	4.3	86.7	90.59
		16	0.36	91.0	4.3	86.7	90.59
		17	0.36	91.0	4.3	86.7	90.59
		18	0.36	91.0	4.3	86.7	90.59
		19	0.36	91.0	4.3	86.7	90.59
		20	0.36	91.0	4.3	86.7	90.59
		21	0.36	91.0	4.3	86.7	90.59
		22	0.36	91.0	4.3	86.7	90.59
		23	0.36	91.0	4.3	86.7	90.59
		24	0.36	91.0	4.3	86.7	90.59
		25	0.36	91.0	4.3	86.7	90.59
		26	0.36	91.0	4.3	86.7	90.59
		27	0.36	91.0	4.3	86.7	90.59
		28	0.36	91.0	4.3	86.7	90.59
		29	0.36	91.0	4.3	86.7	90.59
		30	0.36	91.0	4.3	86.7	90.59

	Social Discount Rate: 15%		
		Cost	Benefit
	0	90	0
	1	130	0
	2	45	0
	3	0	57
	4	0	50
	5	0	43
	6	0	37
	7	0	33
	8	0	28
	9	0	25
	10	0	21
	11	0	19
	12	0	16
	13	0	14
	14	0	12
	15	0	11
	16	0	9
	17	0	8
	18	0	7
	19	0	6
	20	0	5
	21	0	5
	22	0	4
	23	0	3
	24	0	3
	25	0	3
	26	0	2
	27	0	2
	28	0	2
	29	0	2
	30	0	1
	31	0	1
	32	0	1
	Total	267	430

Economic Indices	
B/C=	1.61
NPV=	164
EIRR=	23.7%

Source: JICA Project Team

Figure 5.10 Sensitive Analysis by Changing Cost and Benefit

Changing in Cost & Revenue		Cost Increase		
		Case (0%)	10% Up	20% Up
Benefit Decrease	Base (0%)			
	10% Down			
	20% Down			