CHAPTER 15

CONSTRUCTION PLANNING AND IMPLEMENTATION PLAN

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15.1 Introduction

The construction planning and project implementation plan are studied only to provide succeeding economic and financial analyses with necessary time schedule based on due procedure of project implementation such as feasibility study, detailed design, acquiring land, tendering process and construction works stemmed from construction planning.

15.2 Construction Planning

(1) Components of Construction Planning

The construction planning for the Study is basically discussed in the following three components;

1) Main bridge construction;
2) Approach bridge construction; and
3) Approach road construction.

Each component has a few alternative plans, and the evaluation and selection of alternative plans in each component are not finalized yet. However, it may be generally acceptable that no significant difference is found in the aspect of construction planning at a master plan stage, no matter which alternative plan is selected.
Accordingly, the following discussion is made as an example in the case of ALT 1-3 : Undivided 2-lane with sidewalk in both sides with lane for slow-moving vehicle in both sides without rail-cum-road bridge scheme.

(2) Basic Assumptions of Construction Planning

Since the construction site is to be severed by the Rupsa river, construction planning should be made, considering following components in both sides of river.

1) Main Bridge Construction
The following design features are planned for the Study;
- Superstructure : Continuous PC Box Girder Bridge with tapered girder depth
- Substructure : Wall Type Pier
- Foundation : Cast In-situ Concrete Pile with Reverse Circulation Method

Cofferdam with Steel Pipe Pile Method is required for foundation and substructure works due to deep and high current velocity of the river flow.
Temporary bridges are required to connect cofferdams with landing stage on the dike in order to provide space for concrete piping and labors.

2) Approach Bridge Construction
The following design features are planned for the Study;
- Superstructure : Simple Composite PC I-Girder Bridge
- Substructure : Wall Type Pier with Cantilever
- Foundation : Cast In-situ Concrete Pile with Reverse Circulation Method

3) Approach Road Construction
The following design features are planned for the Study;
- Earthwork : Fill with common excavation with free drain material in wet
- Drainage : U-Ditch with cross drainage by RC pipe
- River Revetment : Mortared rubble slope protection
- Pavement : Asphalt pavement with granular subbase and base course
Number of incidental works are required to secure traffic safety, road user's comfort and beautification.

(3) Quantities of Major Construction Works

Construction planning should be made based on quantities of each main construction work item and selection of construction methods in a site condition. The selection of construction method is discussed in Chapter 12, and quantities of main construction works are summarized in Table 15.2.1 as an example of ALT 1-3.

(4) Construction Time Schedule

Construction time schedule is prepared based on quantity of works and selected construction method.
42 months of construction period are estimated to attain optimum investment schedule as shown in Fig. 15.2.1.

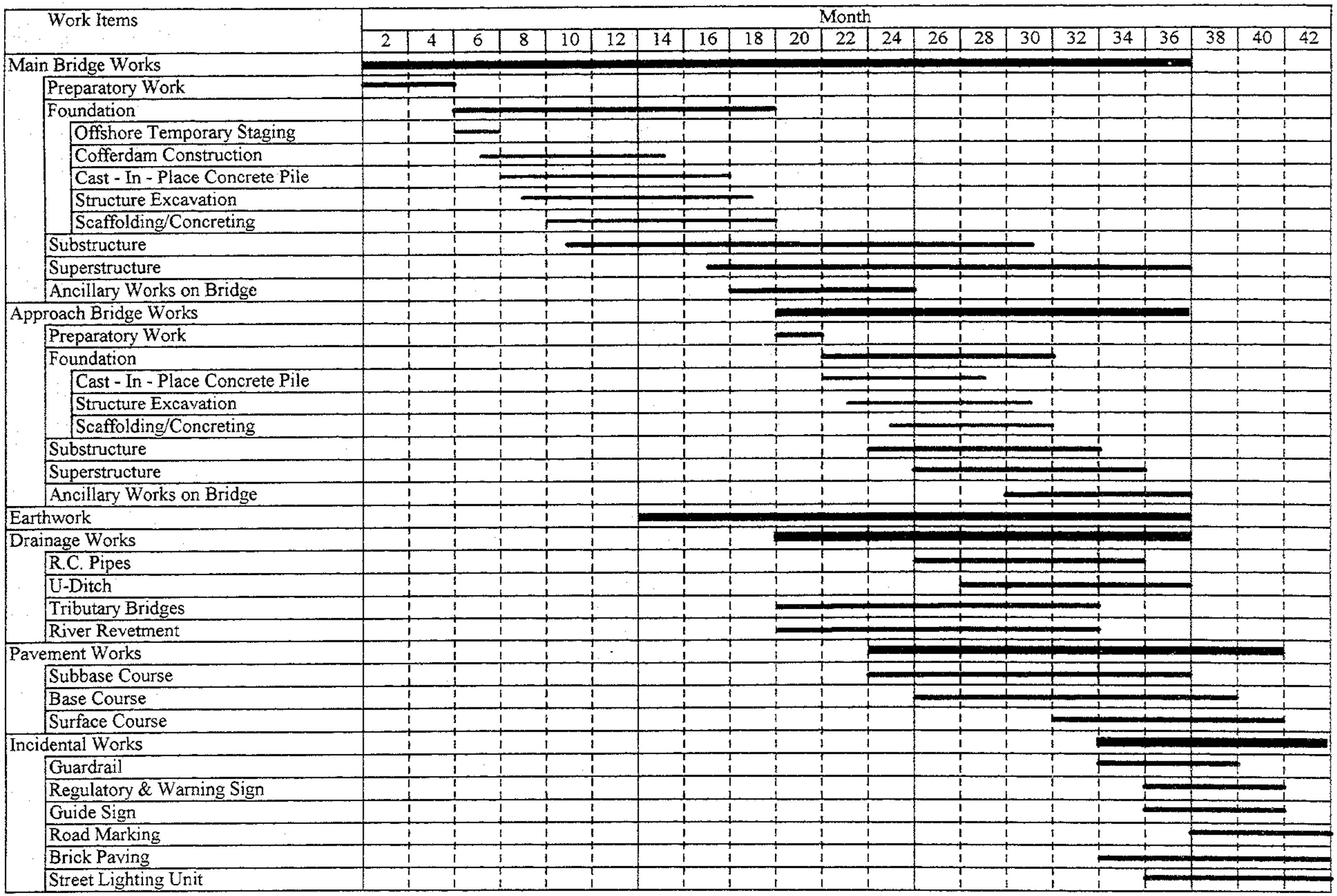


Fig. 15.2.1 Construction Time Schedule

Table 15.2.1 Quantities of Main Construction Works

ITEM NO	DESCRIPTION	UNIT	QUANTITY
2.02	Borrow Material	M^3	562,222
2.03	Free-Draining Material	M^3	167,487
2.04	Permeable Backfill	M^3	15,645
3.02	R.C. Pipe D=60cm	M	2,910
3.04	U-Ditch	M	8,560
3.09	Tributary Bridge	M^2	4,680
3.11	River Revetment	M^2	68,000
4.02	Granular Subbase	M^3	33,420
4.03	Mechanical Stabilized Base	M^3	24,581
4.05	Asphalt Treated Base Course (t=10cm)	M^2	119,585
4.06	Asphalt Concrete Surface (t=6cm)	M^2	69,886
5.02	Offshore Temporary Staging	M^2	960
5.03	Cofferdam Construction and Dismantling	M^2	3,494
5.04	Structure Excavation	M^3	3,505
5.06	Cast - In - Place Concrete Pile (D = 1,500mm)	M	4,837
5.07	Cast - In - Place Concrete Pile (D = 1,000mm)	M	5,957
5.08	Structural Concrete (High Design Strength)	M^3	9,933
5.09	Structural Concrete (Low Design Strength)	M^3	19,961
5.10	Reinforcing Steel, Deformed	TON	4,566
5.11	Prestressing Steel	TON	740
5.12	Structural Concrete in PC I-Girder	M^3	3,359
7.02	Guardrail	M	1,000
7.03	Regulatory & Warning Sign	EACH	68
7.04	Guide Sign	EACH	24
7.05	Road Marking	M^2	5,136
7.07	Brick Paving	M^2	37,264
7.10	Street Lighting Unit	EACH	77

15.3 Basic Assumptions of Implementation Planning

15.3.1 Time Requirements

(1) Feasibility Study

A feasibility study will have to be conducted to confirm the viability of project at a certain level of accuracy after selecting the best alternative plan among several alternatives. In this Study, the pre-feasibility study is carried out, using topographic maps at a scale of 1 to 10,000 and borehole investigation supplemented such existing data and information with centerline survey, bathymetric survey, measurement of current velocity and sinking one borehole with standard penetration tests. Although number of surveys and investigations are still required along a whole stretch of selected route location and at a construction site of bridge, it may be possible to complete a feasibility study in ten (10) months period.

(2) Detailed Design

It is indispensable to conduct a detailed design at a certain level of accuracy to prepare following necessary maps and documents;

1) Land acquisition map after establishing centerline of road and required road Right-Of- Way (ROW);
2) Bill of Quantity of each project package based on designing works;
3) Tender documents for tendering; and
4) Agency estimates for fund allocation.

It may take one (1) year after contracting with a consultant to complete a detailed design even though a professional consultant familiar with Bangladeshi conditions be procured and advanced technology such as computer aided design (CAD) and global positioning system (GPS) be fully utilized.

Since no basis is found in preparation of required fund for detailed design, time requirement between the end of feasibility study and the beginning of detailed design is ignored.

(3) Land Acquisition

Since land acquisition for road as well as railway or river have salient features to require not only spot but long strip along alignment, it is quite usual that an agency concerned is forced to take long negotiation with numbers of owners of lots and structures. On the other hand, it is a matter of fact that ROW acquisition procedure necessitates to be endorsed by the government's prerogative.

The consummation of land acquisition, however, always becomes crucial in a road project, and it fully depends upon the allocation of required funds and the competence of executing agency.

As old saying of "strike while the iron is hot", uninterrupted process of project implementation could facilitate most of well-known difficulties such as land acquisition problem, cost overrun and so forth. On the contrary, slow process of documentation could expose increase of risk against the approved plan.

It is likely possible that some section of future ROW will be able to proceed land acquisition in process of time when detailed design is under way.

Under such circumstances, it may take one (1) year to complete land acquisition in a whole stretch of project road.

(4) Tendering Process

After the completion of detailed design, it usually requires sufficient time to consummate due procedure to select a responsible and bona fide contractor through an international competitive bid. However, it is possible to execute them simultaneously while land acquisition is under way.

It may take six (6) months to complete tendering process from the completion of detailed design.

Since no commitment is found for project implementation, time requirement for funding arrangement is neglected.

(5) Construction Time Schedule

It is well-known "Well begun, Half done". Since construction activities require many preparatory works, an elaborated construction planning is vital for smooth execution.
In this Study, it may take three and half (3.5) years to complete construction of bridge and road, referring to the construction planning as discussed in Section 15.2.

15.4 Implementation time Schedule

For the purpose of economic and financial analyses, project implementation time schedule is prepared as shown in Fig. 15.4.1.

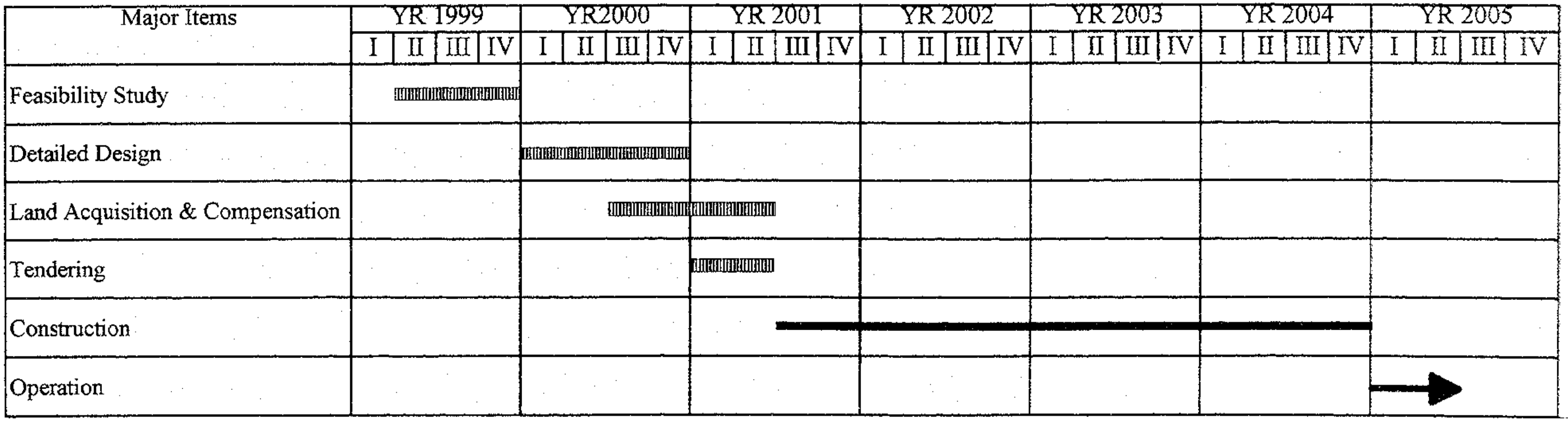


Fig. 15.4.1 Project Implementation Time Schedule

CHAPTER 16

ECONOMIC AND FINANCIAL ANALYSIS

CHAPTER 16 ECONOMIC AND FINANCIAL ANALYSIS

16.1 Project Scenarios

In the traffic forecasts, the "without the Project" scenario (case 0) was assumed as follows: the Rupsa ferry would remain open, but with some improvements to handle traffic growth; the KDA part of the western bypass (about 17 km) is considered to be a stand-alone committed project which would be completed before the year 2005; and the existing road network in the Project area would remain unchanged except for the KDA 17 km project. The two "with the Project" scenarios are: alignment "A" (case 1) along the western route, comprising one bridge (road only) and about 10 km of approach road which would connect to the KDA 17 km section to form an overall road bypass solution; and alignment "B" (case 3) along the eastern route, comprising a bypass road of about 20 km including three bridges (road only). The scenario for alignment "A" is "with the KDA 17 km section and without the Rupsa ferry". The scenario for alignment "B" is "with the KDA 17 km section on the western side" (since it is treated as being committed irrespective of "A" and "B"), and "with the Rupsa ferry". Cases 2 and 4 represent sensitivity tests on cases 1 and 3, respectively. Under alignment "A", the Rupsa ferry would in reality probably stay open for non-motorized traffic and possibly for some small motorized vehicles.

In addition, a railway scenario was developed as follows: a new railway line (rail only) would be constructed between Mongla and Khulna by the year 2005, with necessary new track, bridges and other infrastructure. The assumption is that the new railway line would capture long haul freight traffic to/from the North West and transit freight traffic to/from Nepal. The captured freight traffic only relates to goods loaded/unloaded at the Mongla jetty (i.e., excluding goods handled in the river).

16.2 Study Approaches

16.2.1 Economic Analysis Approach

The economic analysis covers the two road-only solutions (Alignment"A" and Alignment "B"). Financial costs were converted to economic costs as follows: in the capital expenditure cost estimates, the foreign exchange portion (imported goods and services) is assumed to be tax exempt to reflect that the proposed financing from international lending agencies would be on concessional/soft terms – thus, the foreign exchange portion was treated as being the same for both financial and economic costs (border price); and in the local currency portion, estimated local taxes were excluded from the economic costs and local currency labor costs were reduced by a factor of 0.8 to reflect that unskilled labor and some types of semi-skilled labor are not scarce resources in Bangladesh. Some earlier government research suggests that the factor for unskilled labor might be as low as 0.65, but to be conservative a factor of 0.8 was used. Operation and maintenance costs were reduced by 0.8 to allow for local labor not being scarce and to remove taxes on local materials.

In the capital cost estimates for cases 1 and 3, the cost of the KDA 17 km section is excluded because the "without scenario" (case 0) and the "with scenario" (cases 1 and 3) both include the KDA section in terms of traffic. For example, the incremental costs and benefits for case 1 only relate to the 10 km southern section of the western road bypass. The cost estimates include physical contingencies but exclude price contingencies.

Incremental benefits comprise savings in vehicle operating costs (VOCs) and travel time costs (TTCs). The increment reflects the difference between case 0 and cases 1 and 3.

In the economic analysis, the traffic levels assume no tolls. The way by which VOCs and TTCs have been derived is discussed later on in this Chapter.

16.2.2 Financial Analysis Approach

At this Master Plan stage, indicative financial analysis was conducted for two cases: case 1 (alignment "A" – road only) with tolls; and the railway case (rail only – comprising a stand alone new railway line between Mongla and Khulna). Financial analysis was not conducted for case 3 since it involves three road bridges and it is not clear at this master plan stage whether and how tolls would be imposed. Once the picture becomes clearer following the Master Plan stage (alignment "A" versus "B"), the question of tolls for case 3 can be examined as necessary.

The terms of the concessional financing from an international lending agency (e.g.OECF) are envisaged as follows: a soft loan having an interest rate of 1 per cent and a repayment period of 30 years including a grace period of 10 years. The loan could cover up to 80 per cent of capital costs excluding land and compensation.

16.3 Benefits

16.3.1 Travel Time Costs

Under the umbrella of the UK's Department for International Development, RHD is receiving long term technical assistance. The technical assistance program is known as the Institutional Development Component (IDC). After reviewing earlier studies on travel time costs (TTCs), which were found to be based on limited and out of date research, the IDC/RHD group organized two extensive surveys in 1997 so as to develop a greater understanding of the issues involved, and to estimate a definitive set of national TTCs. The results of IDC's work have just been published (Economics Working Paper E7 September 1998 – Travel Time Costs). The TTCs embodied in the IDC/RHD working paper are expressed in economic terms (at 1998 prices).

Travel time costs are an important component of road user costs (RUC), varying in magnitude from 20 per cent of total RUC to over 80 per cent in cases that reduce time delays significantly (such as a new bridge to replace a ferry). The concept of travel time costs is based around the principle that time spent travelling has an "opportunity cost" and could be used in an alternative activity which has more utility (benefit) than travelling. Time costs can be estimated for road users and for freight consignments. Costs may be broken down into "in vehicle time" and "out of vehicle time". The latter may be important to bus passengers waiting for a vehicle, but is specialized in its application and is not considered in the IDC/RHD approach which focuses on "in vehicle" time values.

Time costs will vary between different vehicle types according to the socio-economic characteristics of the occupants and the type of freight carried. In the IDC/RHD approach, TTCs are expressed as hourly values per vehicle by assuming average occupancies and loading factors for each vehicle type. TTCs will vary geographically according to the socio-economic characteristics of each region. It would be expected, for instance, that road users in Dhaka would value their time more than users in remote areas. Thus, it is usual practise to adopt a set of national average TTCs in order to avoid biases. In line with current methodology, the IDC/RHD approach reflects national average TTCs.

Vehicle occupants consist of drivers and passengers. The costs of full time company drivers and helpers are incorporated as crew costs in the estimation of vehicle operating costs and are not considered in the IDC/RHD set of TTCs. Trucks were assumed as not carrying passengers and thus the time costs accruing to truck drivers/helpers are treated as crew costs rather than

TTCs. The cost of delays in moving goods can consist of: interest on the capital that the goods represent; costs due to damage or spoilage of perishable goods; and ancillary costs – e.g., where machinery is immobilzed while waiting for a spare part. However, except where there are major bottlenecks, freight TTCs are generally small and require a heavy flow of high value/perishable goods in order to become significant. A previous study reviewed by IDC/RHD concluded that even a high value perishable consignment had a TTC equivalent to less than one per cent of the total vehicle operating cost of the truck. Moreover, a reduction in spoilage or damage could be due to a smoother road, rather than just reduced journey time. In view of their small resource cost savings, freight TTCs were not considered in the IDC/RHD approach.

It is generally accepted that time spent travelling in work time should be valued at the person's wage rate (i.e., the direct opportunity cost). The approach to valuing time spent for other purposes is not universally accepted. In all approaches, however, the value of non-work time is less than work time, often significantly so. There are three broad methodologies for estimating values of time: average wage; revealed preference; and stated preference.

In the revealed preference approach, the value of time is determined by studying the choices individuals make when faced with a number of alternative means of transport involving different time and cost choices. This method is often difficult to apply, as real life choice situations are difficult to identify and measure. In the stated preference approach, individuals are presented with hypothetical travel choice scenarios designed to reveal how they trade off cost and time. The disadvantage of this approach is that consumers do not always act rationally and do not reveal what their true behaviour would be due to a number of survey biases.

The easiest method to apply (and most simplistic) is the average wage approach by which the wage rates of vehicle occupants are assessed and average rates estimated to reflect the value of time of occupants in different vehicles. An assessment of the number of travellers in work time and non-work time is made for each vehicle type. The TTC for work time is then taken as the estimated wage rate (net of tax but including employer's costs directly associated with the employment). The value of non-work time is taken as a proportion of the wage rate. Considerable debate exists as to what this proportion should be, and existing values range from 20 – 80 per cent of the average wage rate. In Bangladesh values of 20 – 35 per cent have been used to date, which accords with advice that IDC/RHD has received from the UK's Transport Research Laboratory.

To date, there are five principal transport studies that have conducted some original work on TTCs: Jamuna Bridge Feasibility Study 1989; Road Master Plan Project 1992; Road Materials & Standards Study 1994; Dhaka Urban Transport Study (Phase II) 1996; and Dhaka Eastern Bypass 1997. The IDC/RHD group reviewed these studies and several important lessons were learned. In the Jamuna Bridge Study, 65 per cent of passengers were assumed to be in business time. This is considered to be much too high since it undoubtedly includes persons travelling to/from work or on informal work trips that should not be based on the full wage rate. In the Dhaka Urban Study, TTCs were derived by estimating average per capita incomes by dividing household income by household size. This assumed that household income was distributed equally amongst all household members. In fact, this is not correct since about 70 per cent of households have only one wage earner and about 20 per cent have two. In the Dhaka Bypass Study, the Stated Preference survey technique was used to derive TTCs. This was the first time such a technique had been used in Bangladesh. The resulting estimates of average wage were considerably higher than those in earlier studies, and in the end the Bypass Study Team decided not to use the results since the TTCs represented perceived rather than resource values. Also, the results may have been biased by the high incomes in the Dhaka area.

After its review of the earlier studies on TTCs, the IDC/RHD group decided to develop an average set of TTCs which could be applied to vehicles throughout Bangladesh, irrespective of the region or class of road. Based on the above lessons learned, the group decided to launch a survey in September 1997 in order to extend sampling beyond the Dhaka area. The survey focused on bus passengers as they account for the majority of TTCs on the RHD road network. The results correlated significantly with the Dhaka Bypass Study, but it became apparent that there had been too much concentration on the inter-city segment of the market which has a higher income profile than local and rural bus services. Accordingly, the group decided to launch a second survey in December 1997 in order to sample bus passengers on feeder roads.

The survey in September 1997 included a good cross-section of passengers travelling between Dhaka, Rajshahi, Rangpur, Khulna and Barisal. Supplementary surveys were also conducted in Dhaka, Khulna, Rajshahi and Chittagong to extend the national coverage.

Based on the series of IDC/RHD surveys, the distribution of trip purpose for bus passengers resulted in a significant new finding, namely – employer's business trips only account for 8 per cent of all trips on main roads and 6 per cent on feeder roads. Other relevant findings were: a large proportion of businessmen and professional persons travelling on main road buses, with the feeder road market being characterized by less professional persons and more farmers/other "blue collar" occupations; on main road buses, nearly half of the sampled passengers were between 22 and 35 years old, compared with a younger age profile for feeder roads; and incomes of passengers on feeder roads were significantly lower than main road passengers.

In developing the new TTCs, the IDC/RHD group used the average wage approach. The wage rate was used for passengers engaged in employers' business while all other time was valued at 35 per cent of the wage rate. To derive an average TTC for all buses, the individual TTCs were weighted by the annual passenger km for each category (calculated by multiplying the average vehicle occupancy for each bus type by the average daily km travelled). Based on the survey results, the proportion of work time in the bus TTC calculations (full wage rate) was as follows: main roads – air conditioned bus 1 per cent, chair class bus 11 per cent and ordinary bus 12 per cent; and feeder roads – large bus 9 per cent, mini bus 4 per cent and tempo 3 per cent. The average occupancy for each bus type (taken from the surveys) was as follows:

Table 16.3.1 Average Occupancy of Buses

BUS CATEGORY	AVERAGE OCCUPANCY (passengers)
Inter Urban Air Conditioned	36
Inter Urban Chair Class	36
Inter Urban Ordinary Bus	44
Rural Large	64
Rural Mini	36
Rural Tempo	9

IDC/RHD's recommended economic TTCs for 1998 are as follows:

Table 16.3.2 Economic Travel Time Costs for 1998

Vehicle	Occupancy	TTC per passenger Tk./hour	TTC per vehicle Tk./hour
Bus	47.1	12.5	588.6
Car	3.2	28.2	90.2
Auto Rickshaw	2.0	12.5	25.0
Motor Cycle	1.5	12.5	18.8

Note: economic costs reflect conversion by 0.8.

16.3.2 Vehicle Operating Costs

Based on its recent work (VOC paper December 1998), IDC/RHD's recommended economic VOCs for 1998 are as follows:

Table 16.3.3 Economic Vehicle Operating Costs

Vehicle	IRI 3 Tk./km	IRI 4 Tk./km
Truck	10.88	11.58
Bus	13.92	14.17
Car	5.50	5.80
Motor Cycle	1.71	1.79
Auto Rickshaw	3.43	3.59

VOC economic costs were derived based on border prices; local taxes where known were excluded; and local labor and materials were converted by 0.8 except where the local tax on materials was known. The above figures for motor cycles and auto rickshaws were drawn from the ongoing RIP III ADB project since IDC/RHD do not calculate VOCs for these two categories.

16.4 Results of Analysis

16.4.1 Economic Analysis Results

In the economic analysis, the vehicle operating costs for trucks, buses and cars are based on the figures recently developed by IDC/RHD (1998 prices expressed in economic terms). For case 0, the international roughness index was assumed as "IRI 4", while for cases 1 and 3 the assumption was "IRI 3". VOCs for auto-rickshaws and motor cycles are not produced by IDC/RHD. Therefore the VOC figures developed in the ongoing ADB RIP III project were used for auto-rickshaws and motor cycles. For TTCs, the recent figures developed by IDC/RHD were the starting point. To reflect the inherent difficulties in valuing non work time, only 15 per cent of IDC/RHD's TTCs were used in the economic analysis. The 15 per cent is considered to be the working time component of total TTCs (85 per cent is non work time). Travelling to/from work is treated as non work time. The results of the economic analysis, including sensitivity tests, are as follows (more details are in the Appendix-I)

Table 16.4.1 Results of Economic Analysis and Sensitivity Tests

Case 1 base case	EIRR 30%
Case 1 VOC benefits only	EIRR 25%
Case 1 costs increased 10% and benefits reduced 10%	EIRR 26%
Case 1 daily vehicles crossing the bridge in 2015	11,153 vehicles
Case 2 daily vehicles crossing the bridge in 2015	10,844 vehicles
Case 3 base case	EIRR 13%
Case 3 VOC benefits only	EIRR 12%
Case 3 costs increased 10% and benefits reduced 10%	EIRR10%
Case 3 daily vehicles crossing Atherobaki bridge in 2015	9,797 vehicles
Case 4 daily vehicles crossing Atherobaki bridge in 2015	9,768 vehicles

In cases 2 and 4, where some road traffic (mainly truck freight) would be diverted to rail, the projected drop in road traffic is not significant as demonstrated in the above Table.

16.4.2 Financial Analysis Results

Financial analysis was conducted for Case 1 (alignment "A" in the west). The results are summarized below, with more details being provided in the Appendix-I.

Table 16.4.2 Results of Financial Analysis

Case 1 base case	FIRR 4%
Case 1 costs increased by 10% and revenues reduced by 10%	FIRR 1%

In the base case FIRR, the assumed tariffs were:

Table 16.4.3 Assumed Tariffs for Rupsa Bridge and Related Information

	Base Case Tk.	Existing Ferry Tk.	Jamuna Bridge Tk.
Truck	250	88	1,000
Bus	200	38	800
Car	50	19	400
Auto-rickshaw	20	13	not applicable
Motor Cycle	5	3	30

Based on the economic traffic levels (without tolls), the assumed tolls for the base case represent about 12 per cent of total savings in VOCs and TTCs. In the base case calculations, however, traffic has been reduced by 10 per cent to reflect that demand would be slightly lower under the assumed tolls. Based on average occupancy, the assumed toll of 200 taka for a bus equates to 4 taka per passenger. The ferry toll for buses cannot be compared with the 200 taka since only small buses use the ferry service. The base case (FIRR 4 per cent) would result in full cost recovery and a modest surplus which is consistent with the toll strategy adopted for the Jamuna Bridge. The sensitivity test result (FIRR 1 per cent) would be enough for full cost recovery since the 1 per cent loan is only applicable to 80 per cent of capital costs (excluding land/compensation), with a grace period of 10 years.

Financial analysis was conducted for the Railway Case. The results are summarized below and shown in more detail in the Appendix-I.

Table 16.4.4 Results of Financial Analysis for Railway Case

Base Case	FIRR minus 40%
Base Case without capital expenditure for locos/wagons	FIRR minus 18 %

In the base case, the capital costs include infrastructure, five locomotives and 700 wagons. The freight revenue calculations are based on 478,000 tons in the year 2015 (less growth to derive figures for 2005 to 2014) and 430 taka per ton. The details of all the calculations are provided in Chapter 6. Based on the Railway Recovery Program (RRP) agreed upon between the Government and ADB, by which Bangladesh Railway (BR) is obliged to act commercially, it is difficult to envisage a new rail line between Mongla and Khulna. BR's financial condition has improved in recent years but is still weak. In 1996/97, BR recorded a small operating profit but before depreciation. Also, the Government pays for BR's debt service, as well as capital expenditure not financed from loans.

CHAPTER 17

EVALUATION AND RECOMMENDATIONS

CHAPTER 17 CONCLUSION AND RECOMMENDATIONS

17.1 Conclusion

17.1.1 Evaluation on Alternative Plans for Railway Extension to Mongla Port

1) The Asian Development Bank (ADB) as a sole donor in the railway subsector has adopted a long term perspective to Bangladesh Railway (BR) over 30 years. The objectives and scope of such assisting programs are consistent with the macroeconomic rationale, and aims at (i) significant deficit reduction, (ii) termination of open-ended subsides, (iii) labor rationalization, (iv) institutional reforms, and (v) adoption of a rational investment program.

   BR's financial condition has improved in recent years but is still weak. The on-going Railway Recovery Program (RRP) has emphasized recent substantial achievements such as reduction of debt from 1.2 billion Tk. in 1995/96 to 0.8 billion Tk. in 1996/97, and BR has taken action to control capital expenditures and to ensure that investment is targeted in areas which have a clear commercial justification.

2) The scheme of railway extension to Mongla Port opening until Year 2015 has negative financial internal rate of return (FIRR) at all alternative plans as shown in Table 17.1. The sensitivity analysis also reveals that freight revenue could not collect debts even if purchasing costs of 5 locomotives and 700 wagons are set aside from project cost.

3) Based on the Railway Recovery Program (RRP) agreed upon between the Government and ADB, by which Bangladesh Railway is obliged to act commercially, it is difficult to envisage a new rail line between Mongla and Khulna.

4) However, the scheme of rail-cum road bridge is to be studied as an alternative plan of road bridge because it never deny the possibility of railway extension beyond Year 2015.

Table 17.1. Results of Financial Analysis and its Sensitivity Analysis

Alternative	Outline of Scheme			Internal Rate of Return (IRR)	
	Route	Bridges	Rail-cum	Total Investment	w/o Loco & wagon
ALT R-1	Eastern R. (B Route)	Bhairab/Atai/Atherobaki & 6 br.	×	-40.0%	-18.4%
ALT R-2			○	-39.2%	-5.4%
ALT R-3	Western R. (A Route)	Rupsa & 6 br.	×	-39.7%	-15.2%
ALT R-4			○	-39.4%	-8.9%

Notes :
1) Construction costs comprise fill, bridge, ballast, sleeper, rail and signaling.
2) O & M costs are estimated on the assumption that 5 locos & 700 wagons are purchased.
3) The scheme of rail-cum-road bridge is to share the portion of main bridge only.

17.1.2 Evaluation on Alternative Plans for Issues Encompassed the Rupsa Bridge

1) In order to deliberate upon major issues which have been encompassing the Bridge from technical, social, managerial, economical and financial viewpoints, following planning approach are set forth.

   i) The scheme of rail-cum-road bridge in a whole (ALT 1-6/3-6) stretch was not included in the alternative study of road bridge because it was pointed out inferiority as a road bridge through preliminary engineering study and consequent comprehensive evaluation. Accordingly, totaling ten (10) alternative plans for road bridge were set, multiplying two route locations and five cross sectional configurations.

   ii) The selection of route location of Khulna Bypass was discussed in the Interim Report, and it recommended the western route, evaluating them from the qualitative viewpoints of planning parameters such as land availability, future traffic demand, social aspects, construction economy and river morphology.
   Table 17.2 presents additionally quantitative comparison of each route location, and it reveals that the western route is superior to the eastern route at almost all aspects, especially economic indices.
   Therefore, the comparison and evaluation of cross sectional configurations are to be made only for the western route.

2) The evaluation criteria for cross sectional configuration are ; 1) return on investment to compare costs and benefits, 2) requirements of traffic features to accommodate not only quantitative aspects but also quality of traffic and future development to secure flexibility in future. Fig. 17.1 shows the comparison of each alternative plan and evaluates them comprehensively.

3) ALT 1-3 is selected as the most recommendable alternative plan for Rupsa Bridge form the following reasons;

   i) Rupsa Bridge is located in the urbanized area of Khulna and expected major users are local commuters although major benefits are brought from transport cost savings of heavy trucks and long distance buses on regional and arterial road. It is necessary to deliberate transport means for citizens such as auto-rickshaws and motorcycles, and accordingly separated lanes for slow-moving vehicles to accommodate commuters as well as contribute traffic safety and steady flow of traffic.

ii) Number of auto-rickshaws and trucks of quite an old vintage with overloaded or shortage of horsepower make it justify to adopt flatter 3% grade in approach section because mixed traffic of slow-moving vehicles causes present traffic congestion taken place on National Highway No. 7. It is desirable that separated slow-moving vehicles enhance traffic safety as well as smooth traffic flow.

iii) This scheme has remarkable advantage to expand 2-lane carriageway up to 4-lane just in case that traffic demand might increase beyond forecasted one. Total width of carriageway is 13.5 m wide including 2 lanes for slow-moving vehicles, and it is still practical to modify it divided 4-lane with lane width of 3 m wide.

Fig. 17.2 shows the study approach and proposal for the scope of work for Phase II based on the comprehensive evaluation.

Table 17.2 Construction Costs and Indices of Economic Analysis of Alternative Plans

Alternative		Route Location	Direct Construction Cost (M.Tk.)			Economic Analysis			Social Costs (M.Tk.)			Affected Houses
			Bridge	Others	Total	IRR	B/C	N.P.V	Land	Comp.	Total	
1	ALT 1-1	Western Route (A Route)	1,341.1	1,186.8	2527.9	30.5%	3.01	M.Tk. 3,711	73.2	19.7	92.9	25
2	ALT 1-2		1,718.1	1,195.4	2,913.5	27.7%	2.62	M.Tk. 3,432				
3	ALT 1-3		1,874.4	1,191.5	3,065.9	26.7%	2.49	M.Tk. 3,323				
4	ALT 1-4		2,126.9	1,168.6	3,295.5	25.4%	2.32	M.Tk. 3,162				
5	ALT 1-5		2,180.2	1,351.0	3,531.2	24.1%	2.17	M.Tk. 2,988				
6	ALT 3-1	Eastern Route (B Route)	2,581.0	1,467.7	4,048.7	13.2%	1.09	M.Tk. 282	167.6	107.6	275.2	297
7	ALT 3-2		3,307.2	1,541.9	4,849.1	10.9%	0.92	-M.Tk. 295				
8	ALT 3-3		3,607.1	1,511.0	5,118.1	10.2%	0.87	-M.Tk. 491				
9	ALT 3-4		4,011.7	1,462.5	5,474.2	9.4%	0.82	-M.Tk. 751				
10	ALT 3-5		4,196.2	1,818.8	6,014.9	8.2%	0.75	-M.Tk. 1,138				

Note:

1) Direct construction cost of bridge covers costs between abutments and excluding 10 % contingency.

2) In road-cum-railway bridge, direct construction cost of Approach Bridge for railway is not included.

3) 100 m span continuous PC box girder with cast-in-situ concrete pile for Rupsa/Bhairab/Atai Bridge.

4) 50 m span continuous PC box girder with cast-in-situ concrete pile for Atherobaki Bridge.

5) 30 m span composite PC I-girder with cast-in-situ concrete pile for Approach Bridge.

6) 12 % per annum discount rate applied to B/C and Net Present Value (N.P.V).

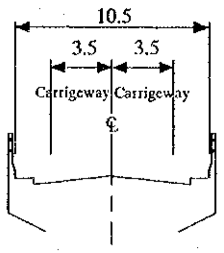
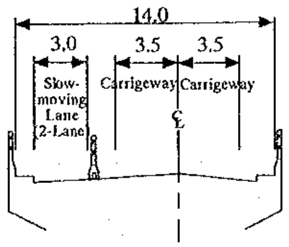
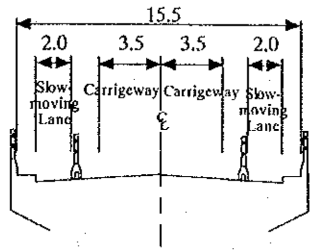
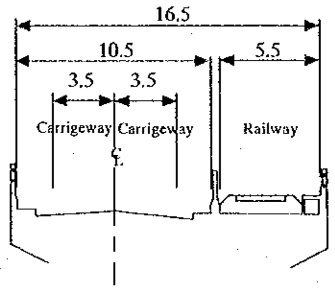
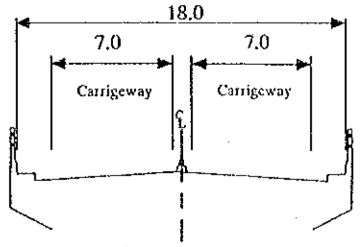
Alternative		ALT 1-1	ALT 1-2	ALT 1-3	ALT 1-4	ALT 1-5
Major Element of Cross Section	Carrigeway	2 - Lane with Sidewalks	2 - Lane with Sidewalks	2 - Lane with Sidewalks	2 - Lane with Sidewalks	4 - Lane with Sidewalks
	Slow-moving Lane	——	2-Lane Two ways (One Side)	2-Lane Two ways (Both Sides)	——	——
	Railway	——	——	——	Single Track	——
Typical Cross Section						
Type of Bridge Structure		Continuous PC Box Girder (Main) + Composite PC I-Girder + Cast In-situ Concrete Pile with Reverse Circulation Method				
Outline of Scheme		1) The basic configuration of 2-lane bridge section. 2) Only for movements of vehicular traffic and pedestrian. 3) Possibility of traffic congestion due to mixed traffic of slow-moving vehicles.	1) Provision of space for slow-moving vehicles. 2) Necessity of traffic management at both abutments. 3) Small number of slow-moving vehicles expected.	1) Provision of sufficient space for slow-moving vehicles. 2) Complete separation of slow-moving vehicles. 3) Alternative 4-lane scheme applicable in future.	1) Provision of space for railway only on Main Bridge. 2) Very limited usage of the space before realization of railway. 3) Imbalance of loading and cross sectional configuration.	1) The basic configuration of 4-lane bridge section. 2) Only for movements of vehicular traffic and pedestrian. 3) Mixed traffic of slow-moving vehicles allowed.
Direct Construction Cost (Million Taka)	Bridge	1,341.1 (100%)	1,718.1 (128%)	1,874.4 (140%)	2,127.0 (159%)	2,180.2 (163%)
	Road	1,186.8 (100%)	1,195.4 (101%)	1,191.5 (100%)	1,168.5 (98%)	1,351.0 (114%)
	Toal	2,527.9 (100%)	2,913.5 (115%)	3,065.9 (121%)	3,295.5 (130%)	3,531.2 (140%)
Economic Analysis	B/C	3.01	2.62	2.49	2.32	2.17
	IRR	30.5%	27.7%	26.7%	25.4%	24.1%
Requirements of Traffic Features		1) Unfavorable for both through traffic and slow-moving vehicles. 2) Unsuitable for traffic on urban road.	1) Practical solution for local traffic feature. 2) Anxiety of increase of traffic in future.	1) Desirable solution for local traffic feature. 2) High traffic safety anticipated.	The same as ALT 1-1.	1) No anxiety of increase of traffic in future. 2) High traffic safety anticipated.
Future Development		No room for modification and adjustment.	The same as ALT 1-1.	Possible 4-lane arrangement in future.	No room for modification and adjustment because of provision of space only on Main Bridge.	No need for modification and adjustment.
Comprehensive Evaluation		This scheme is of regional highway and has only advantage in construction economy. **Fair**	This scheme is practical solution in case of low motorization and also has advantage in construction economy. **Good**	This scheme has advantages in the aspects of local traffic requirements and future development. **Superior**	Additional cost for railway makes IRR lower, and it is hardly deemed due investment. **Inferior**	Uncertain future traffic demand could not justify this scheme. **Poor**

Fig. 17.1 Comparison and Evaluation of Alternative Plans

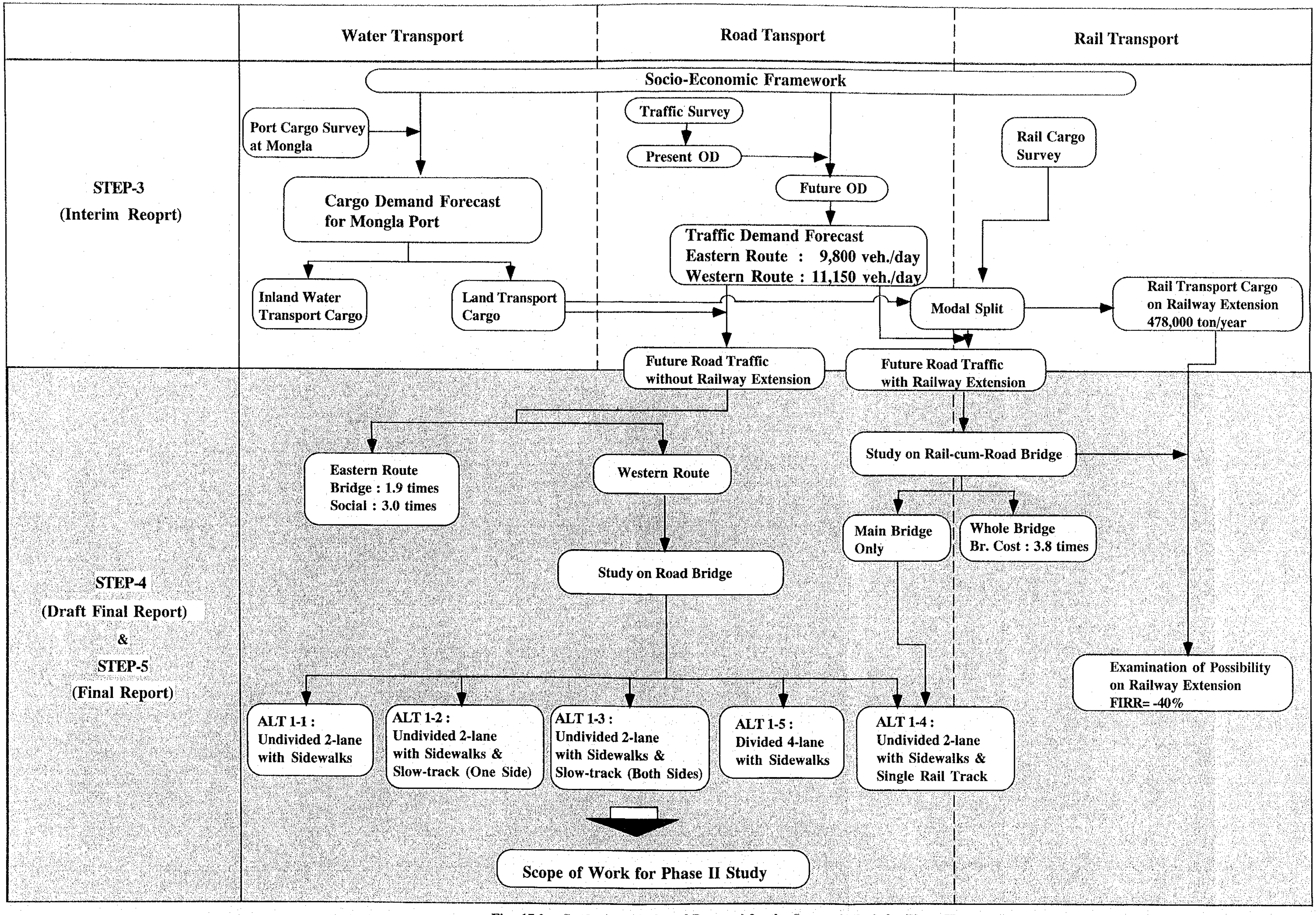


Fig. 17.2 Study Approach and Proposal for the Scope of Work for Phase II