Thematic Evaluation on Economic Benefits of the Smooth Implementation of Japanese ODA Loan Projects

March 2012

JAPAN INTERNATIONAL COOPERATION AGENCY

MITSUBISHI RESEARCHI INSTITUTE, INC.

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Preface

Japan International Cooperation Agency (JICA) makes its endeavour to accelerate the formulation and implementation of Official Development Assistance (ODA) loan projects to date, in order to facilitate prompt achievement of their intended results and their strategic impact in targeted developing countries. As part of such efforts, various activities have been conducted, including seminars to inform the ODA loan recipient countries on the project implementation procedures, an intensive monitoring of potentially delayed projects and technical assistance in related areas, as well as regular dialogues with the developing countries concerned, in order to reinforce the human capacity and facilitate smooth operations on the ground.

To build up on such undertakings and to further speed up the execution of ODA loan projects, it is pertinent for those who are responsible both in Japan and relevant developing countries to analyse the causes of the delays, to seize concretely the economic benefits brought by the punctual implementation of the projects, and to take high awareness on the issue when managing projects.

Thus, this research analysed major causes of the delays and the economic benefits of smooth operations in Japanese ODA loan projects, with a particular focus on four countries in South-East Asia and South Asia, where such assistance is relatively common. This report presents lessons learnt and issues to be considered in the future operations, while indicating the clear steps for the practitioners to calculate the economic benefits of their own projects, during the actual implementation phase. It is expected that the generated information be utilised as a reference to accelerate the project implementation. It is my great pleasure if the results of this research could contribute to the facilitation of the day-to-day work by those who are engaged in ODA loan projects in both Japan and developing countries.

Finally, I wish to express my sincere gratitude to all the people who kindly cooperated and collaborated with us, before accomplishing the research.

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Atsushi Sasaki
Director-General, Evaluation Department
Japan International Cooperation Agency

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Acronym

AP	**Andhra Pradesh**
EIRR	**Economic Internal Rate of Return**
ENPV	**Economic Net Present Value**
FIRR	**Financial Internal Rate of Return**
FNPV	**Financial Net Present Value**
GDP	**Gross National Product**
GRP	**Gross Regional Product**
JICA	**Japan International Cooperation Agency**
L/A	**Loan Agreement**
NPV	**Net Present Value**
NTPC	**National Thermal Power Corporation, Ltd.**
ODA	**Official Development Assistance**
WACC	**Weighted Average Cost of Capital**

Chapter 1 Background, Objectives and Contents of the Study

1.1 Background of the Study

So far JICA has endeavored for the speedy development and implementation of Yen loan projects with a view to enhancing the effectiveness of Japanese ODA and accountability towards the Japanese people. As part of such efforts, JICA has monitored with priority projects being faced with implementation delays, dispatched experts or organized seminars to facilitate the implementation of projects, etc. However, there has been increasing recognition that the current status relating to problems of smooth project implementation must be grasped in order to strengthen policy measures against project implementation delay including *ex-ante* preventive measures.

1.1.1 Evaluation of Project Implementation Delay in the Past Yen loan Project Evaluation and Agendas

JICA has fully introduced the Rating System in Yen loan project evaluation since fiscal 2004.[1] This is a system under which rating is made on the five items of evaluation (Relevance, Effectiveness, Efficiency, Impact and Sustainability), based on the *ex-post* project evaluation within 3 years as a rule after projects have been completed.

Among them, "efficiency" rating evaluates the status of the actual project implementation cost and period compared with the initial plan. The project cost is evaluated in terms of the amount of an additional cost surpassing the initial planned project cost, while the project period is evaluated in terms of a length of time of delay starting from the planned time of project completion measured against the planned implementation period as a period extension rate.

Project delay is evaluated simply and exclusively in terms of time delay in project implementation and no loss caused by the project delay (lost benefit) is computed. The same length of time of project delay will mean different lost benefit (equivalent to the economic benefit that could have been derived from smooth project implementation) calculated in monetary terms, depending upon project contents and the particular circumstances surrounding the project concerned. Therefore, grasping the economic benefit lost due to project implementation delay and showing such lost benefit the project counterpart can be one of the means for ensuring smooth project implementation.

1.1.2 Importance of "Time Management Concept" (Magnitude of Project Delay Impact)

This Study is meant for an analytical research on Yen loan project implementation delay. In the Japanese social capital development sector, the importance of time management is well recognized at both academic and business levels (the term "time management concept" is used).

There are a variety of factors causing project implementation delay. However, after all, a major cause is the fact that awareness on the importance of time management on the part of project stakeholders is not necessarily sufficient.

It is pointed that project delay not only will have adverse impacts on the financial position of specific enterprises and on the beneficial socio-economic impacts that the project concerned is supposed to have on society at large, but also will lead to a decline in the credibility of social capital development projects in providing access to the required services (a sort of resigned perception that it is only natural that no social capital development is supposed to proceed as planned) (see Table 1.1)

[1] Please refer to the following URL for an overall picture of the JICA evaluation system including the Rating System http://www.jica.go.jp/activities/evaluation/about.html

Table 1.1: Impacts of project delay (Impacts that can be avoided by smooth project implementation)

<table>
<tr><th colspan="2">Impact</th><th colspan="2">Contents</th></tr>
<tr><td rowspan="4">Impact relating to individual projects</td><td>Financial impact</td><td colspan="2">・ Aggravation of economic viability of the project concerned (interest cost)
・ Aggravation of the financial position of the project & business entity concerned (cash flows, etc)</td></tr>
<tr><td rowspan="3">Socio-economic impact</td><td>The project concerned</td><td>・ Increase of social cost due to delay (cost for counter-measures against the causes of delay, increase of labor cost and machinery lease cost, etc.)
・ Decrease of social benefit due to delay
・ Decrease of social benefit due to impacts on the financial position</td></tr>
<tr><td>Related investment</td><td>・ Investment opportunity loss and lost profit relating to social capital development projects pre-supposing access to the services to be provided by the project concerned.</td></tr>
<tr><td>Macro-economy</td><td>・ Opportunity loss of economic result & effect due to delay</td></tr>
<tr><td colspan="2" rowspan="2">Impact caused by a decline in the credibility of social capital development projects in providing the required access to services</td><td>Related investment in general</td><td>・ Decline of the effect of the project concerned (synergistic effect) and lost profit in the case where investment relating to socio-economic activities pre-supposing the commencement of service to be provided by the project concerned is delayed due to the wait- and-see situation</td></tr>
<tr><td>Social capital development projects in general</td><td>・ Decline of credibility in the general project evaluation of social capital development projects in general
・ Risk of consensus-making becoming difficult for social capital development projects.</td></tr>
</table>

(Source) Atsushi Hasegawa "A Study of Social Capital Development Project Implementation Management from the Perspective of Time Management Concept" (University of Tokyo doctorate dissertation)

In emerging countries and developing countries, among socio-economic impacts, the impact on macro economy, namely the impact of opportunity loss of economic effect due to project implementation delay is considered to be substantial. This is because in emerging countries and developing countries where social capital is generally lacking, the impact of social capital development on economic growth is considered to be larger than in developed countries. Therefore, this Study envisages to deepen understanding of the socio-economic impacts of project implementation delay on the basis of the fruits of research done in Japan and other countries on the concept of time management in social capital and to enhance awareness on the importance of time management concept on the part of those concerned in Yen loan target countries.

For this purpose, this Study will focus not only on a factual analysis of impacts of project delays but also on a comprehensive approach backed up by multi-faceted quantitative & qualitative analysis tools and based upon a good understanding of local characteristics.

1.2 Objectives of this Study

The objective of this Study against the above mentioned background shall be the following: "To understand the economic benefit to be gained from the smooth (without delay) implementation of large-scale infrastructure development projects and to indicate methodologies for its computation, etc."

1.3 Contents of the Study

The contents of the investigation carried out in this Study are the following:

1.3.1 Analysis of Ex-post Evaluation Reports

Information shall be collected from JICA Ex-post Evaluation Reports relating to all Yen loan projects (approximately 120 projects) on which JICA has conducted *ex-post* evaluation since 2000 and in respect of projects on which detailed information is required, reference shall be made to Appraisal Document of JICA.

<Target countries for analysis>

The following 4 countries whose number of Yen loan projects in the past has been numerous and is expected to be so in the future shall be analyzed:

Target countries: India, Indonesia, the Philippines and Vietnam

<Target sectors for analysis>

The target sectors for analysis shall be the following sectors where numerous large-scale infrastructure projects have been implemented

1) Transport (road and railway)
2) Electricity power (power station/transmission system)
3) Water & sewage services

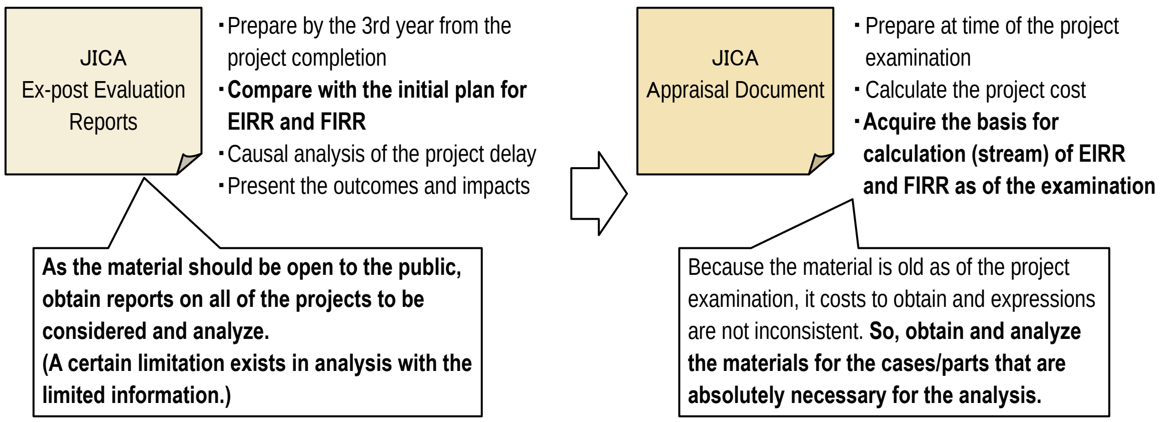

Figure 1-1 Information Gathering on Ex-post Evaluation Reports

(Source) Created by Mitsubishi Research Institute, Inc.

1.3.2 Examination of Methodologies for Computing Benefit to be derived from Smooth Project Implementation

Methodologies for estimating loss in the event that delay has incurred, shall be examined. It is equivalent to estimating benefit in the event that no delay has been caused due to smooth implementation. Here the simplified method for computation shall be examined by way of utilizing results of project evaluation based on cost-benefit analysis conducted before and after project implementation. Incidentally, the benefit estimated here also relates indirectly to impact on the local community (the fact that the benefit loss due to delay is substantial also means that the impact at the local community level is also substantial). In the case study where this methodology has been applied to actual projects, not only the loss of benefit due to delay but also the local level impact shall be analyzed and summarized by way of using qualitative and quantitative data.

In this Study one transport project in a target country has been selected and *in situ* investigation was conducted to grasp in concrete terms the conditions of delay and their impact. The result of this *in situ* investigation is attached to the Appendix.

1.4 Structure of the Study

In Chapter 1, the background, objectives and contents of the Study will be summarized briefly.

In Chapter 2, the result of analysis of Ex-post Evaluation Reports will be summarized and particularly the interrelationship between causes of delay will be summarized in a systematic manner.

In Chapter 3, after various methodologies for delay impact analysis have been summarized, the methodology proposed by this Study and the concrete computation method by way of using cost & benefit flow data will be introduced.

In Chapter 4, after introducing the result of a case study where this methodology has been applied to a case in the power sector as an example, methodologies for applying such methodology to the transport sector and the water& sewage services sector will be summarized.

In Chapter 5, after having summarized the significance of this methodology, policy measures towards the practical use of this methodology will be suggested.

In the Appendix, reference information and data for this Study (which is somewhat of lower priority than the main text) is summarized.

Chapter 2 Analysis of Ex-post Evaluation Reports

2.1 Status of Project Delay in the Target Sector

2.1.1 Number of Target Projects for Analysis

The number of target projects for analysis is as shown in Table 2.1. In terms of target countries, Indonesia and the Philippines have a large number of projects and in terms of sectors, transport (road) and power sectors have a large number of projects.

Table 2.1: The Number of Target Yen Loan Projects for Analysis

Sector \ Country		India	Indonesia	The Philippines	Vietnam	Total
Transport	Road	5	18	21	6	50
	Railway	1	3	4	0	8
Power (power station & transmission systems)		22	14	11	4	51
Water & sewage services		2	3	2	0	7
Total		30	38	38	10	116

(Source) Created by Mitsubishi Research Institute, Inc. from Ex-post Evaluation Reports

2.1.2 Efficiency Rating for Each Project

Table 2.2 shows the efficiency rating and project period extension rate in respect of each of the target projects for analysis extracted from Ex-post Evaluation Reports.

Here, Efficiency Rating is meant an index shown as the standard for the evaluation of project-period-extension rates. If the extension rate is less than 100%, the rating shall be “a”. If the rate is more than 100% and less than 150%, the rating shall be “b”. If the rate is more than 150%, the rating shall be “c” (since 2005). The “a” rated project is desirable in terms of smooth implementation.

In any sector, the most numerous are projects with a project-period-extension rate of “more than 150% of the planned period. On the other hand, there are a few projects with a rate of less than 100%. Among such projects, there is the Simhadri Thermal Power Station Project (India) whose reasons of no-delay project implementation are fully analyzed (see 2.3).

Table 2.2: The Number of Projects per Sector and Project-Period-Extension Rate

Extension rate/sector	Road	Railway	Power	Water & sewage
a: Less than 100% of the plan	3(6.0%)	1(12.5%)	2(3.9%)	1(14.3%)
b: More than 100% and less than 150% of the plan	13(26.0%)	2(25.0%)	8(15.7%)	2(28.6%)
c: More than 150% of the plan	31(62.0%)	4(50.0%)	36(70.6%)	3(42.9%)
Unknown	3(6.0%)	1(12.5%)	5(9.8%)	1(14.3%)
Total	50(100.0%)	8(100.0%)	51(100.0%)	7(100.0%)

(Note 1) The project-period-extension rate is meant a ratio of the number of months actually spent vis-à-vis the planned number of months.
(Note 2) The cells indicating the number of projects with the highest rate in each sector is marked with color.
(Note 3) Attention should be paid to the fact that data reliability is relatively low due to the small number of target projects as far as the railway and water & sewage sectors are concerned.
(Source) Created by Mitsubishi Research Institute, Inc. from Ex-post Evaluation Reports

2.2 Causes of Delay

2.2.1 Stages of project

Diagram 2.1 shows a summarization of the Yen loan project process and the way of thinking on delay to analyze the causes of delay. Namely, here the project delay shall be conceived in terms of time gap (time delay) between the scheduled time of the service commencement as of the time of conclusion of L/A and the actual service commencement time. Midway delays in the course of project implementation such as stops for each project stage and for procedures are also conceived in terms of time gaps between the scheduled implementation time as of the time of conclusion of L/A and the actual time of implementation. Project delays are likely to arise at each stage of the implementation process between the conclusion of L/A and the service commencement.

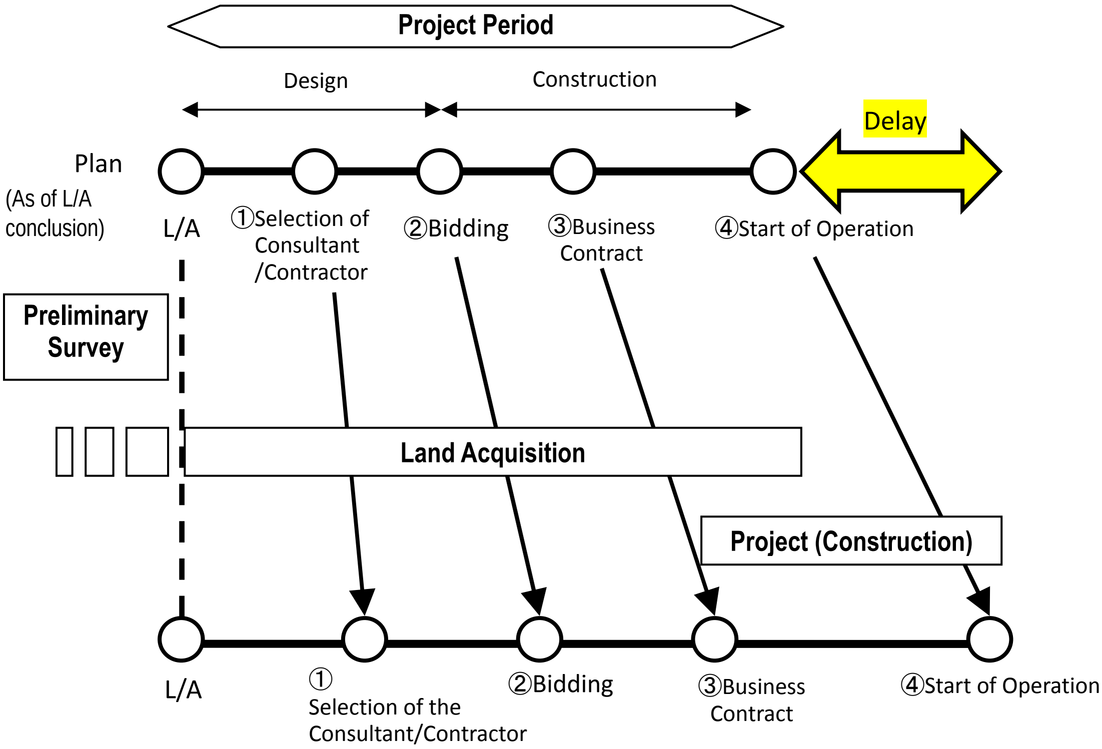

Figure 2-1 Process of ODA Loan Projects and Concept of Delay (L/A ~ Start of Operation)
(Source) Created by Mitsubishi Research Institute, Inc.

2.2.2 Major Delay Cause Stages and Example of Delays

On the basis of delay causes described in Ex-post Evaluation Reports, major causes of delay can be summarized as in Table 2.3.

Table 2.3: Major Causes of Delay at Each Process Stage

Process stage	Major delay cause	Concrete examples
Land Acquisition	Land Acquisition	● Transfer of land from the Forestry Bureau delayed by 4 years. ● Much time consumed for land acquisition for coal ash dump site construction and resettlement of local residents.
Designing	Selection of Contractor and Consultant	● Much time consumed for starting the consultant selection process by way of a review of consultant services.
	Designing	● Due to the lack of as-built-drawings, much time spent before the start of construction works in order to survey the actual status of above-ground and underground public facilities (power transmission lines, gas, water pipes, etc). ● Much time spent for forestry environmental impact assessment.
Construction	Procedure/Approval/Tender	● The start of construction works were delayed due to the delay of tenders, additional geological surveys and change in designs. ● Due to the procrastination of administrative work within the implementing organization for the preparation of split–up & privatization of National Power Corporation (NPC) and in anticipation of the establishment of the National Transmission Corporation (TRASCO), the implementation of the project and construction works stagnated. ● Much time consumed for approval procedures of Public Investment Board (PIB).
	Project Planning	● Much time spent because the intended usual blasting/heavy machinery excavation methods could not be adopted, as the construction area was close to the existing dam and power station, was small and had bad access to the construction site and mainly manual labor work was counted upon. ● The generator broke down because the breaker supposed to operate in an emergency did not function during the test operation after installment. 3 months later, the operation was restarted. But the construction works for coal processing facilities and ash processing facilities were delayed. Part of the delayed works had to be done by halting the operation of the generator. Due to grave power shortages in Karnataka, works could not be carried out except in the rainy season when hydroelectric power stations were in full operation.
	Lack of Operation Capability of Contractor	● Due to the slow work of the construction contractor, the construction works were not completed as scheduled. As the first contractor dismissed filed suit against his dismissal, much time was consumed to obtain the approval of the court relating to the procedure of retender and employment of a new contractor. ● Concrete placing was outsourced to local contractors but some of them were inexperienced.
	Other circumstances relating to entities participating in project implementation	● Problems of fundraising have arisen to contractors as a joint venture selected for the local currency portion of the project, which have led to delays in the procurement of construction materials and to labor shortages.
	Change in Plan	● There were design changes etc. in the Great Metropolitan Traffic Congestion Alleviation Project (changes in the position of stations, positions of base, structure of station entrances, elevated structures, crossing structures). ● The project scope was changed because other civil engineering construction works of higher urgency were prioritized.
	Delay in Payment	● Payment to contractors was delayed due to financial constraint on the part of the implementing organization and payment of custom duties was delayed. ● The local currency portion supposed to be taken care of by the local government came to be in short supply.
Common factors	Natural Hazard (bad weather, natural disasters, etc.)	● *In situ* investigation construction works were delayed due to changeable weathers, etc.
	Change in Political/economic situations	● Security conditions have aggravated due to political instability.
	Other unexpected events	● There were frequent thefts of construction materials at the project site. ● Works delayed due to difficulty in works because of the soft ground not initially expected. ● There arouse strikes by construction laborers.

(Source) Created by Mitsubishi Research Institute, Inc. from Ex-post Evaluation Reports

2.2.3 Causes of delay per sector

With the exception of the power sector, land acquisition is the largest cause of delay. In the power sector, cases of projects delayed due to the problem of land acquisition are relatively few.

The reason may be perhaps that development works take place “along the line” in Yen loan projects in sectors other than the power sector while development works (such as power stations, etc.) in the power sector take place “spot by spot”. On the other hand, delays in various procedures are particularly noticeable. However, it must be noted that the number of projects in the railway and water & sewage services sectors are small and accordingly the number of delay cases is also small. Therefore, generalization in respect of causes of delay may need a consideration.

Table 2.4: Causes of Delay per Sector

Factor/Sector	Road	Railway	Electric Power	Water& Sewage Services
Land Acquisition	18(16.1%)	3(15.0%)	10(9.1%)	4(36.4%)
Selection of Consultant	4(3.6%)	0(0.0%)	4(3.6%)	2(18.2%)
Survey & Designing	3(2.7%)	2(10.0%)	3(2.7%)	0(0.0%)
Procedure/Approval/Tender	16(14.3%)	2(10.0%)	26(23.6%)	3(27.3%)
Project Planning	13(11.6%)	3(15.0%)	10(9.1%)	1(9.1%)
Contractor's Lack of Operation Capability	18(16.1%)	2(10.0%)	12(10.9%)	0(0.0%)
Other Circumstances of Entities	3(2.7%)	2(10.0%)	3(2.7%)	0(0.0%)
Change in Plan	13(11.6%)	2(10.0%)	11(10.0%	0(0.0%)
Delay in Payment Delay	3(2.7%)	0(0.0%)	6(5.5%)	0(0.0%)
Natural Hazard	14(12.5%)	1(5.0%)	11(10.0%)	1(9.1%)
Change in Political/Economic Situations	5(4.5%)	2(10.0%)	7(6.4%)	0(0.0%)
Other Unforeseen Events	2(1.8%)	1(5.0%)	7(6.4%)	0(0.0%)
Total	112(100.0%)	20(100.0%)	110(100.0%)	11(100.0%)

(Note) Causes of delay were classified based on the causes of delay described in Ex-post Evaluation Reports. In cases where there are more than one causes of delay per project, each cause of delay is separately counted. Therefore, the number of causes of delay will not correspond to the number of projects.

In each sector the cell for the highest rate of causes of delay is marked with color.

(Source) Created by Mitsubishi Research Institute, Inc. from Ex-post Evaluation Reports

2.2.4 The Average Number of Months of Delay and the Average Delay Rate per Cause of Delay

Table 2.5 shows the average number of months of delay and the average delay rate per cause of delay. In the event that unforeseen events, changes in politico-economic situations arise or the cause of delay is found in the project plan, the average rate of delay exceeds more than 200%. Of these, delays due to inappropriate project planning (optimistic project planning which has failed to foresee phenomena which should have been envisaged) may have been avoided by way of conducting appropriate project planning based advance information collection, etc.

Table 2.5: Average Number of Months of Delay and Average Delay Rate per Cause of Delay

Cause of Delay	Average Number of Months of Delay	Average rate of Delay
Land Acquisition	50.1	198%
Selection of Consultant	24.0	154%
Survey & Designing	37.0	188%
Procedure/Approval/Tender	33.4	184%
Project Planning	43.1	213%
Contractor's Lack of Operation Capability	46.1	181%
Other Circumstances of Entities	54.2	178%
Change in Plan	34.3	184%
Delay in Payment	43.5	182%
Natural Hazard	50.9	174%
Change in Political/Economic Situations	43.4	217%
Other Unforeseen Events	79.8	233%

(Note) Causes of delay were classified based on the causes of delay described in Ex-post Evaluation Reports. In case where there is more than one cause of delay per project, each cause of delay is separately counted. The average number of months of delay and the average rate of delay were computed per cause of delay. The delay rate is the number of months of delay divided by the planned number of months.

(Source) Created by Mitsubishi Research Institute, Inc. from Ex-post Evaluation Reports

2.3 Example of Smooth Project Management (Simhadri Thermal Power Station, India)

2.3.1 Outline of Simhadri Thermal Power Station Construction Project

This was a project to construct a large scale coal fired thermal power station with a capacity of 1,000 MW (500 MW×2 plants) using domestically produced coal (produced in Orissa of East India) in the suburbs of Vishakhpatnam in Andhra Pradesh (hereinafter AP State) of South India.

Simhadri Thermal Power Station

The objective of the project was to meet increased power demand in AP State, to stabilize power supply, to reactivate the industries in the State, to expand employment opportunities, to electrify agricultural villages, to promote the spread of household electric appliances and thus to contribute to improvement of life styles of local residents' life styles.

This project (the construction of the power station) was completed within a period of implementation shorter than initially planned (see Figure 2-2). This was a highly praised project which obtained an "a" rating in the evaluation of efficiency and an "A" rating in the overall evaluation.

Table 2.6: Simhadri Thermal Power Station Yen Loan Project

Approved Amount/ Reimbursed Amount	(First Phase) 19 billion 817 million Yen/ 19 billion 371million Yen (Second Phase) 12 billion 194 million Yen/ 12 billion 191 million Yen (Third Phase) 27 billion 473 million Yen/ 27 billion 294 million Yen (Fourth Phase) 5 billion 684 million Yen/ 1 billion 251 million Yen
Loan Agreements Signed	(First Phase) February 1997, (Second Phase) March 2001, (Third Phase) February 2002, (Fourth Phase) March 2003
Terms of Loan Agreements	(First Phase) Interest rate 2.3%, Payment Period 30 Years (of which a grace period of 10 years), General untied loan, (Second , Third and Fourth Phases) Interest rate 1.8%, Payment period 30years (of which a grace period of 10 years), General untied loan
Loan completed	(First Phase - Fourth Phase) April 2007
Implementing Organization	National Thermal Power Corporation (NTPC)

(Source) Simhadri Thermal Power Station Yen Loan Project Ex-post Evaluation Report

Table 2.7: Simhadri Thermal Power Station Project Ex-post Evaluation Report

Overall Rating	A
Effectiveness/Impact	a
Relevance	a
Efficiency	a
Sustainability	a

(Source) Simhadri Thermal Power Station Yen Loan Project Ex-post Evaluation Report

2.3.2 Analysis and Examination of Simhadri Thermal Power Station Construction Project

(1) The Causes Having Led to the Reduction of the Project Period (Efficiency)

According to Project Performance Audit Report, the reason why the project implementation period was reduced from the planned 91 months to the actual 84 months was the following: (i) the State Government and municipalities, etc. actively supported the project implementation by way of facilitating the multiple administrative procedures for the project which was highly important for them and therefore the project was handled with high priority; (ii) the capability on the part of NTPC to implement the Yen loan project had much improved because of its long years of experience. For these reasons, delays that might have been caused through Procedures/Approval/Tenders and Land Acquisition, which are usually likely to be major causes of delay, were avoided.

■Project Period Reduction (Efficiency)

Total Project Period (Plan) 91 months ⇒ (Actual) 84 months

(Major items of the project period reduction)

Coal transport facilities	(Plan) 5yr.+4mo.	⇒ (Actual) 5yr.+1mo.
Cooling tower	(Plan) 4yr.+7mo.	⇒ (Actual) 4yr.+3mo.
Effluent treatment facilities	(Plan) 4yr.+4mo.	⇒ (Actual) 3yr.+3mo.

⇓

■Reasons for the Project Period Reduction

(1) NTPC's preferential resource loading

(As a high-priority model business, a sufficient degree of budget allocation was secured for conducting the Project.)

(2) A contractor's high level of performance/credit capability

(3) NTPC's high level of the project performance capability

(4) Support of the local government

(Because of the high priority and importance of the Project for the state of AP, the Project was implemented in a really short time (i.e. for the process of acquiring an environmental clearance), compared to a normal project. Also, the base price for land compensation was set as the 3-4 times higher than the market price, and general grant (incentive) was provided.)

Figure 2-2 Period Reduction of Simhadri Thermal Power Station Project

(Source) Simhadri Thermal Power Station Yen Loan Project Ex-post Evaluation Report

(2) Reasons for Project Cost Reduction (Efficiency)

Major causes for project cost reduction were mainly in the saving of reserve funds. Certain administrative expenses, etc. were also saved. This means that NTPC's project management capability was high.

■Project Cost Reduction (Efficiency)

Total Project Cost (Plan) 97,369M yen ⇒ (Actual) 90,946M yen

(Major items of the project cost reduction)

Engineering cost, management cost, etc.	(Plan) 5,120M yen ⇒ (Actual) 5,008M yen
Chimney	(Plan) 565M yen ⇒ (Actual) 487M yen
Discretionary reserves	(Plan) 4,464M yen ⇒ (Actual) 106M yen
Interest rates during construction	(Plan) 3,628M yen ⇒ (Actual) 3,407M yen

■Reason for the Project Cost Reduction

The project cost reduction was basically from the result of reduction in discretionary reserve. Similarly, the costs of engineering, management, etc. were slightly reduced. However, costs of ash/water treatment, railway incoming lines, etc. were increased from that of initially planned, along with the increase in the quantity consumed.

■Major causes of the management cost reduction

(1) A contractor's/NTPC's high levels of performance/management capability

(2) Support of the local government

Figure 2-3 Cost Reduction of Simhadri Thermal Power Station Project

(Source) Simhadri Thermal Power Station Yen Loan Project Ex-post Evaluation Report

(3) Reason for Operating Ratio Improvement (Efficiency)

The number of any of human errors, machine failures and planned suspensions were below the levels of the planned figured. This is considered to be due to the improvement of operation management capability, the optimization of designs, and the reliability of various machinery and equipment.

■Operating Ratio (Efficiency)

Operation/Effect indicators (Year of 2009/2010)

Facilities utilization ratio (%) (Plan) 85.00 ⇒ (Actual) 97.27
Operating ratio (%) (Plan) 89.00 ⇒ (Actual) 94.38
Transmission end electricity generation (GWh) (Plan) 6,962 ⇒ (Actual) 8,051

■Reasons for the Improvement in Operation/Effect Indicators

(1) Selection of operators with high performance/credit capabilities (reduction in human errors)
(2) Reduction in time/frequency of machine failure
(Plan) 526hr./48 times ⇒ (Actual) 305.02hr./8 times
(3) Reduction in time/frequency of planned suspensions
(Plan) 1,402hr./4 times ⇒ (Actual) 677.31hr./2 times

As a result of improvement in operating ratio, Financial Internal Rate of Return (FIRR) was increased and reached the top levels of the country.

(Plan) 12.03%⇒ (Actual) 12.6%

Figure 2-4 Improvement of Operating Ratio of Simhadri Thermal Power Station Project

(Source) Simhadri Thermal Power Station Yen Loan Project Ex-post Evaluation Report

(4) Major Points for Smooth Project Implementation

As seen in the above, it is noted in Project Performance Audit Report that this project was smoothly and effectively implemented. The reasons may be summarized as follows:

- High implementation capability of the implementation organization (NTPC)
- Selection of reliable contractors and other entities
- Abundant budgetary appropriations made available because of the priority nature of the project
- Strong support of the State and local governments

However, these conditions are not always made available for projects implemented in developing countries. It must be noted that these points made here are not always valid in respect of other power projects or projects in other sectors.

2.4 Interrelationship between Causes of Delay

Based on the analysis of causes of delays and the example of smooth project implementation, the typical causes of delays and interrelationship between causes of delay are summarized in Figure 2-5.

As described above, causes of delay are numerous. But they can be summarized as follows:

(1) Initial optimistic project plan, (2) delay caused by mechanisms of institutional arrangements such as administrative procedures, etc., (3) capability of contractors and consultants, (4) force majeure including natural disasters, etc., and (5) political reasons.

Of these causes of delay, (4) and (5) are beyond the control of project implementation entities. However, the causes of (1) through (3) are considered to be able to be avoided by way of appropriate measures taken by implementation entities.

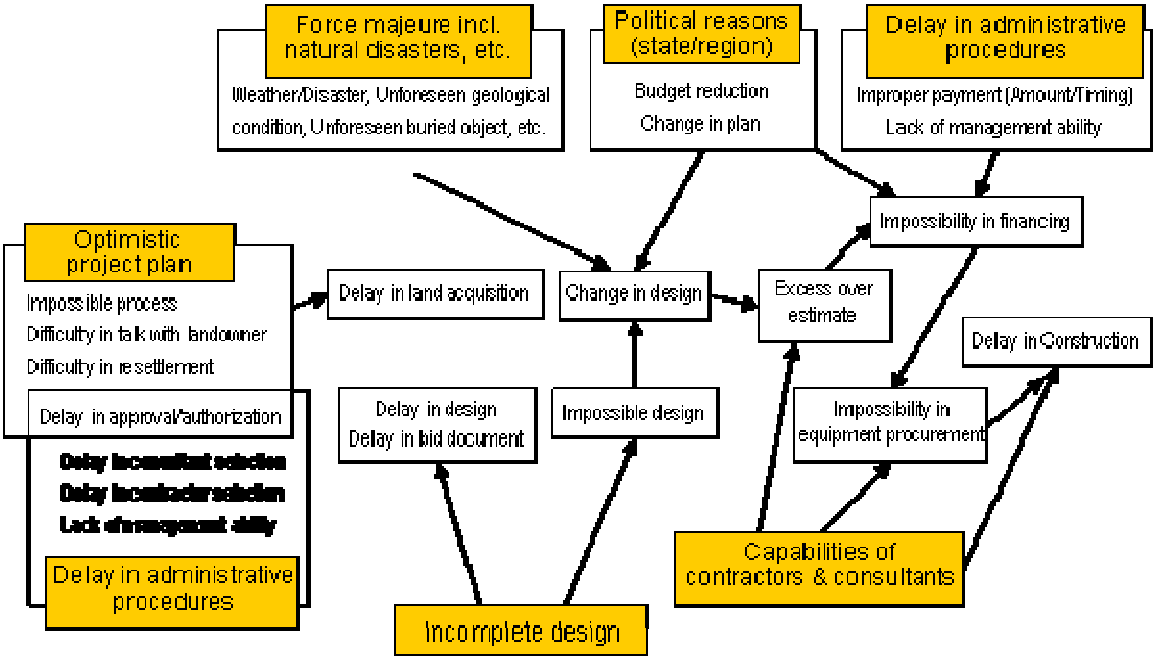

Figure 2-5 Interrelationship between Causes of Delay

(Source) Created by Mitsubishi Research Institute, Inc.

Capter 3 Examination of Methodology for the Computation of Economic Benefit of Smooth Project Implementation

This chapter examines methodologies for estimating loss when delay has been caused. Estimating economic loss in the event that delay has been caused is considered to be tantamount to estimating economic benefit in the event that no delay has been caused due to smooth implementation.

3.1 Way of Thinking on Economic Impacts of Delay

The objective of this Study is “to understand economic benefit to be gained from the smooth (namely undelayed) implementation with regard to major sectors involved in large-scale infrastructure construction projects.”

For this purpose, it is necessary to understand that even for the same length of project implementation delay, lost benefit (equal to the economic benefit gained by smooth project implementation) calculated in monetary terms vary, depending upon the contents and environment of projects as well as to develop methodologies in order to compute such benefit and show it to the counterpart if necessary.

As methodologies for the computation of economic benefit, the following ones are conceivable:

Table 3.1: Methodologies of Numerical Analysis for Computation of Economic Impacts of Delay

Methodology of Analysis	Contents	Merits	Demerits
(1) NPV Analysis Method	Based on the concept of cost-benefit analysis, Net benefit (NPV) in the case of delay and benefit in the case of non-delay, etc. are compared.	・As cost-benefit analysis is already in place, computation will be relatively easy if cost-benefit stream data is available ・An integrated method of computation can be possible without depending on computation per sector & per region ・Sector by sector differences can be reflected in cost-benefit streams ・Analysis on the same basis as *ex-ante* and *ex-post* evaluation is possible. Therefore it is easier to reach common understanding with the counterpart	・Results will change substantially, depending upon parameters set, such as social discounted rate, etc. ・Difficult to clarify differences in benefit per sector or region
(2) Macro-economy model	Impact (GDP growth, etc.) in the case of delay and impact in the case of non-delay is compared by way of a model for computing macro-economic impacts such as GTAP, etc.	・Direct computation of impact on the local community is possible ・Special features of sectors and regions can be directly reflected	・Computation is complicated ・More suitable for measuring the impact of total investment in social infrastructure rather than the impact of individual projects
(3) Analysis based on quantitative data	First to grasp the impact of project implementation by way of comparing statistical data of before & after project implementation and then to assume that in the case of delay such impact will be delayed.	・The special features of sectors and regions can be reflected	・Can be applied only to *ex-post* evaluation ・Constrained by available data→ Needed to analyze detailed data ・Uncertain whether or not the impacts measured are only those from the project concerned.

(Source) Created by Mitsubishi Research Institute, Inc.

These methodologies have their own merits and demerits. However, in this Study, the economic impact of delay (economic benefit of smooth project implementation) shall be computed by using (1) NPV Analysis Method in view of the fact that "Within JICA and also within governments of developing countries which are potential recipients of Japanese Yen loans, a methodology easy to use is wanted" and that "Such methodology must enjoy a certain degree of recognition for the reason that there have been a number of examples of application in Japan (see Table below)".

Table 3.2 Examples of Delay Loss Computation by NPV Methodology in Japan[2]

Sources	Subject of Computation	Project concerned, etc.	Impact of Delay and Project Period Reduction	Remarks
"Basic Research on the Method of Introducing Time Management Concept in Public Utility Works and Reevaluation Method" (Public Utility Research Office, Transport Policy Bureau, Ministry of Transport, March 2003)	Delay loss depending on the timing of occurrence of delay, etc. (rate of benefit reduction from net benefit of reference case)	Railway (hypothetical)	Minus16%	In the case where the project is delayed by 2 years toward the end of the project
		Port (hypothetical)	Minus 13%	
		Airport (hypothetical)	Minus 14%	
A Study on Socio-Economic Impact of Delay of Public Utility Works (Research Institute of Construction and Economy, March 2000)	Delay loss due to delay in the commencement of service	New Shonan By-Pass	Minus 9.4 billion Yen	A loss of 24% of project cost
Effectiveness of City Railway System (Corporation for Transport and Technology, March 2003)	Delay loss due to delay in the commencement of service	Fukuoka City Subway No.1 and No.2 Lines	Minus 1 trillion 777.2 billion Yen	A loss of 110% of project cost

(Source) Compiled from Atushi Hasegawa" A Study on Implementation Management of Social Capital Development viewed from the Perspective of Time Management Concept" (September 2005)

The merit of this methodology is that it enables us to grasp quantitatively and with relative ease economic impacts by way of an integrated method of computation without depending upon computation per sector and per region and that sector-by-sector differences can be reflected in cost-benefit stream.

Moreover, this methodology has a practical merit of enabling us to book a delay loss with an understanding shared with those concerned of Yen loan recipient countries, by way of analysis based on stream data of cost and benefit, which is the basic data for *ex-ante* and *ex-post* evaluation.

Furthermore, according to the standard micro-economic theory, NPV will eventually end up with the impact ending up in regions (change of GRP[3], etc.). Therefore, the social & economic NPV difference is considered to enable us to grasp a certain degree of regional level impacts. Moreover, since the magnitude of financial NPV (FNPV) is in an interrelationship with the magnitude of economic and social NPV, FNPV and regional level impacts are also considered to be in a certain degree of interrelationship.

[2] CEA Annual Report 2009/2010

[3] GRP is the acronym of Gross Regional Products（added value generated within a region).

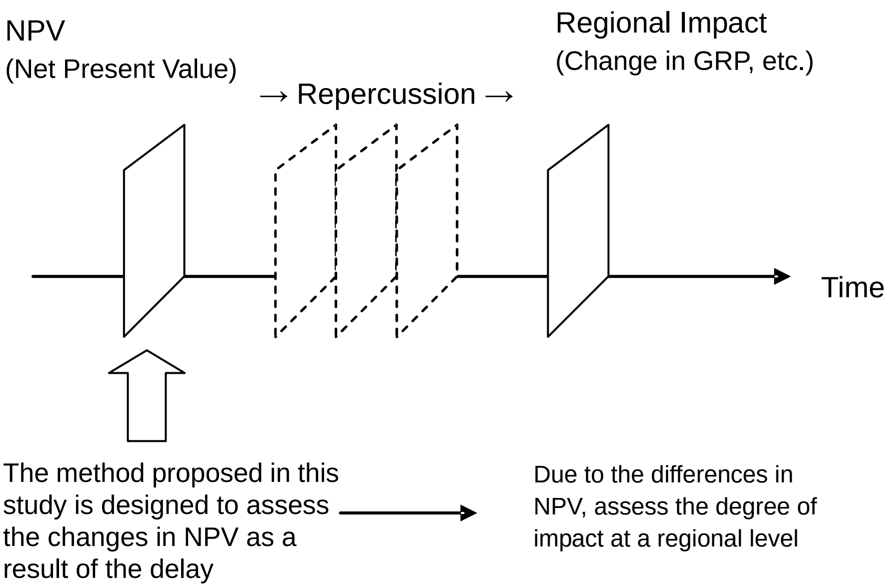

Figure 3-1 Relations between NPV and Regional Impact

(Source) Created by Mitsubishi Research Institute, Inc.

On the other hand, there is a constraining factor. Namely the calculation of the NPV difference may generate substantial change in the result, depending upon the determination of social rates, etc., which are parameters used for the calculation formula. There are certain factors making the exact calculation of social rates difficult. Therefore, while it is advisable to interpret that the economic impact calculated by the NPV difference is nothing but a roughly estimated value, it should be noted that though it is a roughly estimated value, this kind of counter-measure will serve to enhance awareness on the importance of time management on the part of those concerned in developing countries and will become a factor facilitating efforts to control delay.

As shown in the case study in Chapter 4, by collecting information on regional impacts of individual projects and showing such information together with quantitative data such as GRP changes, it will be possible to indicate persuasively that the NPV difference also represents delay in the manifestation of such impacts.

Occasionally there are cases where NPV improves when projects are delayed (such as the case where land acquisition becomes easier and the project site cost goes down as projects are delayed). When concrete methods for the calculation of cost and benefit are discussed in the next and subsequent Chapters, these cases will not be left out of consideration.

3.2 Method for Understanding Economic Impacts of Delay

This section shows the concrete process of grasping the economic impact of delay by way of the NPV difference.

3.2.1 Workflows in this methodology

The following is the workflow in this methodology. First of all, stream data on cost & benefit required for NPV calculation shall be obtained from local governments and then changes that may arise due to delay for each of cost & benefit items shall be assumed. After the concrete conditions have been set such as setting the reference time point for delay, and finally the NPV difference in the case where there exists delay and in the case where there exists no delay shall be calculated.

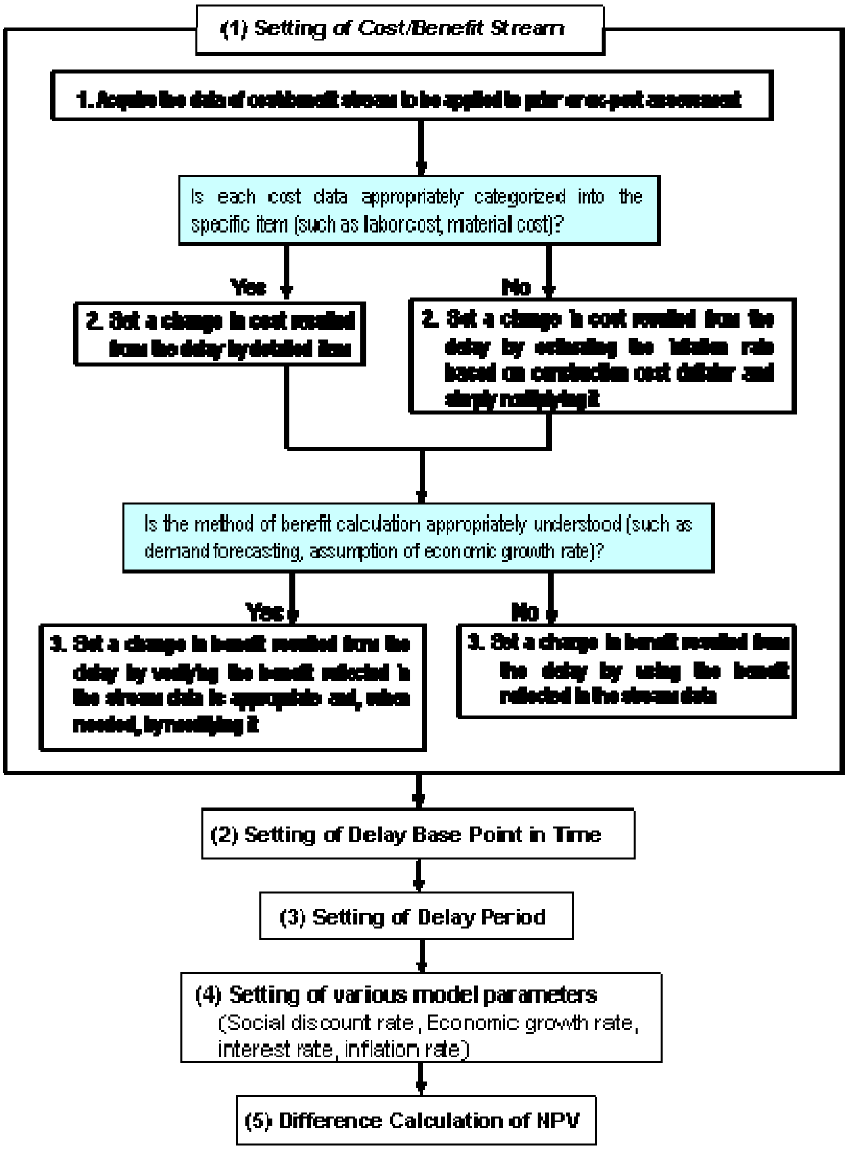

Figure 3-2　Workflows in this Methodology

(Source) Created by Mitsubishi Research Institute, Inc.

3.2.2　Methodology of Computation for Each Item

What follows are a summarization of specific methodologies of computation for various items which are needed by those concerned within JICA and in Yen loan recipient countries in order to understand economic impacts resulting from project implementation delay. More particularly, computation shall be done on the following items in accordance with the workflow.

(1) Developing the stream of cost and benefit
(2) Setting the reference time point for defining delay
(3) Setting periods of delay (They will vary, depending upon whether appraisal is conducted ex-ante, or in the midst of the implementation period, or ex-post.)
(4) Setting various parameters (social discount rate, economic growth rate, interest rate, price increase rate)
(5) Calculating the NPV difference

(1) Developing Stream of Cost and Benefit

In order to show the basic way of thinking on cost and benefit stream, the following Figure summarizes what sort of impact project delay will have on cost and benefit.

This Figure has been developed by way of visualizing public utility projects in general.

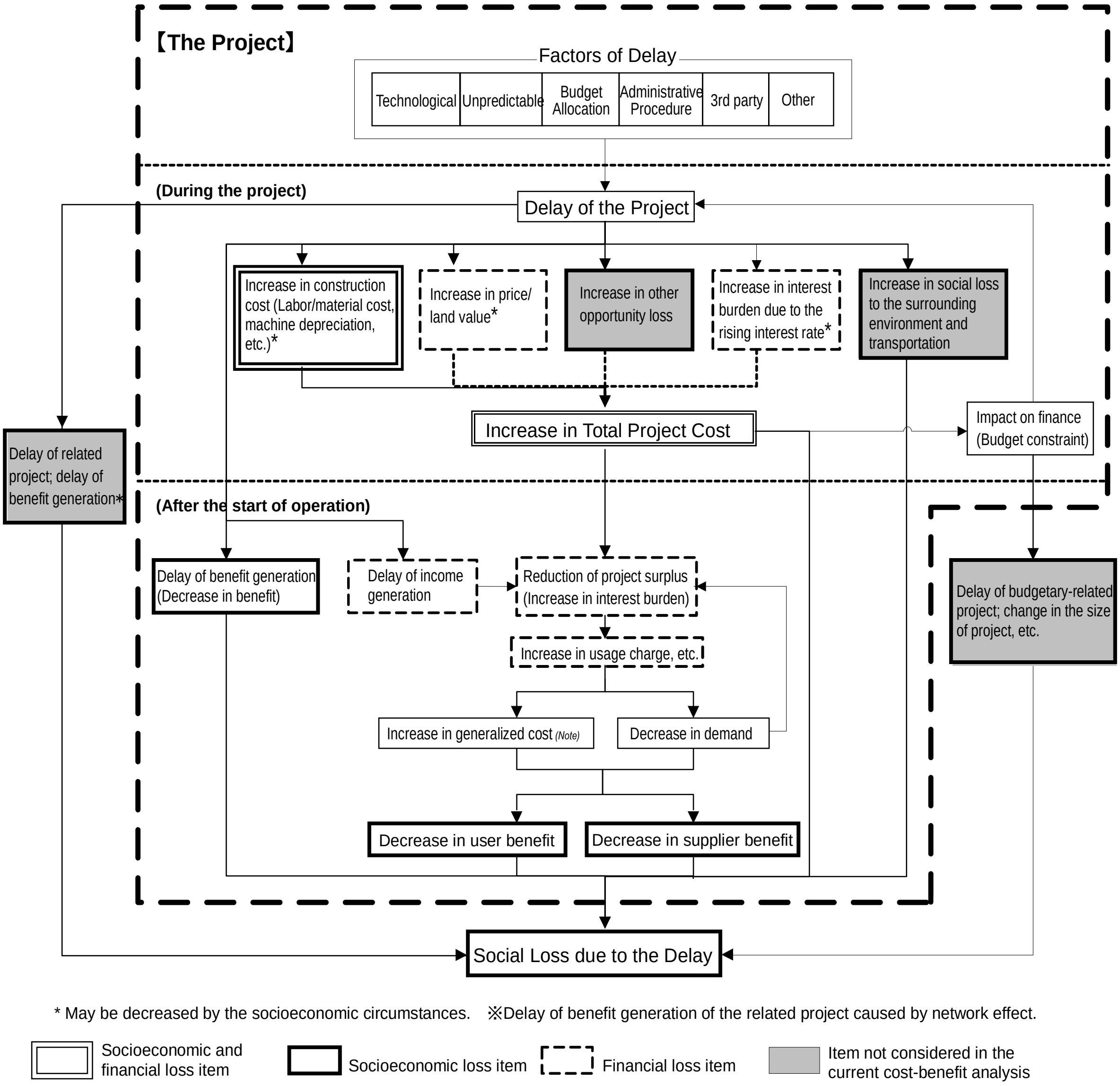

Figure 3-3 Structural Image of Delay Loss Generation

(Note) "Network effect" in the above Figure describes, for example, the delay of a road project may possibly affect the other linked road project which is supposed to exert the original effect, and may also cause the delay of benefit generation.

(Source) Created on the basis of and by adding modifications (such as difference between socio-economic loss and financial loss) to A Basic Research on the Method of Introducing Time Management Concept in Public Utility Works and Re-Evaluation Method (Public Utility Research Office, Transport Policy Bureau, Ministry of Transport, March 2003)

Based on the above summarization, the methodology for the development of cost and benefit stream will be discussed below while taking into account the special features characterizing transport, power and water & sewage service sectors. More particularly, as regards transport projects, the ratio of benefit gained by users from project periods shortened are significant. Such benefit depends largely upon traffic demand. Therefore, these factors shall be taken into account. As regards power projects and water & sewage services projects, benefit depends much upon power or water demand and upon the utility charges set in the future. Therefore, these factors shall be taken into account.

As regards cost & benefit stream, the stream actually utilized for the computation of EIRR or FIRR in evaluation *ex-ante*, evaluation in the midst of project implementation period and evaluation *e- post* evaluation shall be acquired from local government organizations. And on the basis of such stream, cost and benefit shall be computed.

The following is a summarization of concrete methodologies for computing cost and benefit respectively.

1) Method for setting cost

(i) In the case where cost is classified per detailed item

In the case where cost is classified per detailed item in the stream, cost in the case of delay will be computed for each item as follows:

Table 3.3: Summary of Cost Computation Method

Item				Computation Method
Cost Item	Total Project Cost increase	Investigation & Survey Cost Increase		■ The difference between the present value of the cost in the case of no-delay and the present value of the cost in the case of delay is booked. More concretely, <(1) the difference of the present value due to delay in the incurrence of the cost > and <(2) the difference of the present value resulting from the change of the cost itself due to delay> are booked. ■ Basically, (2) is computed per cost item as follows (if more detailed information on the cost change due to delay is available, such changes shall be reflected) ・As regards land acquisition cost and compensation cost, if the cost required for negotiations due to delay, etc. is expected to increase definitely, such cost shall be taken into account. ・As regards investigation and surveying cost, labor cost, materials cost and machinery failure cost, if data on the price increase rate per cost item (deflator[4], etc.) is available, cost changes shall be computed on the basis of such data (For example, if the data is made available that the wage deflator has been increasing at an annual rate of 5%, labor cost shall be increased uniformly by 5% per one-year delay). ・As regards *In Situ* administrative cost increase, the same amount shall be booked both in the case of delay and in the case of non-delay because a certain definite amount is considered to be required always during the period of the construction works (If the one-year delay has generated, it shall be surmised that the *in situ* administrative cost will increase by one-year cost amount). ・Cost changes in management and maintenance cost, fuel cost (in the case of power projects) shall be accordingly measured even after the commencement of service if data on the price increase rate (deflator, etc.) is made available.
		Land Acquisition & Compensation Cost Increase		
		Construction Works Cost Increase	Labor Cost Increase	
			Materials Cost Increase	
			Machinery Failure Cost Increase	
			In Situ Administrative Cost Increase	
	Opportunity Cost Increase	Project Personnel Cost		■ It may be surmised that when the project personnel of the project implementation organization become idle (unutilized), the personnel expenses for them are booked as a loss. However, since such personnel are usually allocated to other posts, no opportunity loss is considered to arise unless it is definite that the personnel become idle.
		Budget of the Project Concerned		■ If the project budget of the local government remains unexecuted and the corresponding budgetary amount remains unutilized, then it means the loss of opportunity. However, it is difficult to envisage such a situation in developing countries where the budget remains simply unutilized. Therefore, it is assumed that no such opportunity loss arises in this model.
	Others	Commitment Charges		■ In the case where commitment charges have been imposed on the country concerned, the payment that becomes due in the case of a project delay will be incurred as cost by the local government and therefore shall be booked as such.
		Consultant Cost Increase (Management Consultant Employed for Yen Loan Project as such)		■ If such cost is likely to increase due to the delay of the project concerned, such change in the cost shall be booked.

(Source) Created by Mitsubishi Research Institute, Inc.

[4] The deflator is one of the price indexes. It is an index to exclude the impact of price change from the reference time point when economic quantities such as GNP and construction cost, etc. at different time points are compared,

(ii) In the case where cost is not classified per detailed item

In the case where no cost is classified per detailed item in the stream data, the change in the cost due to project delay shall be computed by way of first estimating the price increase rate on the basis of the construction deflator, etc. and then multiplying the budgetary cost uniformly by such rate. For example, if the annual construction investment deflator is 10%, the annual cost shall be raised uniformly by 10% per one-year delay.

2) The Methodology for Computing Benefit

(iii) In the case where the details such as the Methodology for Measuring Benefit (Method for Estimating Demand, Method for Assuming Economic Growth Rates) are known

In such case, after verification has been conducted as to whether or not the method for assuming benefit and economic growth rates reflected in the stream data is adequate and after necessary revision has been made, the change due to project implementation delay will be computed.

For example, as regards the transport sector project, when traffic demand is expected to grow in the future in tandem with economic growth, if such estimates can be acquired from the local government, more precise benefit stream data can be developed after the validity of such estimates have been verified and if necessary by revising economic growth rate estimates. It is advisable that the local government be properly informed that after such revision has been made, the delay loss will be computed.

After the basic stream table has been developed, changes in cost due to delay shall be calculated per benefit item in accordance with the following way of thinking:

Table 3.4: Summary of Methodologies for the Measurement of Benefit

<table>
<tr><th colspan="4">Item</th><th>Methodology of Calculation</th></tr>
<tr>
<td rowspan="6">Benefit Item</td>
<td rowspan="6">Project concerned</td>
<td rowspan="2">Transportation</td>
<td>Decrease of Socio-Economic Benefit</td>
<td rowspan="6">
■ The difference of the present value between the case of no-delay and the case of delay is booked.
More particularly, <(1) the difference of the present value due to delay in the generation of benefit> and <(2) the difference of the present value resulting from the change of benefit itself due to delay> are booked.

■ (2) can be determined per sector based on the following way of thinking: (Road projects in the transport sector, power generation& transmission project in the power sector, and water& sewage projects in the water & sewage services sector shall be taken up as examples.)

【Road】
(1) Socio-economic net benefit
• In the transportation sector, benefit is assumed to consist mainly of benefit relating to traffic time reduction effect and vehicle operating cost savings, etc., the amount of benefit depends largely on traffic demand. Benefit resulting from for example road congestion alleviation is considered usually to be included in time reduction effect and vehicle operation cost saving effects.
(2) Financial net benefit
• Financial net benefit is considered to consist mainly of the revenue of charges collected from users and the amount of benefit depends in many cases upon traffic demand and levels of charges. If levels of charges are likely to be changed or traffic demand is likely to change significantly, such changes shall be reflected in benefit computation.

【Power generation & transmission】
(1) Socio-economic net benefit
• The computation method of socio-economic net benefit in the power generation & transmission sector will vary depending on project types. However, in many cases it is surmised to depend on power demand. If power demand is to be considered to change significantly due to project delay, such change shall be reflected in the computation of benefit.
(2) Financial net benefit
• Income from power sales shall be computed according to the following calculation formula. The amount of benefit depends much on electricity charges and power demand. If electricity charges are likely to be revised or power demand is likely to change due to project delay, such expected change shall be reflected in the calculation of benefit.

(Power sales income)
= (the amount of power sales of the power station concerned) × (Unit electricity changes)

【Water & sewage】
(1) Socio-economic net benefit
• The method for the calculation of socio-economic benefit in the water & sewage services sector will vary significantly depending on projects concerned. In many cases the amount of benefit is presumed to depend upon water demand. If water demand is expected to fluctuate depending upon water demand, such fluctuation shall be also reflected in benefit computation.
(2) Financial net benefit
• Water charge income shall be calculated according to the following calculation formula. The amount of benefit depends significantly upon water charges and water demand. If the unit water charges are likely to be changed or due to project delay or demand for water is likely to fluctuate significantly because of delays in the location of industries or resettlement of people due to project delay, such changes shall be also reflected in the calculation of benefit.

(Water charges income)
= (Demand for water from the water& sewage facilities concerned) × (Unit water charges)
</td>
</tr>
<tr><td>Decrease of Financial Net Benefit</td></tr>
<tr><td rowspan="2">Power</td><td>Decrease of Socio-Economic Benefit</td></tr>
<tr><td>Decrease of Financial Net Benefit</td></tr>
<tr><td rowspan="2">Water & Sewage</td><td>Decrease of Socio-Economic Benefit</td></tr>
<tr><td>Decrease of Financial Net Benefit</td></tr>
</table>

Item				Methodology of Calculation
		Increase of Negative Benefit during Construction Period	Increase of Negative benefit from construction works such as traffic jam, noise and vibration	■ Because of the extension of the project period due to the delay, the activities of private entities around the project site are hampered. However, such negative impact is difficult to evaluate in a quantitative manner. Therefore, it will not be booked.
	Related Projects	Decrease of Benefit of Related Projects		• The difference of the present value between the case of no-delay and the case of delay is booked. • As regards the decrease in benefit resulting from the change in the scale of projects related to the main project concerned in terms of budgetary appropriations or resulting from delay in the project start of such related project under the impact of the increased cost of the main project caused by the delay in project implementation, such decrease in benefit shall be booked if such budgetary relatedness between both related and main projects is clear. (As a matter of practice, it is difficult in many cases to identify such budgetary relatedness.)

(Source) Created by Mitsubishi Research Institute, Inc.

(ii) In the Case where the Details such as Benefit Computation Methodology (Demand Forecast Methodology, Economic Growth Visualization Methodology) are not yet grasped

In such case there is no method other than computing changes due to project delay by using the benefit reflected in the stream data. The methodology for computing individual benefits is the same in the case of (i).

(2) Determination of the Reference Time Point for Delay

The reference time point for delay means the starting point of the delay period. As mentioned in 2.2, the time difference between the actual time point of the commencement of service and the reference time point for delay is the delay period. The reference time point for delay is difficult to determine because the time point of the commencement of service in the initial plan is not necessarily the optimal time point of the commencement of service. Basically, it is desirable to presume the optical time point of the commencement of service by means of some methodology and to make it the reference time point of delay. There exist ideas relating to the presumption of the optimal time point of the commencement of service. The practical application of such ideas seems to be difficult owing to the lack of necessary data, etc.

In view of such situation, in this methodology the reference time point for delay shall be the Scheduled Time Point of the Commencement of Service. It is a presumption for expediency. However, similar presumptions have been made to compute loss due to project delay in research works and studies done in Japan. Therefore, such presumptions seem to have a certain degree of rationality. In terms of making it a sort of measure for deterrence against delay, there is a certain degree of meaning in defining the time point of the commencement of service as the reference time point of delay.

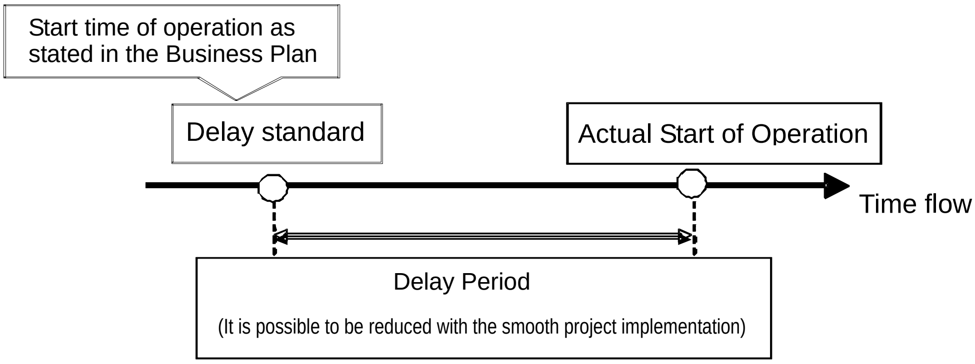

Figure 3-4 Relationship between Delay Standard and Delay Period

(Source) Created by Mitsubishi Research Institute, Inc.

(3) Determination of Delay Period

Two alternative methods are conceivable concerning how to determine the delay period. Namely (i) an approach where certain cases of delay (for example one year, etc.) that may arise in the future during the project period are presumed and (ii) an approach where the delay period is determined on the basis of what has actually happened.

The former (i) corresponds to appraisal *ex-ante* or in the midst of the program implementation and enables those concerned with the project to be fully and aware of the loss amount expected in the case of delay and motivates them to provide an early service in accordance with the project and to persuade the stakeholders to cooperate for the facilitation of project implementation. The latter (ii) corresponds to *ex-post* appraisal and will contribute to enhancing the awareness of those concerned with the project on the need for early provision of service in future projects.

In this Study it is difficult to set in advance appropriate periods as periods of delay for the *ex-ante* appraisal. Therefore, as a sort of sensitivity analysis tool, delays ranging from 1 year to 5 years will be presumed and set for the entire project period. Such analytical approach will enable stakeholders in the project to be aware of the expected impact of delay and the importance of preventive measure (see the Figure below).

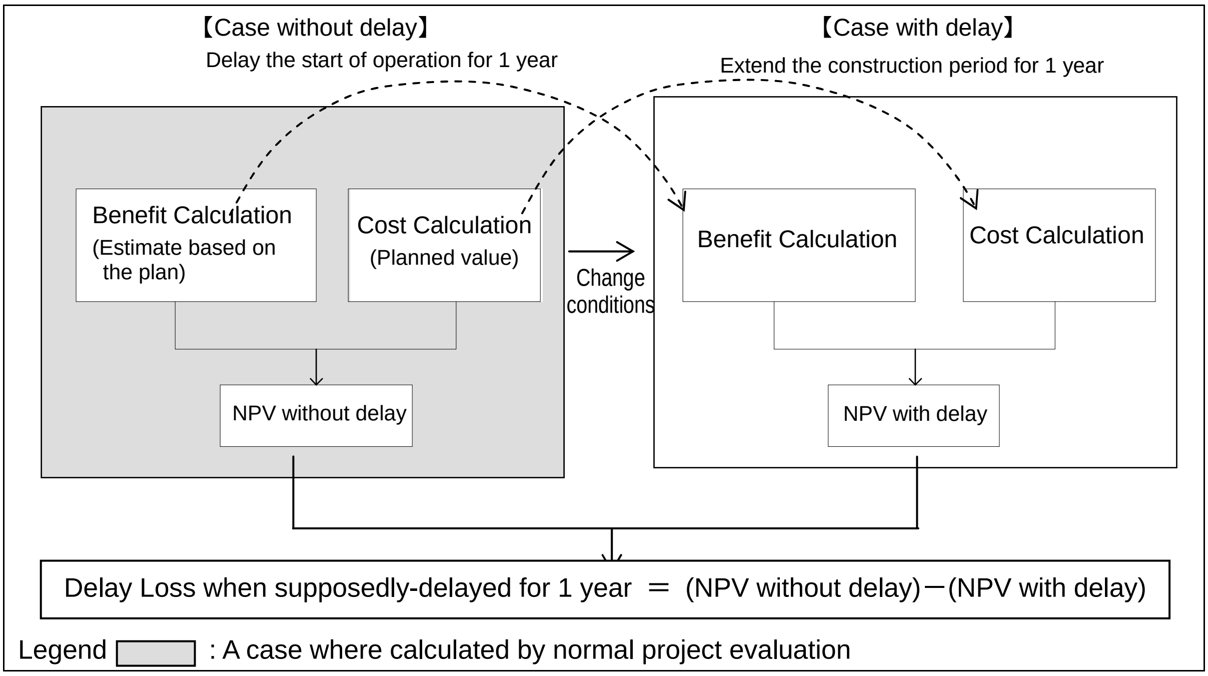

Figure 3-5 Idea of Delay Loss (Prior or Midterm Evaluation)

(Source) Created by Mitsubishi Research Institute, Inc.

Furthermore, it is preferable that the delay period for *ex-post* appraisal be set on the basis of actual delays that arose (see the Figure below). By way of showing to those concerned the loss caused by the delay that has actually taken place, those concerned will be motivated to control such loss in next similar projects.

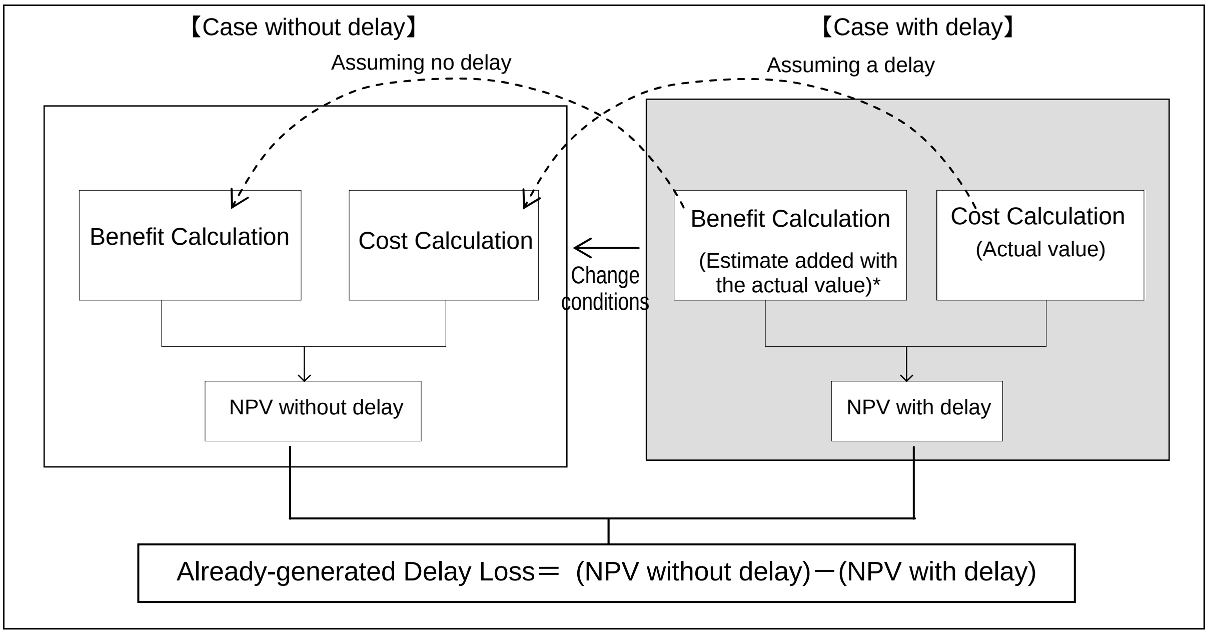

Figure 3-6 Idea of Delay Loss (Ex-post evaluation)

(Source) Created by Mitsubishi Research Institute, Inc.

(4) Setting of Various Parameters

In grasping the economic impact of delay, it is important to set parameters such as Social Discount Rate, Economic Growth Rate, Interest Rate and Price Increase Rate (interest rate is used in measuring financial impact). The method of setting these is shown in the following.

(i) Social Discount Rate

In conducting cost-benefit analysis in project appraisal, it is necessary to add up properly costs and benefits produced at different time points and evaluate them. As is clear from the fact interest is generated in borrowing & lending, however, it is general to think that the cost or the benefit of the same amount differs in value depending upon the time point of its incurrence or generation In cost-benefit analysis the value of one yen at each time point of generation must be equalized and what is used in the calculation of such equalization is the concept of social discount. In a number of countries, it is determined on the basis of the opportunity cost of capital (calculated from the rate of return of foreign loan, capita or investment funds). In Japan it is fixed at a level of 4% with reference to the interest rate of Government bonds.

The determination of a social discount rate must be carried out carefully as it affects significantly on the determination of NPV. As one standard, the hurdle rate (if a project has an expected economic internal rate of return higher than the hurdle rate, the project may be accepted) of Yen loan recipient countries may be utilized. However, it is preferable to carry out sensitivity analysis as much as possible (for example, by letting social discount rates fluctuate within an allowance in the order of plus and minus 5%), because actual social discount rates can fluctuate under the influence of economic conditions. In appraising large-scale public utility projects for infrastructure construction in developed countries such as United States and Australia, sensitivity analysis is carried out sometimes by way of using a few cases of social discount rates.

The following is a summary of the existing research works & studies on social discount rates in the countries which the Study Mission has visited.

Table 3.5: Existing Research Works/Studies on Social Discount Rates in Yen Loan Target Countries

Title of Paper	Author	Calculation and Criteria of Social Discount Rate	URL
Theory and Practices on the Selection of Social Discount Rates for Cost-Benefit Analysis (Research)	Juzhong Zhuang, Zhihong Liang, Tun Lin, and Franklin De Guzman (Asian Development Bank)	The Philippines, Pakistan: 15% and 12%, India: 12% (China National Development and Reform Commission, by Ministry of Construction)	http://www.adb.org/documents/ERD/Working_Papers/WP094.pdf
Results of Analysis on India's Greenhouse Effect Gas Emissions-Five Climate Modeling Research	Prodipto Ghosh, Ph.D. (Ministry of Environment & Forest Protection)	India: 10% (Action Development Integration Organization, by India Energy Resources Research Institute)	http://www.envfor.nic.in/mef/GHG_presentation.pdf
Households Demand for Improved Water Supply Services	Pham Khanh Nam and Tran Vo Hung Son (Hoh Chi Min Economic University, School of Environmental Economy)	Vietnam: 12% ADB Guidelines for Project Appraisal	http://web.idrc.ca/uploads/user-S/11201072431NamRR3.pdf
The Future of Indonesian Forest Agriculture and Large-Scale Agricultural Firms for Carbon Capture and Storage	Kirsfianti Ginoga, Yuliana Cahya Wulan, and Mega Lugina (Indonesia Social Economy Forestry Research Center)	Indonesia: 15% International Agro-Forestry Research Center, by Guidelines for Thrush and Burn Replacing Agricultural Program	http://www.une.edu.au/carbon/CC14.PDF

(Source) Created by Mitsubishi Research Institute, Inc., based on each research paper

According to these existing materials, the following computed values seem to be common for each of the target countries of this Study. However, social discount rates depend upon socio-economic conditions such as the interest rate of government bonds, market interest rates, and investment risks, etc. and are likely to be changed from time to time. Therefore, it is desirable to compute them while collecting the latest information on the target countries as much as possible.

It is also added that the usual practice is that one common social discount rate is utilized without being computed per sector.

Table 3.6: Computed Values of Social Discount Rates in the Target Countries

Target Country	Computed Value of Social Discount Rate
India	12%
Indonesia	15%
The Philippines	15%
Vietnam	12%

(Source) Created by Mitsubishi Research Institute, Inc., based on each research paper

(ii) Economic Growth Rate

In cost-benefit analysis there are cases where it is assumed that the benefit computed for one single year increases chronologically in tandem with economic growth, etc. For example, as regards road construction projects, if it is assumed that traffic volume will grow in tandem with economic growth, the benefit resulting from road project implementation is supposed to increase because time loss is to be generated through traffic congestion, etc. if there is no road project implementation. Therefore, an analysis taking into account the impact of traffic congestion becomes possible by way of taking into account the economic growth.

Usually these assumptions on economic growth are in many cases reflected in the stream data as of the time of *ex-ante* appraisal and as of the time of *ex-post* appraisal (a list in which annual costs and benefits are chronologically summarized). Therefore, it is desirable to conform to these assumptions. However, in these cases as well, it is preferable, if possible, to conduct sensitivity analysis by way of assuming more than one pattern of scenario. For example, if an increase in traffic demand is assumed, it may be an idea to conduct computation in the case scenario of non-increase in traffic demand.

(iii) Borrowing Rate (if financial NPV is computed)

It is preferable to apply as the borrowing rate the standard interest rate (such as WACC) utilized for financial analysis in the country concerned. As in the case of social discount rate, it may be an idea to carry out sensitivity analysis by way of assuming more than one pattern of scenario.

(iv) Price Increase Rate

In the case of the calculation of financial NPV, the nominal price increase rate shall be computed. In the case of the calculation of socio-economic NPV, the net price increase rate (the nominal price increase rate divided by GNP deflator, etc.) shall be computed.

As regards the price increase rate, if the cost-benefit stream data contains data per detailed cost item (for example, data per labor cost per materials cost), it is preferable to acquire and apply price increase rate deflators matching with them. However, in the existing *ex-post* evaluation materials or in the course of *in situ studies* it will not be possible to get hold of stream data per such detailed cost item. Perhaps in many of Yen loan target countries it will be difficult to obtain such data. Therefore, basically it will suffice to adjust the total cost by the construction cost deflator, etc., without computing price increase rates per cost item.

(5) Computation of the NPV Difference

Based upon these assumptions, the difference between the NPV resulting from the smooth project implementation and the NPV resulting from project implementation delay (the net present value) shall be regarded as the benefit gained from smooth project implementation. Namely, the benefit resulting from the smooth project implementation shall be computed in terms of the reverse side of the loss incurred from project delay.

The formula for estimating the amount of the delay loss is the following:

$$\text{Amount of Delay Loss} = \Delta\text{NPV} = NPV(T) - NPV(T+t)$$
$$= \left[\sum_{i=1}^{T+N} \frac{b_i}{(1+r)^i} - \sum_{i=1}^{T+N} \frac{c_i}{(1+r)^i}\right] - \left[\sum_{i=1}^{T+t+N} \frac{b'_i}{(1+r)^i} - \sum_{i=1}^{T+t+N} \frac{c'_i}{(1+r)^i}\right]$$

Here T = Project period

N = Calculation period

t = Delay period

r = Social discount rate in the case of socio-economic benefit, Borrowing rate in the case of financial benefit

b_i and b'_i = Annual benefit in i year in the case of non-delay and in the case of delay respectively

c_i and c'_i = Annual cost in i year in the case of non-delay and in the case of delay respectively

NPV is the sum of the present value of the cash inflow (benefit) resulting from the project and the present value of the cash outflow (cost) incurred by the project. Here, by the present value is meant the amount gained from investment in the project converted by a specific discount rate into the value as of the time of investment. If such NPV is more than zero, the project is regarded as being investment worth. As discussed above, such NPV is computed both in the case of smooth project implementation and in the case of project delay and the difference between both shall be regarded as economic benefit resulting from smooth implementation.

Like FIRR and EIRR in Internal Rate of Return indexes, FNPV difference (hereinafter △FNPV or financial benefit) shall be used as an index to grasp financial impact and ENPV difference (hereinafter △ENPV or socio-economic benefit) will be used as an index for grasping socio-economic impact.

(6) Methodology for Applying Cost-Benefit Analysis to Stream

1) Concrete Method for Calculation of NPV Difference

Here, the concrete method for calculating the NPV difference on the basis of cost-benefit stream data shall be proposed. The spreadsheet and the data summarized here are also stored in the CD-ROM of this Study Report.

It is assumed that as stream data for a hypothetical road project the data found below has been already made available as of the time of the *ex-ante* appraisal. Here, it is assumed that the social discount rate for converting into the present value is 15% and that the monetary unit is one thousand in the Japanese Yen. In this case, the ENPV of this road project as the time of the *ex-ante* appraisal is computed as being 1,725,042 (thousand Yen).

Table3.7: Stream of Cost as the Time of *EX Ante* Appraisal (Hypothetical Road Project)

（Unit: Thousand Yen）

Year	Cost			Benefit			Discount Factor	Present Value of Cost	Present Value of Benefit
	Construction Cost	Operation & Management Cost	Total	Vehicle Operating cost Reduction	Time Reduction	Total			
1	45,000		45,000	0	0	0	1.0000	45,000	-
2	130,000		130,000	0	0	0	0.8696	113,043	-
3	180,000		180,000	0	0	0	0.7561	136,106	-
4	250,000		250,000	0	0	0	0.6575	164,379	-
5	250,000		250,000	0	0	0	0.5718	142,938	-
6		2,000	2,000	380,000	180,000	560,000	0.4972	994	278,419
7		2,000	2,000	390,000	190,000	580,000	0.4323	865	250,750
8		2,000	2,000	400,000	200,000	600,000	0.3759	752	225,562
9		2,000	2,000	410,000	210,000	620,000	0.3269	654	202,679
10		2,000	2,000	420,000	220,000	640,000	0.2843	569	181,928
11		2,000	2,000	430,000	230,000	660,000	0.2472	494	163,142
12		2,000	2,000	440,000	240,000	680,000	0.2149	430	146,161
13		2,000	2,000	450,000	250,000	700,000	0.1869	374	130,835
14		2,000	2,000	460,000	260,000	720,000	0.1625	325	117,020
15		2,000	2,000	470,000	270,000	740,000	0.1413	283	104,583
16		2,000	2,000	480,000	280,000	760,000	0.1229	246	93,400
17		2,000	2,000	490,000	290,000	780,000	0.1069	214	83,355
18		2,000	2,000	490,000	290,000	780,000	0.0929	186	72,482
19		2,000	2,000	490,000	290,000	780,000	0.0808	162	63,028
20		2,000	2,000	490,000	290,000	780,000	0.0703	141	54,807
21		300,000	300,000	490,000	290,000	780,000	0.0611	18,330	47,658
22		2,000	2,000	490,000	290,000	780,000	0.0531	106	41,442
23		2,000	2,000	490,000	290,000	780,000	0.0462	92	36,036
24		2,000	2,000	490,000	290,000	780,000	0.0402	80	31,336
25		2,000	2,000	490,000	290,000	780,000	0.0349	70	27,249
Total	855,000	338,000	1,193,000	9,140,000	5,140,000	14,280,000		626,832	2,351,873

NPV
1,725,041

(Source) Created by Mitsubishi Research Institute, Inc.

Here it is assumed that as of the time of the *ex-ante* appraisal the impact of delay is to be grasped and that the impact of one-year delay in the project construction period has been grasped. As delay factors delay in the selection of contractors, etc. are assumed. It is also assumed that in the cost-benefit stream data no cost is incurred in the first year and that the construction cost is to be incurred from the second year onward.

Furthermore, it is assumed that due to one-year delay, the cost increases by 10% because of the substantial hike of construction cost and maintenance and management cost.

Based upon these assumptions, the result of cost-benefit stream simulation in the case of one-year delay is shown below. In this case ENPV has proved to be 1,444,434 (thousand Yen). When compared with the non-delay case, a loss of 280,606 (thousand Yen) is estimated to have occurred.

Table 3.8: Cost Stream as of the Time of the *Ex Ante* Appraisal (Hypothetical Road Project: One-Year Delay Assumed

(Unit: Thousand Yen)

Year	Cost			Benefit			Discount Factor	Present Value of Cost	Present Value of Benefit	
	Construction Cost	Operation& Management Cost	Total	Vehicle Operating cost Reduction	Time Reduction	Total				
1	0		0	0	0	0	1.0000	-	-	←No cost incurred in the first year due to project delay
2	49,500		49,500	0	0	0	0.8696	43,043	-	
3	143,000		143,000	0	0	0	0.7561	108,129	-	
4	198,000		198,000	0	0	0	0.6575	130,188	-	
5	275,000		275,000	0	0	0	0.5718	157,232	-	
6	275,000	2,200	277,200	0	0	0	0.4972	137,817	-	
7		2,200	2,200	380,000	180,000	560,000	0.4323	951	242,103	←Time point of generation of benefit delayed by one year due to project delay
8		2,200	2,200	390,000	190,000	580,000	0.3759	827	218,043	
9		2,200	2,200	400,000	200,000	600,000	0.3269	719	196,141	
10		2,200	2,200	410,000	210,000	620,000	0.2843	625	176,243	
11		2,200	2,200	420,000	220,000	640,000	0.2472	544	158,198	
12		2,200	2,200	430,000	230,000	660,000	0.2149	473	141,863	
13		2,200	2,200	440,000	240,000	680,000	0.1869	411	127,097	
14		2,200	2,200	450,000	250,000	700,000	0.1625	358	113,770	
15		2,200	2,200	460,000	260,000	720,000	0.1413	311	101,757	
16		2,200	2,200	470,000	270,000	740,000	0.1229	270	90,942	
17		2,200	2,200	480,000	280,000	760,000	0.1069	235	81,217	
18		2,200	2,200	490,000	290,000	780,000	0.0929	204	72,482	
19		2,200	2,200	490,000	290,000	780,000	0.0808	178	63,028	
20		2,200	2,200	490,000	290,000	780,000	0.0703	155	54,807	
21		2,200	2,200	490,000	290,000	780,000	0.0611	134	47,658	
22		330,000	330,000	490,000	290,000	780,000	0.0531	17,533	41,442	
23		2,200	2,200	490,000	290,000	780,000	0.0462	102	36,036	
24		2,200	2,200	490,000	290,000	780,000	0.0402	88	31,336	
25		2,200	2,200	490,000	290,000	780,000	0.0349	77	27,249	
26		2,200	2,200	490,000	290,000	780,000	0.0304	67	23,695	← Due to project delay the final year of the project life time will be delayed by one year
Total	940,500	374,000	1,314,500	9,140,000	5,140,000	14,280,000		600,672	2,045,107	

↑ Cost increased by 10%

NPV
1,444,434

(Source) Created by Mitsubishi Research Institute, Inc.

2) Methodology of Correction in the midway of the Project

This methodology can be applied not only to assess *ex-ante* and *ex-post* the impact of delay on the basis of the result of the *ex-ante* appraisal and the *ex-post* appraisal, but also to assess such impact during the implementation period and to warn counterparts against possible project delays and accompanying losses with regard to projects likely to be delayed or projects already being delayed, by showing the concrete computed figures and by stating that if delay really happens it will mean a loss of ●% in terms of NPV and thus to prevent delays in advance.

In this case as well, analysis shall be conducted basically by the cost-benefit stream data as of the time of the *ex-ante* appraisal. The following shows how to correct the stream in such case.

(1) Correction of Cost Data

If data on the cost incurred up to the time point concerned is available, the cost stream as of the time of the *ex-ante* appraisal shall be preferably corrected by using such data.

For example, as regards the hypothetical road project, suppose that as mentioned above, the following cost stream had been obtained as of the time of the *ex-ante* appraisal.

Table 3.9: Cost Stream as of the Time of the *ex-ante* Appraisal (Hypothetical Road Project)

Year	Cost		
	Construction Cost	Operation& Management Cost	Total
1	45,000		45,000
2	130,000		130,000
3	180,000		180,000
4	250,000		250,000
5	250,000		250,000
6		2,000	2,000
7		2,000	2,000
8		2,000	2,000
9		2,000	2,000
10		2,000	2,000
11		2,000	2,000
12		2,000	2,000
13		2,000	2,000
14		2,000	2,000
15		2,000	2,000
16		2,000	2,000
17		2,000	2,000
18		2,000	2,000
19		2,000	2,000
20		2,000	2,000
21		300,000	300,000
22		2,000	2,000
23		2,000	2,000
24		2,000	2,000
25		2,000	2,000
Total	855,000	338,000	1,193,000

(Source) Created by Mitsubishi Research Institute, Inc.

Suppose, for example, that the impact of delay is analyzed in the third year of the construction works as regards this project. Suppose that the cost incurred in the first and second years has piled up more than the initially scheduled amount and that against 45,000 planned for the first year, it went up to 50,000 and against 130,000 planned for the second year, it went up to 140,000. If it is expected that there will be no revision for the remaining construction cost, it is desirable that as of that time, the stream be revised as follows:

Table 3.10: Cost Stream as of the time of the Third Year of the Construction Works (Hhypothetical road project: A case of non-delay assumed)

* The colored cells are revised parts.

Year	Cost		
	Construction Cost	Operation& Management Cost	Total
1	50,000		50,000
2	140,000		140,000
3	180,000		180,000
4	250,000		250,000
5	250,000		250,000
6		2,000	2,000
7		2,000	2,000
8		2,000	2,000
9		2,000	2,000
10		2,000	2,000
11		2,000	2,000
12		2,000	2,000
13		2,000	2,000
14		2,000	2,000
15		2,000	2,000
16		2,000	2,000
17		2,000	2,000
18		2,000	2,000
19		2,000	2,000
20		2,000	2,000
21		300,000	300,000
22		2,000	2,000
23		2,000	2,000
24		2,000	2,000
25		2,000	2,000
Total	870,000	338,000	1,208,000

(Source) Created by Mitsubishi Research Institute, Inc.

As regards the cost for the remaining project works, it is also desirable to revise it as needed if it has proved to be that “the cost is likely to pile up because of price hikes in construction materials, etc.”

For example, if a substantial cost increase of 10% is expected, the construction cost for the third year onward must be revised as follows:

Table 3.11: Cost Stream as of the time of the Third Year of the Construction Works
(Hypothetical road project: A case of non-delay assumed)
* The colored cells are revised parts.

Year	Cost		
	Construction Cost	Operation& Management Cost	Total
1	50,000		50,000
2	140,000		140,000
3	198,000		198,000
4	275,000		275,000
5	275,000		275,000
6		2,000	2,000
7		2,000	2,000
8		2,000	2,000
9		2,000	2,000
10		2,000	2,000
11		2,000	2,000
12		2,000	2,000
13		2,000	2,000
14		2,000	2,000
15		2,000	2,000
16		2,000	2,000
17		2,000	2,000
18		2,000	2,000
19		2,000	2,000
20		2,000	2,000
21		300,000	300,000
22		2,000	2,000
23		2,000	2,000
24		2,000	2,000
25		2,000	2,000
Total	938,000	338,000	1,276,000

(Source) Created by Mitsubishi Research Institute, Inc.

In case it is forecast as of the time of the third year that the construction works for from the third year through the fifth year is likely to change and that there will be one-year delay, it is necessary that the cost to be incurred must be apportioned out to the period of from the third year through the sixth year. If the details of the plan of works are available, such apportionment should be made preferably according to the progress rate. If such details are not available, it can be assumed as a simplified method that one third each of the cost to be incurred from the third year through the fifth year will be reduced and these reduced portions will be incurred in the sixth year. The following table is the cost stream developed after such revision has been made according to the above Table.

Table 3.12: Cost Stream as of the time of the Third Year of the Construction Works

(Hypothetical road project: A case of delay assumed)

* The colored cells are revised parts.

Year	Cost		
	Construction Cost	Operation& Management Cost	Total
1	50,000		50,000
2	140,000		140,000
3	132,000		132,000
4	183,333		183,333
5	183,333		183,333
6	249,333		249,333
7		2,000	2,000
8		2,000	2,000
9		2,000	2,000
10		2,000	2,000
11		2,000	2,000
12		2,000	2,000
13		2,000	2,000
14		2,000	2,000
15		2,000	2,000
16		2,000	2,000
17		2,000	2,000
18		2,000	2,000
19		2,000	2,000
20		2,000	2,000
21		300,000	300,000
22		2,000	2,000
23		2,000	2,000
24		2,000	2,000
25		2,000	2,000
Total	938,000	336,000	1,274,000

(Source) Created by Mitsubishi Research Institute, Inc.

(2) Correction of Benefit Data

It seems that there are not many cases where the benefit stream needs a large revision as of the time of the *ex-ante* appraisal and in the midway of the project implementation. However, it is desirable to revise the benefit data on the basis of the latest economic growth rate data, etc. after the commencement of the project implementation if demand is likely to change significantly owing to large changes in economic growth rates. For example, suppose that as of the time of the *ex-ante* appraisal, the following benefit stream was made available. Equally, suppose that this benefit was computed based on the assumption of a net economic growth rate of 10%.

Table 3-13: Benefit Stream as of the Time of Ex-ante Appraisal (Hypothetical road project)

Year	Cost		
	Vehicle operating cost reduction	Time reduction	Total
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
6	380,000	180,000	560,000
7	390,000	190,000	580,000
8	400,000	200,000	600,000
9	410,000	210,000	620,000
10	420,000	220,000	640,000
11	430,000	230,000	660,000
12	440,000	240,000	680,000
13	450,000	250,000	700,000
14	460,000	260,000	720,000
15	470,000	270,000	740,000
16	480,000	280,000	760,000
17	490,000	290,000	780,000
18	490,000	290,000	780,000
19	490,000	290,000	780,000
20	490,000	290,000	780,000
21	490,000	290,000	780,000
22	490,000	290,000	780,000
23	490,000	290,000	780,000
24	490,000	290,000	780,000
25	490,000	290,000	780,000
Total	9,140,000	5,140,000	14,280,000

(Source) Created by Mitsubishi Research Institute, Inc.

Here, suppose that when the impact of delay is analyzed in the third year of the construction works, the economic growth rate forecast after the commencement of the works has become lower than as of the time of the *ex-ante* appraisal, say 8%. Furthermore, suppose that the GDP elasticity coefficient of road traffic demand was 0.9. In such case, the demand predicted value as a whole is considered to be brought down by 0.9 (108/111). In that case, the benefit computation shall be revised as follows because benefit is basically considered to decline in proportion with demand.

Table 3.13: Benefit Stream as of the Time of the Third Year of the Construction Works

(Hypothetical road project: No-delay case assumed)

* The colored cells are revised parts.

Year	Cost		
	Vehicle operating cost reduction	Time reduction	Total
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
6	373,776	177,052	550,828
7	383,612	186,888	570,500
8	393,449	196,724	590,173
9	403,285	206,560	609,845
10	413,121	216,397	629,518
11	422,957	226,233	649,190
12	432,793	236,069	668,863
13	442,630	245,905	688,535
14	452,466	255,742	708,207
15	462,302	265,578	727,880
16	472,138	275,414	747,552
17	481,974	285,250	767,225
18	481,974	285,250	767,225
19	481,974	285,250	767,225
20	481,974	285,250	767,225
21	481,974	285,250	767,225
22	481,974	285,250	767,225
23	481,974	285,250	767,225
24	481,974	285,250	767,225
25	481,974	285,250	767,225
Total	8,990,299	5,055,814	14,046,113

(Source) Created by Mitsubishi Research Institute, Inc.

If information needed for benefit revision (revised economic forecast value, GDP elasticity of demand in the demand forecast model, etc.), it is preferable in terms of ensuring persuasiveness to conduct project delay impact analysis after the benefit stream data revision has been conducted.

Chapter 4 Case-study on the Economic Impact of Project Delay

A case-study will be carried out on the Simhadri Thermal Power Station Development Project described in Chapter 2 by way of utilizing the methodology discussed in Chapter 3.

4.1 Simhadri Thermal Power Station Project (India)

This was a project to construct a large scale coal fired thermal power station with a capacity of 1,000 MW (500 MW×2 plants) using domestically produced coal (produced in Orissa of East India) in the suburbs of Vishakhapatnam in Andhra Pradesh (hereinafter AP State) of South India.

The objective of the project was to meet increased power demand in AP State, to stabilize power supply, to reactivate the industries in the State, to expand employment opportunities, to electrify agricultural villages, to promote the spread of household electric appliances and thus to contribute to improvement of life styles of local residents.

As stated in Chapter 2, the planned period of this project was 91 months from the project start of February 1997 through the project completion of August 2004. However, the actual project period was 84 months from February 1997 through January 2004, which meant that the project period was shortened by 7 months.

In this case-study, the impact resulting from the commencement of service earlier than planned and impact resulting from the project delay will be grasped on the basis of the cost and benefit stream for FIRR computation acquired as of the time of the *ex-post* appraisal, financial data of National Thermal Power Cooperation (NTPC) of India, an implementation organization, data on power demand and supply, data on the regional economy, etc. The stream data acquired as of the time of the *ex-post* appraisal was based on a construction period of 84 months (7 years). FNPV will be computed for 3 cases, namely for a case where the construction period has been shortened by one year (the actual case) against where reference time point of 8 years from the commencement of the construction works (no-delay case), a case where there has been no project delay, and a case where there has been one–year delay. And based on FNPV differences, the impact of the project implementation delay and the commencement of service earlier than initially planned shall be computed on a trial basis.

Qualitative and quantitative analysis will be also conducted on the impact on the regional economy and on regional industries in the scenario of the project period shortened and in the scenario of the project period extended. As there is no EIRR computed as of the time of the *ex-post* appraisal, here analysis on ENPV (socio-economic benefit) will not be carried out the *ex-post* appraisal.

4.1.1 Socio-economic conditions as the prerequisite for analysis

Before carrying out specific analysis, the socio-economic conditions will be reviewed since they form the prerequisite for such specific analytical work.

(1) Demand and supply of power in India

With a rapid economic growth, India is now the fifth largest energy-consuming country in the world. However, its supply is still unable to meet its demand. As is clear from the Diagram below, power supply has been always below power demand during the period of from 1997 through 2009. Yet, the power insufficiency rate has been on the increase.

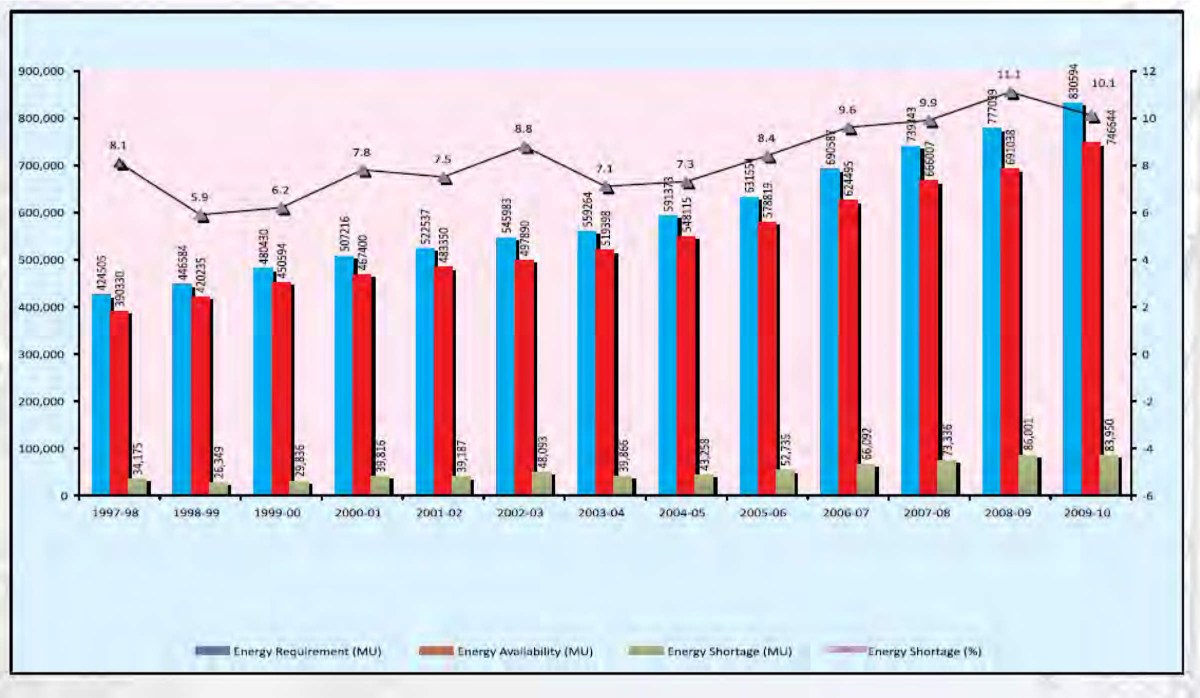

Figure 4-1 Conditions of Power Supply & Demand in India

(Source) Central electricity authority Annual Report 2009-10

Given this situation, the Indian Government has been promoting the 11th Five Year Plan (April 2007-March 2012) under the banner of "Power Supply to Every Corner of the Country By 2012". The Plan focuses on the development of new power sources and transmission & distribution systems and targeted at the power plant construction of a grand total capacity of 78,577 MW that consists of hydroelectric power stations (a total capacity of 16,553 MW), thermal power stations (a total capacity of 52,905 MW) and nuclear power plants (a total capacity of 3,338 MW) (see the Table below. Later the target level was raised to 62,000 MW). The New Early Power Development & Reform Program is being promoted on a nation wide scale especially with a view to developing high voltage transmission systems in agricultural regions. Under the 12th Five-Year Plan starting in April 2012, a target of power sources development with a total capacity of 100 million kW was set.

Table 4.1: Power Sources Capacity Expansion Plan Target under the 11th Five-Year Plan (April 2007-March 2012) (unit: MW)

Sector	Hydroele	Thermal				Nuclear power	Total
			Coal	Brown coal	Gas & liquid fuel		
Central government sector	9,685	26,800	24,310	1,000	1,490	3,380	39,865
State government sector	3,605	24,347	23,135	450	762	—	27,952
Private sector	3,263	7,497	5,460	0	2,037	—	10,760
Total	16,553	58,644	52,905	1,450	4,289	3,380	78,577

(Source) White Paper on Strategy for 11th Plan, Central Electricity Authority & Confederation of Indian Industry (2007)

(2) Status of Power Projects in Andhra Pradesh (AP) State

In AP State where the Simhadri Thermal Power Station is located, the power sector of the State among the best managed in India. The credit rating of the State is the third best in India and the investment climate of the State is among the most favorable in India.[5] During the period of 13 years between 1996 and 2009, the total power generation facility capacity increased approximately 2 times from 6,136MW (1996) to 6,136MW (2009). The annual total volume of power generation increased 2.2 times from 30,119GWh/year (1996) to 67,387GWh/year (2009).

5 International Development Association (IDA) website http://web.worldbank.org/WBSITE/EXTERNAL/EXTABOUTUS/EXTIDAJAPANESE/0,,contentMDK:21628272~pagePK:51236175~piPK:437394~theSitePK:3359127,00.html

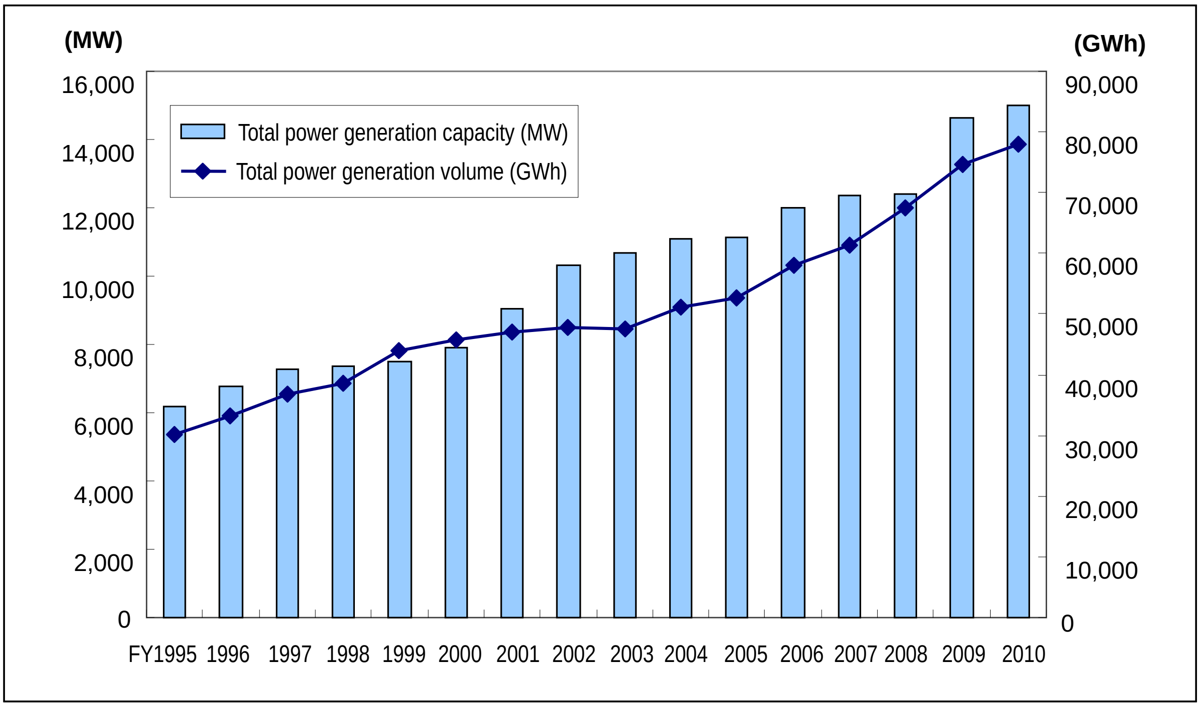

Figure 4-2 Changes in Capacity & Volume of Total Power Generation in AP State
(Source) APTRANSCO

However, power demand and supply situation in AP State is tight. It was only during the period of 3 years between 2004 and 2006 immediately after the commencement of service of the Simhadri Thermal Power Station that the demand & supply gap in AP State was eliminated.

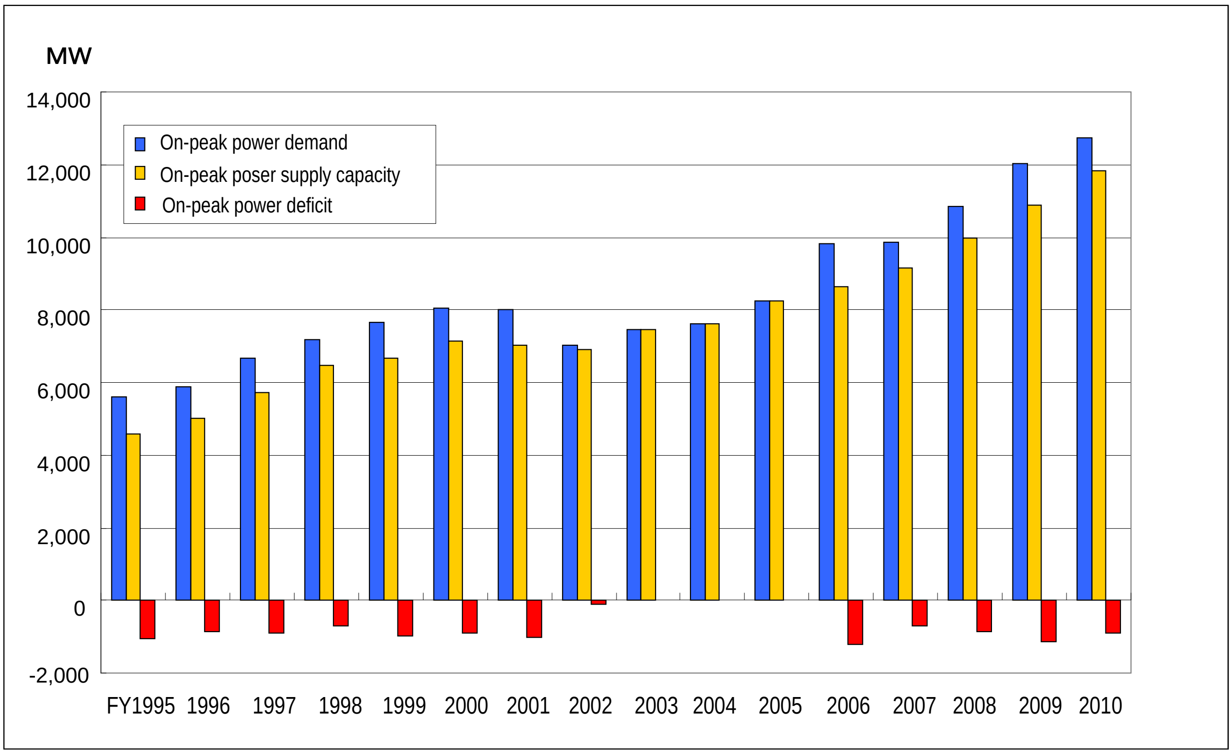

Figure 4-3 Changes in Demand & Maximum Possible Supply of Power in AP State

(Source) APTRANSCO

In AP State, sophisticated industries in sectors of IT, biotechnology and pharmaceuticals, etc. are rapidly being concentrated mainly in and around Hyderabad, the State capital, with the result that power demand in the Metropolitan Area is rapidly expanding. AP State situated in the vast plains of the Deccan Plateau has an active agricultural sector backed up with a number of large grain-producing regions where electrification in irrigation pumps is being advanced with power demand rising fast. For these reasons, increasing power supply is still unable to catch up with increasing power demand.

Factors of insecurity in domains other than power generation capacity remain as exemplified by the strike, which broke out in July 2011 in Singareni Collieries Company Limited (SCCL) producing 60% of the coal used for power generation in the State and put AP on the verge of a major All-State[6] 。

(3) Financial Position of NTPC

The following is a summary of the financial position of NTPC (implementation organization of the Simhadri Thermal Power Station Project) for the period of from 2002 through 2010. Its income from the sales of energy has been expanding favorably. Its profit before tax has expanded approximately 2.5 times from 47,331 (million rupees) in 2002 to 120,496 (million rupees) in 2010. Its payment capability is high, with its current rate and debt to equity maintained at high levels.

[6] JCOAL Magazine No. 80（July 29,2011）（Japan Coal Energy Centre）

Table 4.2: Data on the Financial Position of NTPC

(Unit: Million rupee)

Item		2002	2003	2004	2005	2006	2007	2008	2009	2010
A)	Operating Income									
	Earned from									
	Sale of Energy	199,810	190,571	232,415	266,564	325,344	369,462	417,912	461,687	547,046
	Consultancy & Other Income	4,492	61,816	24,110	26,806	28,422	30,651	34,379	30,652	26,949
	Total	204,302	252,387	256,525	293,370	353,766	400,113	452,291	492,339	573,995
	Paid & Provided for									
	Fuel	110,312	122,150	137,235	163,947	198,181	220,202	271,107	294,627	353,738
	Employees Remuneration & Benefits	8,268	8,835	8,823	9,684	11,580	18,960	24,631	24,124	27,897
	Generation, Administration & other expenses	10,814	9,813	12,062	12,721	15,619	16,284	18,192	20,940	26,460
	Provision (Net)	1,567	−3,813	−6,160	334	73	7	76	−19	15,443
	Prior Period / Extra Ordinary	803	183	−102	2,488	−109	2,745	1,083	−778	−16,387
	Profit before Depreciation, Interest & Finance Charges and Tax	72,538	115,219	104,667	104,196	128,422	141,915	137,202	153,445	166,844
	Depreciation	15,291	20,232	19,584	20,477	20,754	21,385	23,645	26,501	24,857
	Profit before Interest & Finance Charges and Tax	57,247	94,987	85,083	83,719	107,668	120,530	113,567	126,944	141,987
	Interest & Finance Cost	9,916	33,697	16,955	17,632	18,594	17,980	19,962	18,089	21,491
	Profit before tax	47,331	61,290	68,128	66,087	89,074	102,549	93,595	108,855	120,496
	Tax (Net)	11,256	8,682	10,058	7,885	20,427	28,401	11,582	21,573	29,470
	Profit after tax	36,075	52,608	58,070	58,202	68,647	74,148	82,013	87,282	91,026
	Dividend	7,080	10,823	19,790	23,087	26,385	28,859	29,684	31,333	31,333
	Dividend tax	395	1,387	2,680	3,238	3,896	4,905	5,017	5,276	5,148
	Retained Profit	28,600	40,398	35,600	31,877	38,366	40,384	47,312	50,673	54,546
B)	What is Owned									
	Gross Fixed Assets	366,106	400,281	431,062	460,396	507,273	533,680	623,530	668,501	727,552
	Less: Depreciation	167,456	187,736	207,914	229,501	250,792	272,743	294,153	320,888	335,192
	Net block	198,650	212,545	223,148	230,895	256,481	260,937	329,377	347,613	392,360
	Capital Work-in-progress, Construction Stores & Advances	63,863	74,953	99,285	136,340	168,392	224,784	264,049	321,043	382,706
	Investments	36,674	173,380	207,977	192,891	160,943	152,672	139,835	148,071	123,448
	Current Assets, Loans &	194,132	135,468	129,073	157,245	221,827	255,488	309,253	308,158	353,968
	Total Net Assets	493,319	596,346	659,483	717,371	807,643	893,881	1,042,514	1,124,885	1,252,482
C)	What is Owed									
	Long Term Loans	127,090	149,415	166,719	201,195	244,516	271,777	345,663	377,836	431,750
	Working Capital Loans	5,067	5,113	4,159	778	328	129	14	134	133
	Current Liabilities & Provisions	45,850	80,941	67,467	61,402	70,263	79,299	106,886	107,582	130,729
	Total Liabilities	178,007	235,469	238,345	263,375	315,107	351,205	452,564	485,552	562,612
D)	Others									
	Deferred Revenue on account of Advance against depreciation						13,734	19,360	16,108	7,921
	Deferred Foreign Currency Fluctuation Liability						2,554	545	611	965
	Deferred Income From Foreign Currency Fluctuation Liability						–	6,077	–	624
	Deferred Tax Liability (Net)						1	1	2,093	6,030
	Deferred Foreign Currency Fluctuation Asset						–	9,734	3,652	45,952
	Deferred Expenditure From Foreign Currency Fluctuation						–	–	201	–
	Total	271	5,375	3,374	4,408	6,567	16,289	16,250	14,959	10,948
E)	Net Worth									
	Share Capital	78,125	78,125	82,455	82,455	82,455	82,455	82,455	82,455	82,455
	Reserves & Surplus	237,002	277,376	335,308	367,132	403,513	443,932	491,246	541,920	596,468
	Net Worth	315,040	355,501	417,763	449,587	485,968	526,386	573,701	624,374	678,923
F)	Capital Employed	386,343	458,267	500,540	523,572	564,331	588,868	641,834	695,725	713,746
G)	Value Added	79,976	66,341	88,167	97,206	111,012	127,538	140,548	173,313	191,400
H)	No. of Employees *	21,408	20,971	21,420	21,870	23,602	23,674	23,639	23,743	23,797
I)	Ratios									
	Return on Capital Employed (%)	10.9	12.9	12.8	12.5	13.9	14.1	14.3	14.0	14.3
	Return on Net worth (%)	12.1	14.9	14.3	14.2	15.6	16.1	16.7	16.4	16.9
	Book Value per Share (rupee) (RS.)	40.3	45.5	50.7	54.5	58.9	63.8	69.6	75.7	82.3
	Current Ratio	4.2	1.7	1.9	2.6	3.2	3.2	2.9	2.9	2.7
	Debt to Equity	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.6
	Value Added / Employee	3.7	3.2	4.1	4.4	4.7	5.4	5.9	7.3	8.0

(Source) NTPC Annual Report

For reference, an outline of the power stations owned by NTPC is shown in the following Table:

Table 4.3: Outline of the Power Stations Owned by NTPC

STATION-WISE GENERATION 2010-11			
STATIONS	**Fuel Type**	**Capacity (MW)**	**Gross Gen. (MUs)**
Northern Region		**5490**	**45382**
Singrauli	Coal	2000	16913
Rihand	Coal	2000	16319
Unchahar	Coal	1050	8580
Tanda	Coal	440	3570
National Capital Region		**4837**	**32042**
Badarpur	Coal	705	4553
Dadri	Coal	1820	12076
Anta	Gas	413	2488
Auraiya	Gas	652	4369
Dadri	Gas	817	5400
Faridabad	Gas	430	3155
Western Region (WR-I & WR-II)		**8153**	**60785**
Korba	Coal	2600	17377
Vindhyachal	Coal	3260	27011
Sipat	Coal	1000	8456
Kawas	Gas	645	3882
Jhanor Gandhar	Gas	648	4058
Eastern Region (ER-I & ER-II)		**7900**	**51449**
Farakka	Coal	2100	11090
Kahalgaon	Coal	2340	14029
Talcher - Kaniha	Coal	3000	22533
Talcher - Thermal	Coal	460	3797
Southern Region		**4450**	**30879**
Ramagundam	Coal	2600	20560
Simhadri	Coal	1500	8417
Rajiv Gandhi CCP	Liquid Fuel	350	1903
Total		**30830**	**220536**

(Source) NTPC Annual Report 2010-201

(4) A Systematic Summary of Impact in the Actual Case of Commencement of Service Earlier than Planned of Simhadri Thermal Power Station and in the Hypothetical Case of its Project Construction Delay

The following Table is a summarization of impact in the actual case of commencement of service earlier than planned of the Simhadri Thermal Power Station and in the hypothetical case of delay in power station construction, based on the background information described above.

Table 4.4: A Systematic Summary of Impact from Project Delay

Large Item	Small Item	Outlines
(1) Financial Impact	1) FNPV Change	NPV showing the profitability of Simhadri Thermal Power Station as such will change.
	2) Impact on NTPC	As a result of 1), the cash flow of NTPC as a whole changes and its financial position is affected. (The earlier commencement of service will contribute to further improvement of its financial position)
(2) Socio-Economic Impact	1) Impact on Power Supply & Demand	The already tight power demand & supply conditions in AP will be further affected (The earlier commencement of service will improve such situation more rapidly). Efforts for the promotion of negatively the National Five-Year Plan will be affected.
	2) Impact on Electricity Charges	Power prices in AP will be affected.
	3) Impact on Location of Industries	As a result of 1) and 2), location of industries will be affected. (Earlier commencement of service will promote earlier location of industries)
	4) Impact on the Regional Economy	3) As a result of 3), the regional economy and income levels will be affected. (Earlier commencement of service will be able to improve economic situations such as income levels, etc.)

(Source) Created by Mitsubishi Research Institute, Inc.

In the following further analysis will be conducted based on the Table above.

Of these impacts, especially socio-economic impacts may not be always clearly based on statistical data or materials. For example, impacts on power prices and on industrial location will be also affected by policy intentions of governments and other economic factors. Therefore, analysis based on objective statistical data and public materials has limitations. It must be noted that analyses and descriptions in the case-study that follows have been made under such conditions of limitations and constraints.

4.1.2 Analysis of Impact In the Case of the Commencement of Service Earlier than Planned of Simhadri Thermal Power Station and in the Case of Project Delay

(1) Analysis of Financial Impact

1) Setting Parameters

The setting of each parameter needed for financial analysis is summarized as follows:

(i) Borrowing Rate (Discount Rate)

On the basis of a recent WACC (weighted average cost of capital) estimate in India it is set at 2%.[7].

(ii) Price Increase Rate

As regards the construction investment, the price increase rate is set at 5.4% on the basis of the average change rate of construction investment deflator for the latest 5 years, obtained from Handbook of Statistics on Indian Economy 2010-11. As regards the Operation & Management Cost, the price increase rate is set at 5.72% per year on the basis of what was set in the FIRR calculation in the *Ex-post* evaluation. As regards the fuel cost, the price increase rate is set at 5%. As regards the Other Cost, no price increase shall be taken into account since it is smaller compared with other items.

(iii) Energy Sales Price

As regards the unit energy sales price which is the prerequisite for computing benefit, in the FIRR calculation in the *Ex-post* evaluation the 2010 value is set on the basis of CERC Tariff Guidelines and subsequently on the basis of the plan (Ｔhe average increase rate from 2010 through 2027 is set at 2.1%). In this analysis it will be calculated on the assumption that in the case of a project delay the energy sales price as such also will change with a delay proportional to the project delay. For example, in the case of a delay of one year more than the actual construction period of 7 years, the value for 2011 will be set based on the Guidelines and the values for the period of from 2012 through 2028 will be based on the plan value.

(iv) Power Demand

As regards the power sales volume, which is the prerequisite for benefit calculation, in the *Ex-post* evaluation it is assumed to be a definite value from the commencement of service onward. However, in this Study it is assumed that in the case of a project delay power demand as such also will be generated with a delay proportional to the project delay and accordingly calculated. For example, in the case of a delay of one year more than the actual construction period of 7 years, it is assumed that power demand is generated with a time lag, namely power demand for 2010 will be generated in 2011 and power demand for 2011 will be generated in 2012. Likewise, it is assumed that Other Revenues will be generated with a delay proportional to the project delay.

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7 For example, in the 2009 Study Report on Yen Loan Project Formulation, etc., entitled "Study Report on Geothermal Power Generation Project in Uttarakhand (India)" an estimate of WACC 1.98% is adopted as the interest rate for comparison with FIRR.

2) Impact on FNPV

The following Table shows a summary of NPV values computed for each case on the basis of the parameters set above concerning the Simhadri Thermal Power Station Project. The NPV difference compared with the reference time point is shown in the Graph.

Table 4.5: Changes in FNPV in the Simhadri Thermal Power Station Project

(Unit: Million Rupees)

Case	NPV	Difference from the Reference Time Point	Rate of Change from the Reference Time point
Construction Period of 7 Years (The Actual period Assumed)	49,340,467	12,994,713	35.8%
Construction Period of 8 Years (Reference Time Point)	36,345,754	0	0.0%
Construction Period of 9 Years (A Delay of One Year from The Reference time Point)	21,766,345	-14,579,409	-40.1%

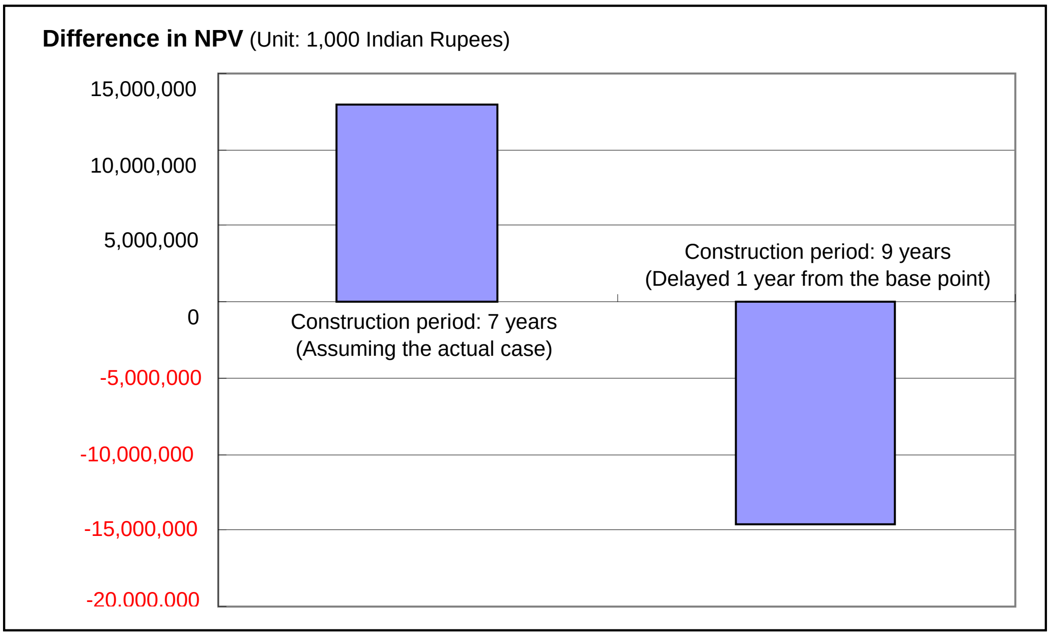


Figure 4-4 Changes in NPV Value at Simhadri Thermal Power Station

(Source) Created by Mitsubishi Research Institute, Inc.

As seen from this analytical result, the increase of NPV resulting from the shortened period of construction works in this project is estimated to be approximately 13 billion rupees. It represents 35.8% of the NPV that could have been obtained if the construction works had been completed as initially planned. As discussed in Chapter 2, the project period could be shortened thanks to the high operational capability of the implementation organization (National Thermal Power Corporation: NTPC) and the selection of reliable contractors, etc. These factors have contributed much to the enhancing FNPV. It is surmised that the shortened project period had much impact on ENPV, though ENPV was not the subject of this analysis.

It has been shown in this case-study that the impact of project delay has proved to be significant by the result that the NPV loss ratio is as high as nearly 40% though the value of the discount rate is relatively low.

Though it may be difficult to draw a final conclusion only on the basis of this target project, power projects seem t be structured in a way that makes the impact of price hikes due to the project delay more likely to be generated because power projects are based on the assumption that there will be substantial cost increases in fuels, etc. in the future.

3) Impact on the Financial Position of NTPC

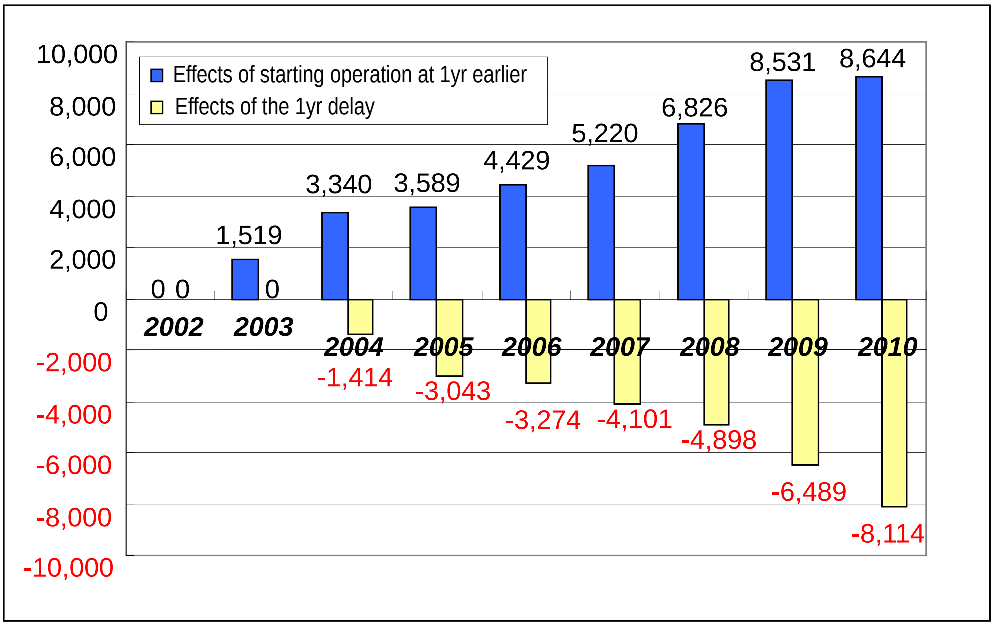
Here, the impact that the change of FNPV of the Simhadri Thermal Power Station Project due to project delay will have on the financial position of NTPC will be analyzed.

More particularly, the financial data of NTPC for the period of from 2002 through 2010 is one reflecting the fact that the Simhadri Thermal Power Station Project was actually completed within the construction period of 7 years, one year earlier than initially planned (the Power Station started its commercial operation in 2003). Therefore, by way of computing power revenue and cost of all items such as fuels cost in the hypothetical case of the construction period of 8 years (the initial plan) and in the hypothetical case of the construction period of 9 years (one-year delay in project implementation) and by way of having them reflected in the financial data of NPTC, the impact that such changes in the construction period of the Simhadri Thermal Power Station Project will have on the profit before tax of NTPC as a whole will be estimated. The following is the result of such estimation:

Table 4.6: Change in the Profit before Tax of NTPC as a Whole Resulting from the Change of the Construction Period of Simhadri Thermal Power Station Project

(Unit: Million Rupees)

Item	2002	2003	2004	2005	2006	2007	2008	2009	2010
Commencement of Service in 2003 (Construction Period of 7 Years) (The Actual Construction Period Assumed)	47,331	61,290	68,128	66,087	89.,074	102,54	93,595	108,855	120,496
Commencement of Service in 2004 (Construction Period of 8 Years)(Reference Time Point)	47,331	58,771	66,307	65,838	88,234	101,759	91,989	107,149	120,383
Commencement of Service in 2005 (Construction Period of 9 Years) (A One-Year Delay)	47,331	59,771	64,893	64,209	88,003	100,932	91,192	105,557	118,758
Impact of One-Year-Earlier Commencement of Service	0	1,519	1,821	249	840	790	1,606	1,706	113
Impact of One-Year-Late Commencement of Service	0	0	-1,414	-1,629	-231	-827	-797	-1,591	-1,625
Ratio of Impact of One-Year-Earlier Commencement of Service to Profit in the Period Concerned	0.0%	2.5%	2.7%	0.4%	1.0%	0.8%	1.7%	1.6%	0.1%
Ratio of Impact of One-Year-Late Commencement of Service to Profit in the Period Concerned	0.0%	0.0%	-2.1%	-2.5%	-0.3%	-0.8%	-0.9%	-1.5%	-1.4%



(Cumulative values from 2002; Rupees in millions)

Figure 4-5 Change in Pre-Tax Profits of the NTPC as a whole, in association with Change in Construction Period of Simhadri Thermal Power Station Project

(Source) Created by Mitsubishi Research Institute, Inc.

As known from this estimation, in terms of the impact of one-year-earlier commencement of service, it meant an improvement of the annual profit before tax in the order of approximately 100-1,800 (million rupees) and accordingly it meant a profit improvement in the order of an accumulated total of approximately 8.6 billion rupees for the period of from 2002 through 2010. It is indicated that the early commencement of service led to boosting the profit of NTPC. In terms of the impact of one-year-late commencement of service, it means an annual loss of profit before tax in the order of approximately 200-1,600 (million rupees) and accordingly it means an accumulated total loss of 8.1 billion rupees for the period of from 2002 through 2010.

The increased portion of the annual profit before tax, resulting from the earlier commencement of service, accounts for a maximum of about 3% of the profit for the period concerned. When the power charges (retail charges) revised on April 1, 2007[8] and the power charges revised on April 1, 2009 in AP are compared, it is noted that those for farmers are increasing while those for households remain the same and those for commercial businesses are decreasing.

Table 4.7: Changes in Power charges in AP State[9]

Year	For Household (4KW)	For Commerce (10KW)	For Agriculture (5HP) 1HP = 0.746KW
April I, 2007	396.63	624.67	23.75
April 1,2009	396.63	619.50	30.75
Rate of Change	0%	-0.8%	29.5%

(Source) Central Electricity Authority Annual Report 2009-10 and 2007-2008

Even if NTPC tries to achieve profit increases by means of raising the unit power sales price, the State Government, the other Party of power sales contracts, will find it difficult to accept such price increase, given the current situation where it is difficult to raise unit retail power sales prices and negotiations are expected surely to be difficult. In view of these factors, an increase in cash flows could have an impact more significant than figures show. It can be noted that an early commencement of service or avoidance of project implementation delay could have a certain degree of impact on the business management of power generation entities.

As stated above, the financial position of NTPC is very sound. Therefore, even if the Simhadri Thermal Power Station had experienced a delay of one year or a few years, such delay would not have had fatal impact on the cash flow of NTPC. However, it should be kept in mind that the smooth implementation of Yen loan projects including those other than this project will contribute to the improvement of business management of entities.

[8] Retail power charges are fixed by the Power Regulation Commission, while the whole sales prices at which power companies such as NPTC sell power to the State is fixed in power sales contracts concluded between power companies and the State Government.
[9] In its recent efforts to reform the power sector, AP State has been trying to raise power sales prices for the agricultural sector and to lower them for the industrial sector.

(2) Analysis of Socio-Economic Impact resulting from the Early Commencement of Service and Project Delay

1) Impact on Power Demand & Supply

As stated above, power demand & supply in AP State continues to be in a tight state even after the commencement of service at the Simhadri Thermal Power Station. According to the Project Performance Audit Report of 2009, the Simhadri Thermal Power Station accounts for 8% of the total capacity of power generation facility, and 11.9% of the total generation volume in AP State and plays an important role in the power generation sector in AP State. Therefore, if the construction works period of the Simhadri Thermal Power Station had been 8 years (Commencement of service in 2004) or 8 years (Commencement of service in 2005) instead of 7 years (Commencement of service in 2003), a power demand & supply gap of approximately 10% would have been caused in AP during the period of from 2004 through 2005 (see the Figure below).

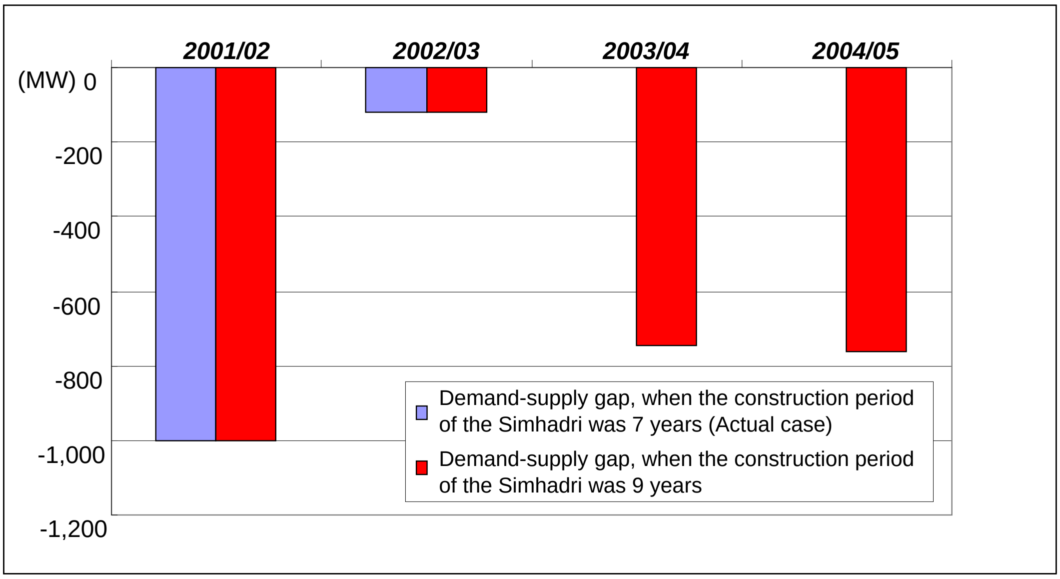


Figure 4-6 Change in Demand-Supply Gap for 2001-2004 in association with the Change in Construction Period of Simhadri Thermal Power Station Project

(Source) Central electricity authority Annual Report 2009-10 and 2007-2008

2) Impact on Power Prices

As stated above, electricity charges in India are fixed by the Power Regulation Commission of each State according to the conditions in each State in accordance with the National Tariff Policy. As seen on the Table below, the level of electricity charges in AP State (for the use of the households and commerce sectors) are as high as those in Great Metropolitan Areas such as New Delhi and Mumbai.

Table 4.8: Electricity Charges by Region in India (Examples)

(Unit: 0.01 Rupees / kWh)

Region	For Households Use (4KW)	For Commerce Use (10KW)	For Agricultural Use (5HP) * 1HP = 0.746KW
AP State	396.63	619.50	30.75
Delhi (BYPL/BRPL/NDPL)	351.75	602.00	167.45
Mumbai (Reliance Energy)	558.34	831.66	150.90

(Source) Central Electricity Authority Annual Report 2009-10

Under these circumstances, the power sales price of the Simhadri Thermal Power Station is cheaper than those of other power stations because of its high power generation efficiency. According to the 2009 data, it was 221 (0.01Rs/kWh) the average of coal fired thermal power stations is 279 (0.01Rs/kWh).[10]

As power prices tend to be fixed from the policy point of view, it would be difficult to conclude that the high efficiency of the Simhadri Thermal Power Station will have immediate effects on the retail prices of electricity. However, it is considered that the power supply from the Simhadri Thermal Power Station will have restraining effects on the power prices in AP State. In the case of if an early commencement of service is achieved in power project implementation, its effects are likely to be produced more quickly.

[10] Based on the Central electricity authority Annual Report 2009-10

Table 4.9: Power Prices of Coal-Fired Thermal Power Stations in India (2009)

Name of Utility/Power Station	Energy Source-Coal/Gas	State where theunit is located	InstalledCapacity	Rate of Sale ofPower
MUZAFFARPUR THERMAL POWER STATION	THERMAL-COAL	BIHAR	220	365
BADARPUR TPS	THERMAL-COAL	DELHI	705	328
DADRI (NCTPP)	THERMAL-COAL	UTTAR PRADESH	1330	305
RIHAND STPS	THERMAL-COAL	UTTAR PRADESH	2000	198
SINGRAULI STPS	THERMAL-COAL	UTTAR PRADESH	2000	145
TANDA TPS	THERMAL-COAL	UTTAR PRADESH	440	295
F. G. UNCHAHAR TPS	THERMAL-COAL	UTTAR PRADESH	1050	269
FARIDABAD TPS.	THERMAL-COAL	HARYANA	55	452
PANIPAT TPS	THERMAL-COAL	HARYANA	1367.8	311
DEEN BANDHU CHHOTU RAM TPP, YAMUNA NAGAR	THERMAL-COAL	HARYANA	600	338
INDRAPRASTHA POWER STATION	THERMAL-COAL	DELHI	247.5	416
RAJGHAT POWER HOUSE	THERMAL-COAL	DELHI	135	339
KOTA THERMAL POWER STATION	THERMAL-COAL	RAJASTHAN	1240	260
SURATGARH THERMAL POWER STATION	THERMAL-COAL	RAJASTHAN	1500	327
ANPARA A TPS	THERMAL-COAL	UTTAR PRADESH	630	153
ANPARA B TPS	THERMAL-COAL	UTTAR PRADESH	1000	203
HARDUAGANJ TPS	THERMAL-COAL	UTTAR PRADESH	233	397
OBRA A TPS	THERMAL-COAL	UTTAR PRADESH	372	213
OBRA B TPS	THERMAL-COAL	UTTAR PRADESH	1000	201
PANKI TPS	THERMAL-COAL	UTTAR PRADESH	210	367
PARICHHA TPS	THERMAL-COAL	UTTAR PRADESH	220	335
PARICHHA EXTN.TPS	THERMAL-COAL	UTTAR PRADESH	420	326
RAJ WESTPOWER LTD.	THERMAL-COAL	RAJASTHAN	135	453
ROJA THERMAL POWER PLANT PH-I	THERMAL-COAL	UTTAR PRADESH	300	340
KORBA STPS	THERMAL-COAL	CHHATTISGARH	2100	113
SIPAT STPS	THERMAL-COAL	CHHATTISGARH	1000	204
VINDHYACHAL STPS	THERMAL-COAL	MADHYA PRADESH	3260	194
GANDHI NAGAR TPS 1-4	THERMAL-COAL	GUJARAT	660	319
GANDHI NAGAR TPS 5	THERMAL-COAL	GUJARAT	210	265
KUTCH LIG. TPS 1-3	THERMAL-COAL	GUJARAT	215	251
KUTCH LIG. TPS 4	THERMAL-COAL	GUJARAT	75	240
SIKKA TPS 4	THERMAL-COAL	GUJARAT	240	395
UKAI TPS	THERMAL-COAL	GUJARAT	850	224
WANAKBORI TPS 1-6	THERMAL-COAL	GUJARAT	1260	264
WANAKBORI TPS 7	THERMAL-COAL	GUJARAT	210	262
AMARKANTAK PH-II TPS	THERMAL-COAL	MADHYA PRADESH	240	193
AMARKANTAK PH-III TPS	THERMAL-COAL	MADHYA PRADESH	210	220
SANJAY GANDHI TPS/SGTPS PH-I/SGTPS PH-II	THERMAL-COAL	MADHYA PRADESH	840	205
SANJAY GANDHI TPS/SGTPS PH-III	THERMAL-COAL	MADHYA PRADESH	500	223
SATPURA TPS	THERMAL-COAL	MADHYA PRADESH	1142.5	191
BHUSAWAL TPS	THERMAL-COAL	MAHARASHTRA	482.5	312
CHANDRAPUR(MAHARASHTRA) STPS	THERMAL-COAL	MAHARASHTRA	2340	204
KHAPARKHEDA TPS-II	THERMAL-COAL	MAHARASHTRA	840	272
KORADI TPS	THERMAL-COAL	MAHARASHTRA	1100	244
NASIK TPS	THERMAL-COAL	MAHARASHTRA	910	326
PARLI TPS	THERMAL-COAL	MAHARASHTRA	940	307
PARAS	THERMAL-COAL	MAHARASHTRA	312.5	342
MUNDRA	THERMAL-COAL	GUJARAT	300	371
SABARMATI POWER PLANT	THERMAL-COAL	GUJARAT	400	0
SANVARDEM DIV. -VII	THERMAL-COAL	GOA	12	240
O. P. JINDAL STPS	THERMAL-COAL	CHHATTISGARH	1000	536
NEYVELI TPS I	THERMAL-COAL	TAMIL NADU	600	177
NEYVELI TPS-I EXPN.	THERMAL-COAL	TAMIL NADU	420	208
NEYVELI TPS-II	THERMAL-COAL	TAMIL NADU	1470	153
RAMAGUNDEM STPS	THERMAL-COAL	ANDHRA PRADESH	2600	196
SIMHADRI	THERMAL-COAL	ANDHRA PRADESH	1000	249
BELLARY TPS	THERMAL-COAL	KARNATAKA	500	289
RAICHUR TPS	THERMAL-COAL	KARNATAKA	1470	263
JSW(JINDAL) ENERGY LIMITED	THERMAL-COAL	KARNATAKA	260	510
JSW(JINDAL) ENERGY LIMITED	THERMAL-COAL	KARNATAKA	600	399
BOKARO `B` TPS	THERMAL-COAL	JHARKHAND	630	369
CHANDRAPURA(DVC) TPS	THERMAL-COAL	JHARKHAND	390	369
DURGAPUR TPS	THERMAL-COAL	WEST BENGAL	350	369
MEJIA TPS	THERMAL-COAL	WEST BENGAL	1340	369
FARAKKA STPS	THERMAL-COAL	WEST BENGAL	1600	282
KAHALGAON TPS	THERMAL-COAL	BIHAR	2340	286
TALCHER TPS	THERMAL-COAL	ORISSA	460	183
TALCHER KANIHA	THERMAL-COAL	ORISSA	3000	189
Barauni T P S	THERMAL-COAL	BIHAR	365	320
PATRATU TPS	THERMAL-COAL	JHARKHAND	770	278
IB VALLEY TPS	THERMAL-COAL	ORISSA	420	151
TENUGHAT THERMAL POWER STATION	THERMAL-COAL	JHARKHAND	420	213
D.P.L. TPS	THERMAL-COAL	WEST BENGAL	701	288
KOLAGHAT THERMAL POWER STATION	THERMAL-COAL	WEST BENGAL	1260	231
BAKRESHWAR THERMAL POWER PLANT	THERMAL-COAL	WEST BENGAL	1050	192
BANDEL THERMAL POWER STATION	THERMAL-COAL	WEST BENGAL	450	208
SANTHALDIH THERMAL POWER STATION	THERMAL-COAL	WEST BENGAL	490	196
SAGARDIGHI THERMAL POWER PROJECT	THERMAL-COAL	WEST BENGAL	600	177
CALCUTTA ELECTRIC SUPPLY CORP. LTD. §	THERMAL-COAL	WEST BENGAL	1225	409
DISHERGARH POWER STATION	THERMAL-COAL	WEST BENGAL	12.2	388
CHINAKURI POWER STATION	THERMAL-COAL	WEST BENGAL	30	388
HIRAKUD POWER	THERMAL-COAL	ORISSA	367.5	314
JOJOBERA TPS	THERMAL-COAL	JHARKHAND	427.5	251
			Average	279

(Source) CENTRAL ELECTRICITY AUTHORITY website
http://www.cea.nic.in/reports/monthly/executive_rep/nov11/34-41.pdf

3) Impact on the Location of Industries

In India the Bureau of Energy Efficiency (BEE) has been established within the Ministry of Power as a specialized organization to carry out the planning and promotion of energy saving policies. The BEE has identified 15 sectors as energy intensive industries and has been taking active steps to promote energy saving. These industries do not necessarily count only on power energy. However, industries such as those in sectors of aluminum, chemicals and buildings & facilities for business uses are significantly affected by power demand and supply situations.

Table 4.10: Energy Intensive Industries in India

1. Aluminum
2. Fertilizers
3. Iron and Steel
4. Cement
5. Pulp and paper
6. Chlor Alkali
7. Sugar
8. Textile
9. Chemicals
10. Railways
11. Port Trust
12. Transport Sector (industries and services)
13. Petrochemicals, Gas Crackers, Naphtha Crackers and Petroleum Refineries
14. Thermal Power Stations, hydel power stations, electricity transmission companies and distribution companies
15. Commercial buildings or establishments

In AP State where the Simhadri Thermal Power Station is located, industries in sectors such those of IT, biotechnology and pharmaceuticals are being agglomerated and especially the development of the secondary and tertiary industries is remarkable as indicated below:

Table 4.11: Change and Rate of Change of Income per Industry in AP State

(Unit: Million rupees)

Amount

Item	2005-06(QE)	2006-07(AE)	2007-08(P)	2008-09(Q)	2009-10(UA)
Primary Sector	672,730	702,490	831,250	994,120	1,042,550
Secondary Sector	492,010	570,380	892,500	975,170	1,060,790
Tertiary Sector	1,158,570	1,334,470	1,541,720	1,804,180	2,010,150

P=Provisional Q = Quick Estimates UA = Updated Estimates.

Rate of Change

Item	2006-07(AE)	2007-08(P)	2008-09(Q)	2009-10(UA)
Primary Sector	4.4%	18.3%	19.6%	4.9%
Secondary Sector	15.9%	56.5%	9.3%	8.8%
Tertiary Sector	15.2%	15.5%	17.0%	11.4%

(Source) AP State website http://www.aponline.gov.in/quick%20links/apfactfile/apfactfile_4.html

These industries can be considered to be in the category of energy intensive industries. Therefore, the agglomeration of these industries in AP State might have been facilitated owing to improvement in power demand and supply situations resulting from the earlier commencement of service of the Simhadri Thermal Power Station and its indirectly expected downward pressure effects on power prices, etc.

4) Impact on the Regional Economy

Chronological developments in GDP and gross power generation volumes in AP State are summarized in the following Graph:

From this Graph, it can be surmised that both are strongly correlated (a correlation coefficient of 0.99) and that economic growth and power supply in the region is strongly interrelated.

It is considered that through the expansion of power generation in AP State, the Simhadri Thermal Power Station facilitates and gives a certain degree of impact on the regional economy. Therefore, it is surmised that the early commencement of service of the Simhadri Thermal Power Station also contributes to the growth of the regional economy as a whole (it has the effect of quickening economic growth).

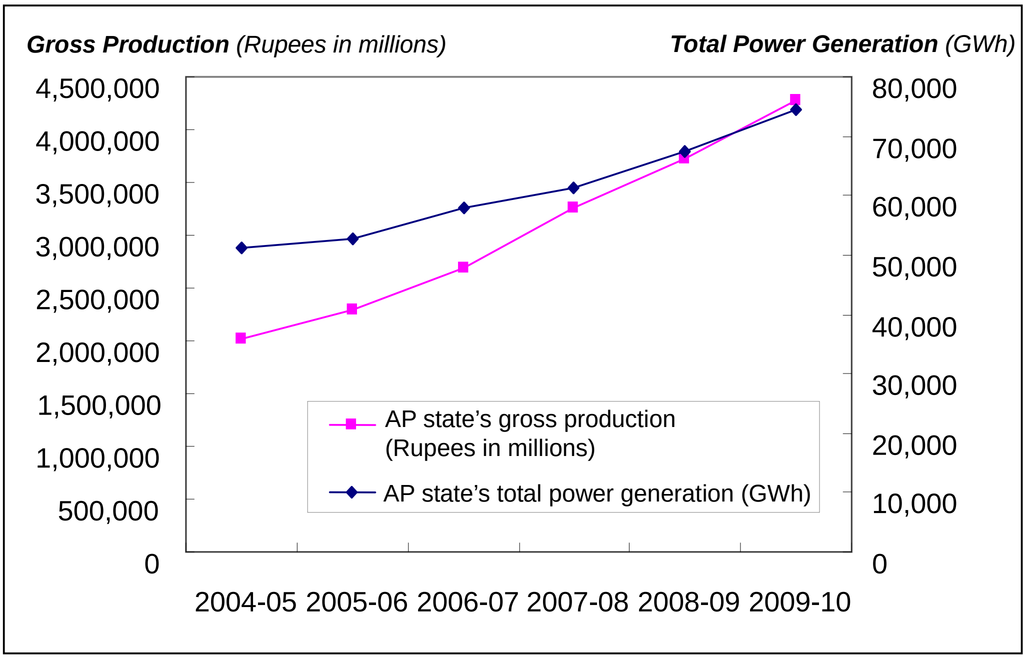


Figure 4-7 Changes in Gross Production & Total Power Generation of AP State

(Source) Created by Mitsubishi Research Institute, Inc., based on APTRANSCO and the Handbook of Statistics on Indian Economy 2010-11

4.2 Applying the Methodology to Sectors other than the Power Sector (Transportation and Water & Sewage Services)

Next, based on the above case study on the Simhadri Thermal Power Station, the points to be noted in applying this methodology to other sectors are summarized. As regards the transportation sectors, since benefit computation methods, etc. vary significantly, depending upon sub-sectors (road, port, airport, etc.), an example of trunk road development project (general roads without highway tolls) will be taken up.

4.2.1 Application of the Methodology to a Arterial Road Development Project (Transport Sector)

(1) Computation of NPV (Socio-Economic Impact)

In the case of a trunk road (with no tolls charged) development project no FNPV needs to be examined.

Since socio-economic net benefit consists mainly of user benefit resulting from time reduction effect and vehicle operating cost reduction, etc., the amount of benefit depends much on traffic demand. User benefit shall be computed on the basis of the available stream data and it shall be assumed that in the case of project delay, the time point of generation of benefit shall be also delayed in proportion to the time portion of the project delay.

(2) Grasping the Effect of Project Delay on Socio-Economic Impact

The effect of project delay on socio-economic impact can be interpreted as having spread to it through the impact on users. More particularly, impacts on the following industries are thinkable:

Table 4.12: Effect of Transport Sector Project Delay on Socio-Economic Impact

Category of Impact	Contents
(1) Impact on Agriculture, Forestry & Fishery	Generation of impact on agriculture, forestry & fishery (improved efficiency of transport and decline of prices of agricultural products resulting from such improved efficiency, etc.) will be delayed.
(2) Impact on Mining & Manufacture	Generation of economic impact (improved efficiency in the transport of raw materials, location of factories in the region concerned, improved business convenience, etc.) on mining & manufacture will be delayed.
(3) Impact on Service Industries (Tourist industry, etc.)	Generation of impact on service industries, especially on tourist industry (increase in the number of tourists and location of hotels, and improved business convenience, etc. resulting from improved convenience in terms of making round-and-express trips) will be delayed.

(Source) Created by Mitsubishi Research Institute, Inc., based on Ex-post Evaluation Reports related to the transportation sector, etc.

The following methodologies will be useful for qualitative and quantitative analysis on these impacts.

1) Analysis on Traffic Demand Data

In the case of a road construction project, the following procedures will be useful. Namely, *in situ* investigation shall be cared out concerning the traffic demand using the road section of the project concerned to observe the kinds of users of that particular road section (whether used by many trucks or by many sightseeing buses, etc.) and also to understand what kind of industries are mainly affected by the impact resulting from the project delay. More concretely, If data is available on traffic volume and users' benefit (in the case of *ex-ante* evaluation, forecast value and in the case of *ex-post* evaluation the current value) per kind such as trucks, buses, passenger cars, etc., the extent of impact on each industry can be grasped in more concrete terms because it is considered that trucks relate to agriculture, forestry & fishery, and mining & manufacture, and buses relate mainly to tourist industry.

2) Analysis on Production Volume and Production Value, etc. of Each Industry

It will be possible to understand co-relationship between the change in the volume of traffic and the change in production output if chronological data on the volume of production (in the case of agriculture, forestry & fishery, volume of shipment) and the value of production of each industry can be collected *in situ* and can be compared with chronological data on the volume of traffic in the surrounding areas. If the strong co-relationship between traffic volume and production volume and value is grasped as seen in the development of trends in gross production and power generation volume in AP State, evidence supporting that the generation of traffic demand will be delayed by the delay of the project and that such delay in the generation of traffic demand will lead to the delay of impact on the regional economy, will be gained.

3) Analysis on the Status of Location of Each Industry

By way of grasping the status of location of industries (in the case of the manufacturing industry, factories, and in the case of the service industry, bus companies and hotels, etc.) in the areas surrounding the project site, a certain degree of analysis on the impact of the project delay on the location of industries will be possible. If local companies have already developed location plans as of the time of the *ex-ante* appraisal in anticipation of the implementation of the project concerned, the project delay will have direct impact on the delay of industrial location. If such information has been collected, it will be possible to indicate in concrete terms that the project delay will have serious impact on the regional economy.

4.2.2 Application of methodology on Water & Sewage Services Sector

(1) Computation of NPV (Financial Impact)

As in the power sector, it is necessary to grasp the financial impact due to the project delay in the water & sewage sector. The methodology for computing the FNPV difference is basically the same with that for computing it for power projects. It is desirable that on the basis of the computed impact on FVPV, the impact on the financial position of the entity as a whole be analyzed and examined.

(2) Grasping the Effect on the Socio-Economic Impact

As regards the effects of project delay on socio-economic impact, the following can be pointed out:

Table 4.13: Effects of Project Delay in the Water & Sewage Sector on Economic Impact

Category of Impact	Contents
(1) Impact on Sanitation	By means of water & sewage projects, sanitation conditions will be improved, especially water & sanitation related diseases, etc. will decline and accordingly a drop in death rates will occur. With project delay the generation of such effects will be delayed. With drops in the incidence of diseases, a drop in medical cost and sickness leaves will be also expected. The generation of such effects is also delayed.
(2) Impact on Activities of Local Residents	By means of water& sewage projects, local residents are expected to be liberated from going to draw water and to allocate more of their labor to other economic activities (mini/small-scale business and other household work). The generation of such effects will be also delayed by the project implementation delay.
(3) Impact on Industrial Activities	From water& sewage projects, positive impact (improvement in sanitation and in customer satisfaction, etc.) on the commercial activities and tourist industry in the region will be expected. Project delay will result in delaying the generation of such effects.

(Source) Created by Mitsubishi Research Institute, Inc., based on Ex-post Evaluation Reports related to the water & sewage services sector, etc.

The following methodologies will be useful for the qualitative & quantitative analysis of these impacts:

1) Analysis on the Development of Trends of Incidence of Water & Sanitation-Related Diseases in the Region Concerned

Supporting evidence can be provided by way of collecting *in situ* data on the incidence of water & sanitation related diseases and the development of trends of related medical cost, etc. in and around the region concerned and in the case of *ex-ante* evaluation by way of grasping in quantitative terms, the relationship between these diseases and the rate of spread of water & sewage services, etc. Effects of the project delay on human life can be grasped to a certain extent if concrete correlations with the trends of death rates, etc. are found.

2) Analysis of Data on Regional Economic Activities

If data on economic activities (the number of business entities and commercial facilities, etc.) in the region concerned can be made available and if their correlations with the rate of spread of water & sewage services and with water demand, etc. are grasped, the proposition that the delay in the implementation of the project concerned will lead to the delay in the spread of water & sewage services and it will lead further to the delay in the generation of impacts on the regional economy, will be supported.

Chapter 5 The Results of the Study

5.1 The Results of this Study and Significance of the Methodology Proposed

The results of this Study can be summarized as follows:

- In this Study, the factors of project delay were summarized on the basis of Ex-post Evaluation Reports, etc. and it was indicated that these factors of delay could be categorized into (1) Initially Optimistic Project Planning, (2) Delay in Terms of Institutional Processing such as Administrative Procedure, (3) Lack of Operational Capability of Contractors and Consultants, (4) *Force Majeure* including natural disasters, etc., and (5) Political Reasons.
- On that basis, as a simplified methodology for understanding the economic impact of delay in project implementation the methodology of utilizing the NPV difference was proposed in view of the possibility of being able to obtaining data from local governments, etc.
- The validity and effectiveness of this methodology was verified by way of conducting a case-study of the Simhadri Thermal Power Station Project. Based on the results obtained from this case-study, the methodology proposed in this Study is considered to have certain validity. Especially this methodology is considered to be effective even with a relatively large-scale project like the Simhadri Thermal Power Station Project, if impact on the regional economy is easy to grasp on the basis of data, etc.
- As shown in Chapter 3, in the event that delay has been foreseen in the midway of project implementation, the loss likely to result from such project delay can be indicated with greater persuasiveness by way of computing the impact of such delay after the revision of cost and benefit stream on the basis of data available as of that time point.
- In the future, by way of making a simple estimation of the impact resulting from such project delay based on the cost and benefit stream data obtained at the time of the actual *ex-ante* and *ex-post* evaluation work, the awareness on project delay loss on the part of Yen loan recipient countries can be promoted; and such exercise will also serve as an incentive for efforts to control project implementation delay as such. Furthermore, by way of indicating the result of qualitative analysis relating to the impact of project delay on the regional economy, understanding will be further deepened on project delay loss. For example, according to the results of analytical work conducted on the basis of Ex-post Evaluation Reports, major factors of project delay are the delay in land acquisition, the working plan based on bad outlook and the delay in the selection of consultants, etc. If such delay factors are to be indicated in advance to local governments, such act of advance indication will serve as an incentive for local governments to process smoothly the selection of consultants and land acquisition, etc.

5.2 Future Agendas

5.2.1 Accumulation of Examples of Analysis Based on the Application of This Methodology and Improvement of This Methodology

In this Study, a case-study of the Simhadri Thermal Power Station Project was conducted to verify the validity of the methodology. It is advisable that in months and years to come, more examples of application of this methodology should be accumulated with a view to enhancing efforts for improving it.

More particularly, it is necessary to accumulate analytical examples in other sectors such as transportation, water & sewage services and examples where analysis has been conducted after the revision of cost and benefit stream. In the event that problems have been identified with the method of computation and validation of parameters such as discount rates and with the method of computation and validation of stream data, care should be taken to improve them.

5.2.2 Creating the Mechanism of Process towards "Clarification of Social Loss Due to Project Delay" by Means of This Methodology

It is necessary to create the mechanism of step by step process involving also the governments of recipient countries in order to develop the habituation of clarifying social loss due to project delay and to share perception on its importance.

For the moment, the first agenda to be addressed is to accumulate analytical examples of this methodology. When the stage is reached where the validity and effectiveness of this methodology have been more confirmed, it is desirable to see the mechanism firmly established after having undergone the following procedures.

Table 5.1: Process toward "Clarification of Social Loss Due to Project Delay"

Step	Content
Step (1): Characteristics of Delay Factors in Target Countries and Their Summarization	In the basis of Project Performance Audit Report, etc. on Yen loan projects in target countries, major delay factors and their characteristics (whether or not time consumed in the selection of consultants, whether or not it is the problem of process control, etc.) shall be summarized and information shall be shared among the persons concerned.
Step (2): Estimating Delay Loss in the Cost-Bnefit Analysis conducted at the Time of Feasibility Study (FS) (Case-Study)	Several projects in target countries shall be selected for case-studies and loss in the case of delays of approximately from 1 year through 5 years shall be estimated with a touch of sensitivity analysis when the cost & benefit analysis is conducted at the time of FS to compute EIRR or FIRR. For this purpose it shall be ensured that JICA should be able to access to necessary data such as cost and benefit stream data right from early stages prior to project implementation.
Step (3): Estimating Delay Loss in the Midway of the Project (Case-Study)	The possibility of delay in the midway of the project period in the projects selected in shall be monitored. If delay in the midway of the project period is foreseen, delay loss shall be recomputed on the basis of the latest information available at that stage and necessary steps shall be studied with a view to sharing information with the implementation organization of the target country.
Step (4): Information Sharing and PDCA Cycle Creation at the Annual Meeting at the JICA Local Office with the Local Government	At the annual meeting held at the JICA Local Office with the local government organizations information shall be shared on the results of delay loss estimation, etc. and PDCA Cycle shall be created to request measures to be taken for improvement on an ongoing basis. In connection with the creation of the Cycle, it is desirable to study the possibility of creating a mechanism for deterring project delay (incentive system, etc. for construction companies having completed the works successfully within the initially scheduled period).

(Source) Created by Mitsubishi Research Institute, Inc.