Eastern Seaboard Development Plan
Railway Project

1. Project Summary and Japan's ODA Loan

(1) Background: Development of new transportation network was urgently required for meeting transportation demands arising from implementation of the Eastern Seaboard Development Plan, in particular the construction of an international commercial port at Laem Chabang and the industrialization of the region as a whole driven by the industrial estates. The transportation network development was planned to target both modes of road and railway transport. Of these two modes, the railway network was primarily intended to handle long distance, large quantity transport of freight for the said region.

(2) Objectives: To accommodate the demand for massive transport of cargoes (containers, etc.) handled in the Laem Chabang Port, and for long distance, large-volume transport of resources and energy (LPG, etc.) for the development of the Map Ta Phut Industrial Complex.

(3) Project Scope: The following five railway projects are involved in the Eastern Seaboard Development Plan. Among these five projects, three are ODA loans. The subjects of this evaluation were two out of these three projects, for which the loan covered the full amount of foreign currency portion for the required cost. Since these five railways jointly work as an integral railway network, the assessment of the operation, maintenance, project effects and impacts in this report covers all the five projects.

Project name	Application	Remarks
Chachoengsao - Sattahip Railway	Lines exclusively for freight to satisfy the transportation demand for the ports and industrial estates to be constructed in the Eastern Seaboard.	Thai government project
Si Racha - Laem Chabang Railway		Ex-Post evaluation completed
Sattahip - Map Ta Phut Railway		**In the scope of this evaluation**
Klong Sip Kao - Kaeng Khoi Railway	Lines exclusively for freight, bypassing Bangkok where the traffic is heavily congested, to regularly satisfy the transportation demand between the Eastern Seaboard and other regions.	**In the scope of this evaluation**
Lat Krabang ICD*	Inland intermediate yard for freight containers	Thai government project

*ICD: Inland Container Depot

(4) Borrower/Executing Agency: Both are State Railways of Thailand (SRT) (Guarantor: Kingdom of Thailand)

(5) Outline of the Loan Agreement:

	Sattahip - Map Ta Phut Railway	Klong Sip Kao - Kaeng Khoi Railway
Loan Amount	¥3,002 million	¥8,158 million
Loan Disbursed Amount	¥2,826 million	¥7,298 million
Date of Exchange of Notes	September 1988	February 1990
Date of Loan Agreement	September 1988	February 1990

Loan Conditions Interest Rate Repayment Period(Grace Period)	 2.9% 30 years (10 years)	 2.7% 30 years (10 years)
Final Disbursement Date	January 1997	December 1999

2. Analysis and Evaluation

(1) Project Scope: Both for Sattahip-Map Ta Phut Railway (hereinafter referred to as S-M Railway) and Klong Sip Kao-Kaeng Khoi Railway (hereinafter referred to as K-K railway), the tracks and auxiliary facilities were constructed, according to by and large the original plan.

(2) Project Implementation Schedule: Delay of about four years occurred both in S-M and K-K railway projects. In the case of S-M railway, much time was spent for coordination with the relating agencies (Industrial Estate Authority of Thailand, etc.), and there was a delay in preparation for placing orders for construction work by SRT. In the case of K-K railway, a delay was occurred in the selection of consultant. In either case, the delay could have been shortened if SRT had taken appropriate measures such as higher performance of administrative procedures.

(3) Project Cost: The cost for S-M railway was 1.5 times the planned amount. This is due to the rise of construction unit cost reflecting the bullish situation of the construction industry in Thailand at the time. The additional cost was covered by additional allotment of the local currency budget. For K-K railway, the work volume was increased because the more extensive soft ground was encountered than estimated in the detail design phase, resulting in increased local currency cost. As a whole, however, this railway work was completed at the total cost close to the initially planned amount.

Comparison of Original Plan and Actual

Sattahip - Map Ta Phut Railway	Plan	Actual
①Project Scope		
- Civil work/Track construction [1)]	24 km	24 km
- Signaling system/Communications equipment	One set	One set (including additional pieces of equipment)
- Consulting Service [2)]	F 55 M/M／L 187 M/M	F 72.5 M/M／L 267.7 M/M
②Implementation Schedule (commencement to completion)[3)]	September 1989 to March 1991	May 1992 to April 1995
③Project Cost		
Foreign currency	¥3,002 million	¥2,823 million
Local currency	300 million bahts	1,085 million bahts
Total	¥4,502 million	¥6,946 million
Exchange Rate	1 baht = ¥5.0	1 baht = ¥3.8

Klong Sip Kao – Kaeng Khoi Railway	Plan	Actual
①Project Scope		

- Procurement of construction/ maintenance equipment	One set	One set (partially deleted)
- Civil work/track construction[1)]	82.55 km	82.42 km
- Signaling system/communications equipment	1 set	1 set
- Consulting service		
Civil work/track construction	F 119 M/M／L 85 M/M	F 109 M/M／L 141 M/M
Signaling system/communications equipment	F 68 M/M	F 56.2 M/M／L 134.5 M/M
②Implementation Schedule (commencement to completion)		
- Civil work/track construction	January 1991 to December 1992	April 1993 to May 1995
- Signaling system/communications equipment	November 1991 to October 1993	September 1995 to October 1997
③Project Cost		
Foreign currency	¥8,158 million	¥7,282 million
Local currency	1,269 million bahts	1,956 million bahts
Total	¥15,265 million	¥14,910 million
Exchange Rate	1 baht = ¥5.6	1 baht = ¥3.9

1) Including construction of the station buildings.
2) The letter "F" for the consulting service represents "foreign consultant", and "L" means "local consultant".
3) Not including the maintenance period.

(4) Project Implementation Scheme: The executing agency is State Railways of Thailand (SRT). With the railway projects in the Eastern Seaboard Development Plan, some difficulties were found in coordination with the simultaneously ongoing projects of highway network and industrial estates. Nevertheless, the remarkable delay could have been limited by improved strategies such as more prompt proceeding of administrative procedures in SRT.

(5) Operations and Maintenance: SRT has been operating the railway business for 81 years, having well established guidelines and manuals for maintenance and inspection of tracks, signaling system and communications equipment. Though no significant problem is pointed out for the maintenance of the railways evaluated here, it is necessary to tackle some issues including aged equipment and facilities, and unsatisfactory maintenance because of insufficient budget.

(6) Operational Performance (See Appendix 1 for more detailed discussion): The transportation record of each railway in 1998 is summarized in the table below. The Chachoengsao-Sattahip railway, as the trunk line in the Eastern Seaboard, mainly conveys freight containers and LPG. The Si Racha-Laem Chabang railway (hereinafter referred to as S-L railway) achieved a traffic volume 1.5 times as large as the amount projected in the appraisal, showing an operational performance exceeding the initial estimation. Though the operation efficiency needs to be improved further by increasing the traffic frequency, and providing regular operation conforming to the timetable, it can be said that the S-L railway project attained success. In contrast, S-M railway achieved no more than 10% of the initially estimated freight transport volume, failing to fully accomplish the project objectives and providing a limited project effects. For this railway, around 50% of the initially projected transport volume (mineral resources and agricultural products) could not be achieved because of change in the preconditions, so it was unavoidable. The remaining 40% or so (energy, industrial products) was absorbed by other transportation means. Some demand for railway transportation may be created by improvement of SRT's train operation. Though the achieved transport volume of K-K railway is less than 40% of the projection, it is reasonable to say that the project objectives were attained, since some freight transportation was impossible without this

railway that bypasses Bangkok. Further effects can be expected of this railway through enhancement of the operation efficiency. The Lat Krabang ICD is handling a container volume as large as the full installation capacity. This ICD has ameliorated the convenience and availability of railway transportation of containers.

(Unit: thousand tons)

Project name	Projection at the time of Appraisal	Actual Transportation volume	Main freight
	1998	1998	
Chachoengsao - Sattahip Railway	-	4,188	Container, crude oil, LPG
Si Racha - Laem Chabang Railway	2,200	3,283	Container, crude oil
Sattahip - Map Ta Phut Railway	4,000	421	Petroleum
Klong Sip Kao - Kaeng Khoi Railway	5,017	1,760	Crude oil, LPG, petroleum
Lad Krabang ICD (1998)	437 thousand TEU (Truck 47%, railway 53%)		Container

(7) Management Performance of SRT (See Appendix 2 for more detailed discussion): Increased freight transportation in the Eastern Seaboard has raised the fare income of SRT. Nevertheless, the operating income of this company has been adverse for many years. Its business is therefore supported by Thai government's subsidy. The deficit tends to be on the rise, and cash flow tends to become tight. More effective management of SRT is essential for keeping the effects of the ODA loan projects. Furthermore, to limit the outlay of the Thai government, improvement of the financial status and management of SRT is indispensable.

(8) Project Effects and Impacts

(i) Quantitative Effects

(a) Transportation of Freight Handled in the Laem Chabang Port: The railway network in the Eastern Seaboard transports approximately 21% of the containers handled in the Laem Chabang Port (12,693 thousand tons in 1998). As shown by this figure, the contribution by the railways is great, as they are the nucleus of the land transportation network originating from and bound for the Laem Chabang Port.

(b) Transportation of Energy Between the Eastern Seaboard and Other Regions: The energy transported by the Eastern Seaboard railways to the northern and northeastern regions accounts for about 27% of the Thai LPG production (approximately 1.80 million tons), and approximately 52% of the production of the Petroleum Authority of Thailand (PTT). As demonstrated by these figures, the railways notably contribute to long distance transportation of LPG produced in the Eastern Seaboard.

(c) Financial Internal Rate of Return (See Appendix 3 for more detailed discussion): Since it is difficult to divide the benefit of the five railways in the Eastern Seaboard Development Program, it is desirable to consider the FIRR of these five projects as a whole. The FIRR calculated from the records is low, that is, 0.7%. As SRT has been running a deficit, however, it can be rightly said that the investment in these railways is relatively efficient.

(ii) Qualitative Effects

(a) Support to the Industrial Development of the Eastern Seaboard: The projects remarkably contributed to the industrial development of the area, through inland transportation of cargoes handled in Laem Chabang Port and massive transportation of energy.

(b) Diversifying Transportation Modes: The railway network in the Eastern Seaboard perform freight

transportation in conjunction with highways and other national roads, playing a role of diversifying the massive transportation into different modes.

(c) Effect on the Traffic Congestion in Bangkok: The newly constructed K-K railway provides a direct link between the Eastern Seaboard and northern/northeastern regions of Thailand, bypassing Bangkok. This results in reduction of closing time span at grade crossings. Though it is not so significant if viewed from the total traffic volume in Bangkok, some mitigating effect has been achieved.

3. Lessons Learned

(1) When a state-owned enterprise implements an ODA loan project and performs its operation and maintenance, considerable attention should be devoted to the financial sustainability of the state-owned enterprise.

(2) For assisting the railway sector, it is important to provide supports to the improvement of financial performance and the enhancement of operational efficiency of the enterprise implementing the project.

Comparison between Projection at the time of Appraisal and Performance of the Freight Transportation, and Utilization Status of the Railway Network

(1) Projection at the time of appraisal and performance of the freight transportation

The railway network constructed in the frame of the Eastern Seaboard Development Plan is used for land transportation of containers, sugar, etc. exported or imported in Laem Chabang Port, and LPG and petroleum produced in the Map Ta Phut Industrial Complex. For evaluating the achievement of objective of these railway projects in the Plan, the initial projections of freight demand are compared with the performance for the three ODA loan projects.

Si Racha - Laem Chabang Railway

In the case of the Si Racha - Laem Chabang Railway, the freight transportation volume projected at the time of appraisal was 2,200 thousand tons for 1998[1]. The performance in 1998 was about 1.5 times this projection, 3,283 thousand tons. The reason for such a notably large performance was that the volume of containers handled in Laem Chabang Port far surpassed the initial projection. The volume of containers handled in this port recorded in 1998 was 1.43 million TEU, that is more than twice the projection at the time of the ODA loan appraisal of the port. Consequently, the container transportation volume of the Si Racha - Laem Chabang Railway recorded in fiscal 1998 attained a level about 1.7 times the initial projection for 2000.

Table 1 Si Racha - Laem Chabang Railway: Projection at the time of appraisal and performance of the freight transportation (in thousand tons)

	Projection at the time of Appraisal		Performance
	1995	2000	1998
Container	858	1,573	2,664
Tapioca	400	400	-
Sugar, molasses	312	360	17
Crude oil	-	-	602
Total	1,570	2,333	3,283

Sources: Appraisal documents and SRT

For tapioca, the container volume to be handled in Laem Chabang Port was predicted, after the appraisal of this project, to exceed the projection. Considering the handling capacity of this port, it was determined not to handle tapioca there, and as a result, the Si Racha - Laem Chabang Railway did not transport tapioca[2]. Though the result for sugar is much smaller than the projected transportation volume, the railway transports almost all the volume handled by private enterprises operating the sugar-molasses terminals in Laem Chabang Port (example: 94.3% of the sugar export in fiscal 1998). The transportation of crude oil was not included in the initial projection.

Taking into account the fact that containers make up major part of the cargoes handled in Laem Chabang Port (handling volume in fiscal 1998 : containers about 12,693 thousand tons, general cargo about 1,197 thousand tons), the railway has satisfactorily achieved the initial objective that is to contribute to land transportation of cargoes handled in Laem Chabang Port. In addition, the total of

[1] In the projection of freight transportation at the time of appraisal, the transportation volume of each item was estimated only for two points of time, 1995 (3 years after the planned operation start) and 2000. For the period between these years, and each year to 2005 (3,410 thousand tons), the total transportation volume was supposed to increase steadily. Consequently, there is no projected values of each item for 1998. The analysis of the difference between projection and performance of each item, discussed here, uses the projected values per item for 2000 that is the closest to the time of evaluation.

[2] Tapioca is exported from a private port in Bangkok and a private port in Ko Si Chang island in the offing of Laem Chabang.

other freights also far exceeds the projection. Thus the effects larger than the initial projection were accomplished.

It should be noted, however, that the Port Authority of Thailand (PAT) and private enterprises operating container terminals in the port complained about the infrequent train operation and delay for about one hour after the scheduled time. In spite of such complaints, the results show a transportation volume far surpassing the projection. This means there is a strong demand for railway transportation of freight containers from Laem Chabang Port, demonstrating the importance of this railway.

Sattahip - Map Ta Phut Railway

Table 2 Sattahip - Map Ta Phut Railway: Projection at the time of appraisal and performance of the freight transportation (in thousand tons)

	Projection at the Time of Appraisal		Performance
	1992	2000	1998
Potash (potassium carbonate)	-	1,000	-
Rock salt	296	296	
Rice	500	500	-
Tapioca	760	760	-
LPG	132	132	-
Petroleum	-	1,460	421
Petro-chemical product	162	400	-
Steel product	300	600	-
Total	2,150	5,146	421

Sources: Appraisal documents and SRT

The transportation volume projected at the time of appraisal for the Sattahip - Map Ta Phut Railway was 4,000 thousand tons for 1998[3]. But the result was 421 thousand tons, that is, no more than about one tenth of this prediction. Among the cargoes included in the initial projection, only petroleum was transported as of fiscal 1998. The description below analyzes by cargo category the reasons why the demand for freight transportation was not created.

Potash (potassium carbonate), accounting for around 19% of the projected transportation volume, was planned to be mined and refined in the Northeastern region of Thailand, under the initiative of the Thai government, and transported to Map Ta Phut Port, from which it would be transported to south-east Asian countries; it would be partially used for production of fertilizer in the fertilizer plant in the Map Ta Phut Industrial Complex. Rock salt, making up around 6% of the projected transportation volume, was planned to be obtained as byproduct of potash mining, and conveyed to the Map Ta Phut Industrial Complex for manufacturing caustic soda, etc. However, potash mining and refining have not yet started in the Northeastern region of Thailand, so there has been no transportation demand for either item.

The agricultural products (rice, tapioca), that account for about 25% of the projected transportation

[3] In the projection of freight transportation at the time of appraisal, the transportation volume of each item was estimated only for two points of time, 1992 (planned operation start year) and 2000 (beyond this year, the freight volume would be stationary). For the period between these years, the total transportation volume was supposed to increase steadily. Consequently, there are no projected values of each item for 1998. The analysis of the difference between projection and performance of each item, discussed here, uses the projected values per item for 2000 that is the closest to the time of evaluation.

volume, were planned to be exported from Map Ta Phut Port. However, Map Ta Phut Port actually serves as an industrial port handling solely the cargoes from the Map Ta Phut Industrial Complex, and no agricultural products are exported from this port[4]. As a result, the railway does not transport rice or tapioca to this port.

For LPG, covering about 2.5% of the projected transportation volume, the gas produced in the natural gas separation plant of the Petroleum Authority of Thailand (PTT) in the Map Ta Phut Industrial Complex would be transported to the Northeastern and Northern region of Thailand. LPG has been conveyed through the pipeline on the ground from the plant mentioned above to the transportation terminal near Laem Chanbang, then transferred to the railway. According to the original plan, part of LPG would be directly transported by the railway from Map Ta Phut after the completion of natural gas separation plant Unit 2. However, even after the increase in production following the completion of the separation plant Units 2 and 3, LPG is entirely transported through the pipeline on the ground to the transportation terminal near Laem Chanbang, then transferred to the railway, without utilizing the Sattahip - Map Ta Phut Railway.

Petroleum is carried out from the refineries located in the Map Ta Phut Industrial Complex. Only for this item among the predicted ones, the transportation demand was actually created. However, the initially projected transportation demand was 1,460 thousand tons (about 28% of the projected transportation for 2000), whereas the result in 1998 was as little as one third of the projection (421 thousand tons). There are at present refineries of two companies, Rayong Refinery Co., Ltd. (RRC) and Star Petroleum Refining Co., Ltd. (STAR) in the Map Ta Phut Industrial Complex. The petroleum from RRC's refinery alone is transported by the railway. Royal Dutch / Shell Group, that is the main customer of RRC, transports over a long distance the whole of petroleum to the Northern and Northeastern regions of Thailand. In the case of STAR, its main customers, Caltex Petroleum Corporation and PTT, select the road and sea transportation, so it has no lead track to its refinery.

For the petro-chemical products, accounting for about 8% of the projected transportation, the demand for carrying out the products made in the Map Ta Phut Industrial Complex was expected. However, the petro-chemical products are solely carried out by road and sea transportation, creating no demand for railway transportation.

About 12% of the projected transportation volume was for the steel products made in the Map Ta Phut Industrial Complex. Though there are seven steel related product plants in this complex, none of them uses the railway transportation as with the case of the petro-chemical products.

As mentioned above, the initially projected freight transportation demand is broken down as follows: about 25% for long distance transport of particular mineral resources (potash and rock salt in northeastern Thailand) planned to be handled in Map Ta Phut Industrial Port and industrial complex, about 25% for agricultural products planned to be exported from said port, about 30% for long distance transport of energy (petroleum and LPG) produced in the Map Ta Phut Industrial Complex, and about 20% for industrial products (petro-chemical and steel products) manufactured in this complex.

For the first two items (particular mineral resources and agricultural products), no transportation demand was created because of change in preconditions (potash mining/refining not implemented, change in items handled in Map Ta Phut Industrial Port). The reason why potash mining/refining has not been implemented is the result of careful studies done repeatedly on the feasibility of this project. The agricultural product export was suspended because the handling volume of raw materials and products of the factories in the Map Ta Phut industrial complex exceeded the initial projection. These reasons are beyond control of SRT, so the demand for transport in these fields cannot be created by business effort of SRT. Therefore, the fact that no demand for railway transportation was created

[4] Rice is exported from a private port in Bangkok. For tapioca, see footnote 2.

was unavoidable.

On the other hand, for the energy and industrial products manufactured in the Map Ta Phut Industrial Complex, the transportation demand was generated, but it was absorbed by other modes (trucks, pipeline, sea transport). Consequently, no demand for railway transportation emerged, except for the transport of petroleum representing about 10% of the projected total transportation volume. One of the reasons for this may be the weaker competitiveness of the railways than other modes, though they are convenient for long distance and large quantity transportation, due to the ineffective operation such as train operation deviating from the timetable[5]. The SRT is advised to strive for creating the demand for railway transportation by improving the train traffic, for example, train operation conforming to the timetable.

For short distance transportation of energy and industrial products within Eastern Seaboard and Bangkok metropolitan region, however, it should be noted that road transportation is more effective by nature. Especially for transport to the inland district of the Eastern Seaboard, it is not efficient to transport by the railway which passes only along the coastal area of Eastern Seaboard, because cargoes should be transferred onto trucks. The merit with railways is long distance, large volume transport to the Northeastern and Northern regions of Thailand[6]. Whether improved business practice of SRT can produce the transportation demand of Sattahip - Map Ta Phut Railway depends upon the existing volume of long distance land transportation of the energy and industrial products manufactured in the Map Ta Phut Industrial Complex to the Northeastern and Northern regions of Thailand.

The Sattahip - Map Ta Phut Railway is the industrial track exclusively for Map Ta Phut Industrial Port and the industrial complex. This railway is therefore intended for satisfying exclusively the transportation demand of the port and industrial complex. About 50% of the initially projected transportation demand was not achieved because of the change in the preconditions. Therefore, it is not appropriate to evaluate the achievement of the project objectives and effects, by simply considering the results that failed to attain the initial projection. Railway transportation is used for conveying petroleum produced in the Map Ta Phut Industrial Complex to the Northeastern and Northern regions of Thailand. This fact shows this railway attained, from the qualitative viewpoint, the initial objective, i.e., long distance, massive transport of freights relating to the industrial port and complex. However, since only one petroleum refinery in the complex utilized the railway, the demand for railway freight transport is small. Therefore, the Sattahip-Map Ta Phut Railway project attained its objectives to a limited degree and project effects were not fully materialized.

Klong Sip Kao - Kaeng Khoi Railway

Table 3 Klong Sip Kao - Kaeng Khoi Railway: Projection at the time of appraisal and performance of freight transportation (in thousand tons)

	Projection at the time of Appraisal		Performance
	1991	2001	1998
Potash (potassium carbonate)	1,400	1,900	-

5 According to the interviews from three private companies in the Map Ta Phut Industrial Complex (two petro-chemical and one steel product manufacturers), they prefer transportation by trucks because the cargoes reach the destination without midway transfering, and they can deliver and receive cargoes whenever they want. These companies suggest that it would be possible for them to use the railway, if the trains would be operated regularly, and at shorter intervals, and with discounted fare.

6 For transportation to southern Thailand, sea transportation using Map Ta Phut Industrial Port would be advantageous.

Cement	1,350	1,500	236
LPG	125	275	484
Crude oil / petroleum	900	1,260	1,023
Fertilizer	150	250	-
Sugar	-	-	17
Other	90	90	-
Total	4,015	5,275	1,760

Source: Appraisal documents and SRT

The freight transportation volume by Klong Sip Kao - Kaeng Khoi Railway projected at the time of appraisal was 5,017 thousand tons in 1998[7]. The result in 1998 was however only 1,760 thousand tons, that is about 35% of the projection. The main items of the projected transportation were particular mineral resources mined in the Northeastern Thailand (potash, about 36%), cement (about 28%) to be conveyed from Northeastern Thailand to the Eastern Seaboard, and energy (about 29%) to be transported between the Eastern Seaboard and Northern and Northeastern regions of Thailand. The difference between projection and performance is analyzed in the following for each freight category[8].

The result for potash was about 36% of the projected transportation volume. As mentioned before, the mining/refining project of potash in Northeastern Thailand has not been implemented, generating no demand for railway transportation of potash.

Cement accounts for about 28% of the projected transportation. The achievement in fiscal 1998 was less than 20% of the projection for 2001. The projected cement transportation was that from Ban Chong Tai cement plant of Siam Cement, which has an industrial track from the SRT Northeast line, and that from Map Kabao plant of Siam City Cement to the Eastern Seaboard. The cement actually transported for TPI Polene was cement purchased from these two plants, as projected initially .

For LPG accounting for about 5% of the projected transportation volume, the result in fiscal 1998 attained a level about 1.8 times as large as the projection for 2001. In the case of crude oil and petroleum, making up about 24% of the projected transportation volume, the result in fiscal 1998 reached about 80% of the projection for 2001. The result for all the energy types including LPG, crude oil and petroleum in fiscal 1998 already attained the level close to the projection for 2001.

The potash transportation, that is about 36% of the projected transportation volume, was not implemented because of changes in the preconditions. Hence, it is not appropriate, as with the Sattahip - Map Ta Phut Railway, to evaluate the achievement of the project objectives and effects, by simply considering the results which failed to attain the initial projection. Especially for energy, the transportation volume in fiscal 1998 already attained the level equivalent to the projection for 2001. It fully achieved the initial objective of transporting energy produced in the Eastern Seaboard to Northern and Northeastern Thailand. For cement too, it can be rightly said that the initial objective was fulfilled as far as the content of transported cement is concerned (transportation from the planned plants to the planned destination), though the transportation volume record is lower than the projection.

[7] The breakdown of freight transportation was projected for three points of time, 1991 (planned operation start year), 2001 and 2011. For the period between these years, the freight volume of each item was supposed to increase steadily. Since the year of these three closest to the evaluation time is 2001, the analysis of the difference between projection and result is based on the projection for 2001 in this document.

[8] In addition to these main freight items, fertilizer accounted for about 5% of the projected transportation. The fertilizer produced in Map Ta Phut Industrial Complex was supposed to be transported to the northern / northeastern districts of Thailand. Though a fertilizer plant in this complex started operation in 1998, its product is not transported by railway.

Since cement is a major freight item that makes up approximately a quarter of the total cargo volume of SRT, there may be a good potential of generating demand for the Klong Sip Kao - Kaeng Khoi Railway. In fact, fiscal 1997 and 1998 experienced a notable growth - about ten times - in cement transportation. Because of sluggish economy, however, the cement production in Thailand decreased remarkably (23 million tons in 1998) from the level before the currency crisis (37 million tons in 1996). The future growth in cement production will depend upon the economic situation in Thailand. If there is a demand for long-distance transportation of cement from the two plants of Siam Cement and Siam City Cement to the Eastern Seaboard and eastern part of Bangkok, such demand can be accommodated by the railway by business effort and expertise of SRT.

(2) Utilization status of the railway network in the Eastern Seaboard

To evaluate the operational performance of the railway network in the Eastern Seaboard on the basis of its capacity, the actual numbers of trips per day were compared with that of the track capacity[9]. (Fig. 1)

The track capacity of the Si Racha - Laem Chabang Railway is 58 trips, whereas the actual number of trips in 1998 is 38. From this result, it seems possible to increase the frequency of train operation in response to the demand of Laem Chabang Port for container transportation. However, since the actual number of trips exceeds the track capacity[10] in the Chachoengsao - Sattahip Railway (between Si Racha and Chachoengsao) and Bangkok - Aranyaprathet Railway (between Chachoengsao and Lat Krabang ICD[11]), that link with the Si Racha - Laem Chabang Railway, it is impossible to operate the trains more frequently in the Si Racha - Laem Chabang Railway.

If there are dense traffic zones such as the section between Si Racha and Chachoengsao, and Chachoengsao and Lat Krabang ICD, irregular operation not conforming to the timetable may occur. The private enterprises operating the container terminals complain about the delays in train operation by SRT. One of the reasons for delays is the insufficient track capacity. For increasing the container transportation volume and ensuring regular train operation conforming to the timetable, it is indispensable to enlarge the track capacity[12].

In the case of the Sattahip - Map Ta Phut Railway, as already mentioned, the number of trips per day was only 6 against 48 of the track capacity, because of the small demand of railway freight transportation for the Map Ta Phut Industrial Complex and Port.

In the Klong Sip Kao - Kaeng Khoi Railway, the number of trips per day was 24 against 26 of the track capacity. Without construction of this railway, all the cargoes now conveyed by it would be transported via Bangkok. About 86% of the cargoes are (except cement) transported between the Northern/Northeastern regions of Thailand and Eastern Seaboard. As mentioned above, considering the excessively dense traffic between Si Racha and Chachoengsao, and between Chachoengsao and

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9 The track capacity represents the number of trains per day which can run safely on the track (section) in question. SRT calculates the track capacity by using this formula.

Track capacity = 1440 ÷ (T + t) x 0.7
where
1440 is the number of minutes a day (60 x 24),
T is the passing time span of the slowest train running through the section in question,
t is the time required for deceleration at stations and grade crossings in the section in question,
0.7 is the safety factor.

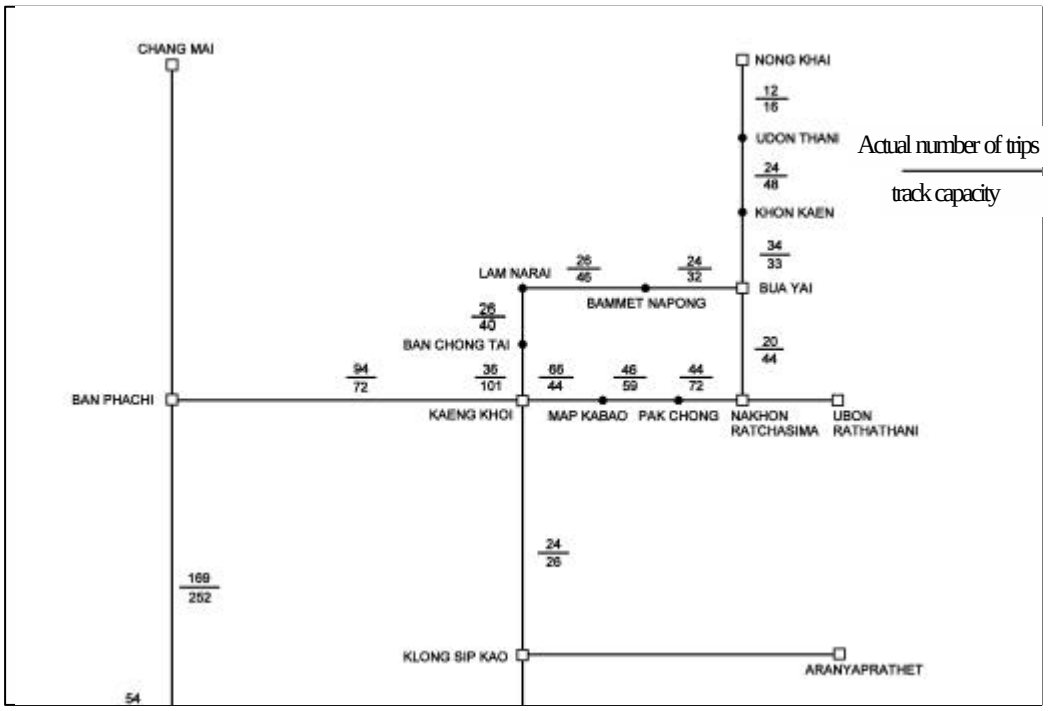
10 The track capacity is a theoretical value. Actually, it is possible to operate trains more frequently than the track capacity. If the operation exceeds the track capacity, however, the train operation tends to become irregular, not conforming to the timetable.

11 Lat Krabang ICD is located between Hua Takhe station and Makkasan station.

12 Between Laem Chabang Port - Lat Krabang ICD, the track has been doubled. Nevertheless, the track capacity is insufficient.

Lat Krabang ICD, such freight transportation would not be available without Klong Sip Kao - Kaeng Khoi Railway. It is therefore right to conclude that this railway has fully achieved the initial objective to link the Northern/Northeastern regions and Eastern Seaboard, bypassing Bangkok.

Fig. 1 Track capacity and actual number of trips per day of the eastern and northeastern lines of SRT (1998)



Management Performance of the State Railways of Thailand (SRT)

The railway network constructed in the frame of the Eastern Seaboard Development Plan, as a whole, significantly contributes to the freight transportation in this area. The increase of freight cargoes raises the fare income of SRT. The SRT, however, has been running a deficit in the business, and its operation is supported by Thai government's subsidy.

As shown in Table 1, after fiscal 1990 when the network in said area started operation, the fare income of SRT was increasing till the economic crisis in 1997. Since the increase in personal expenses and depreciations surpassed the income increase, however, an operating deficit was recorded almost every year. For fiscal 1998, SRT predicted both operating and recurring deficits would be on the rise, reflecting the income decrease due to sluggish economy and exchange loss. From the balance sheet of SRT (Table 2), it is known that cash flow at SRT is tight as the current ratio and quick ratio[13] tend to drop.

Table 1 Profit and loss account of SRT (in million bahts)

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Operating revenue	4,505	5,477	5,842	6,166	7,525	7,337	7,897	8,466	7,102
Passenger fare	2,792	3,180	3,574	3,790	3,846	3,847	4,080	4,154	4,012
Freight	1,230	1,325	1,312	1,365	1,421	1,526	1,626	1,713	1,579
Lat Krabang ICD	-	-	-	-	-	-	18	95	147
Other real estates, etc.	483	972	956	1,011	2,258	1,964	2,173	2,504	1,364
Operating expenses	4,863	5,790	6,392	6,910	7,289	8,112	8,713	9,163	8,951
Personal expenses	N.A.	3,110	3,594	4,006	4,080	4,747	4,992	N.A.	N.A.
Depreciation	447	503	536	632	756	858	1,041	1,168	1,227
Operating income	-358	-312	-550	-744	236	-775	-816	-697	-1,850
Interest payment	359	402	486	564	746	769	673	942	1,320
Profit or loss on conversion of foreign exchange	-115	-62	-147	-95	-158	-186	-66	56	-370
Recurring income	-832	-776	-1,183	-1,403	-668	-1,729	-1,556	-1,583	-3,540

Note: The years are the fiscal years of Thailand (example: 1998 = from October 1, 1997 to September 30, 1998). For fiscal 1998, the prediction by SRT is shown here.
Itemizing was changed according to the Japanese accounting standard.

Source: SRT

[13] Quick ratio = (current assets − materials and supplies such as maintenance equipment and appliances, fuel) ÷ current liability

Table 2 Balance sheet of SRT (in million bahts)

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Current assets	2,402	2,215	2,419	2,524	4,341	2,890	3,784	4,338	4,025
Cash/deposit	118	83	87	100	54	87	92	266	257
Materials and supplies	1,421	1,526	1,584	1,717	1,749	1,737	2,247	2,149	1,854
Fixed assets	20,212	21,711	23,785	28,519	32,284	32,641	37,432	40,421	45,453
Land/building/ equipment	15,204	16,631	18,473	22,956	27,453	31,352	35,512	37,734	42,542
Current liability	823	1,236	1,826	3,134	4,362	2,813	4,965	6,105	6,089
Fixed liability	13,436	14,144	16,300	18,692	21,211	15,691	16,720	21,253	22,992
Capital	8,269	8,546	8,078	9,217	11,053	17,027	19,530	17,401	20,398
Current ratio	291.8%	179.2%	132.5%	80.5%	99.5%	102.8%	76.2%	71.1%	66.1%
Quick ratio	119.2%	55.7%	45.7%	25.7%	59.4%	41.0%	31.0%	35.8%	35.7%

Note: The years are the fiscal years of Thailand (example: 1998 = from October 1, 1997 to September 30, 1998). For fiscal 1998, the prediction by SRT is shown here.

As mentioned above, SRT has been operating in deficit and cash flow is tight. The deficit tends to increase, and the cash flow is getting more tight. For maintaining the effect of ODA loan projects, the SRT which is the operating entity, should implement more efficient management. For limiting the financial burden incurred by the Thai government, it is essential to improve the financial performance and management of SRT.

The railways (especially national railways) in the world are suffering adverse business operations, because of severe competition with other traffic modes. Improvement of management is therefore vital, by implementing grade separation (separation of business for tracks from that for vehicle operation), partial privatization, etc. Since it is not in the scope of ex-post evaluation to determine specific strategies for management improvement of SRT, such issues are not addressed here. As a result of the ex-post evaluation, it is recommended that, for maintaining healthy railway operation, SRT be positively committed to improving management including, if necessary, large-scale innovation.

Financial Internal Rate of Return (FIRR)

The values of FIRR of the Railway Project in the Eastern Seaboard Development Plan, calculated in the appraisal and re-calculated ("Performance"), are summarized in Table 1. For the three ODA-financed projects, the re-calculation was based upon the same preconditions used in the appraisal, for enabling comparison with the values estimated in the appraisal. The difference between appraisal projection and performance of freight volume is reflected in the difference of FIRR, viz.; for the Si Racha - Laem Chabang Railway, the re-calculated FIRR exceeds the estimation in the appraisal, and in contrast, for the Sattahip - Map Ta Phut Railway, notably below, and for the Klong Sip Kao - Kaeng Khoi Railway too, below the appraisal projection.[14]

Table 1 FIRR of the railway projects in the Eastern Seaboard Development Plan

	At the time of Appraisal	Performance
① Si Racha - Laem Chabang Railway	14.2%	18.2%
② Sattahip - Map Ta Phut Railway	14.3%	-11.5%
③ Klong Sip Kao - Kaeng Khoi Railway	7.7%	-9.4%
④ Chachoengsao - Sattahip Railway	-	2.7%
⑤ Lat Krabang ICD	-	4.7%
⑥ Whole Railway Project in the ESDP	-	0.7%

1) SRT does not disclose the earnings and expenses of each railway line. So, the income and maintenance costs were estimated as follows. The fare income was estimated as a function of extension and transportation volume of each line, using the freight fare per ton-km of SRT. The maintenance cost was calculated on the basis of the extension and number of trips of each line, using the maintenance cost per train-km provided by SRT. The transportation volume of each line was supposed to be constant from fiscal 1998 on. FIRR was calculated on the basis of price in 1998.

2) For railways ③ to ⑤ (for ③, both for the "appraisal" and "performance"), the fare income, construction cost, maintenance cost exclusively for the line in question alone are included in the calculation. For ① and ②, the preconditions used in the appraisal were involved in the calculation (see the description on the next page). The project life considered in the appraisal was 30 years after construction start for ① and ②, whereas 30 years after operation start for ③. The project life used in the re-calculation is 30 years after operation for all the projects. The project life of the whole of the railway projects is 30 years after the operation start of the completion of the last line.

The calculation of FIRR for the Si Racha - Laem Chabang Railway and Sattahip - Map Ta Phut Railway at the time of appraisal includes the freight fare income of the Chachoengsao - Sattahip Railway occurring as a result of the construction of the Si Racha - Laem Chabang Railway and Sattahip - Map Ta Phut Railway, in addition to the fare income of these railways (except for the freight transportation not concerned with these railways). As for the costs, the maintenance cost of the Chachoengsao - Sattahip Railway was included in the calculation, but the construction cost of this

[14] As for the future freight transportation, the transportation volume is supposed to level off from fiscal 1998 on. Even if the supposition is changed, that is to say, the transportation is supposed to increase, the conclusion drawn is almost the same as that discussed above. If the profit is supposed to increase 5% a year for each line (the maintenance cost is also supposed to increase 5% a year), the FIRR is 20.6% for Si Racha-Laem Chabang railway, -7.8% for Sattahip-Map Ta Phut railway railway, and –5.5% for Klong Sip Kao-Kaeng Khoi railway.

railway was regarded as sunk cost, and the construction cost of the Si Racha - Laem Chabang Railway and Sattahip - Map Ta Phut Railways alone was included.

The Si Racha - Laem Chabang Railway and Sattahip - Map Ta Phut Railway are the branch lines of the Chachoengsao - Sattahip Railway. Almost all the freights on the Chachoengsao - Sattahip Railway were created as a result of construction of these branch lines. Taking into account this fact, it is rational to consider these three railways form one network, and regard the fare income of this whole network as the project's profit. Moreover, to evaluate the profitability of the whole of the railway projects in the Eastern Seaboard Development Plan, it is suitable to refer to the FIRR of the entire railway network including also the construction cost of the Chachoengsao - Sattahip Railway newly constructed in the frame of the Plan. Furthermore, it is more desirable to calculate the FIRR of the whole of the five projects, because the freights on these three lines comprise also those generated by the new investment in the Klong Sip Kao - Kaeng Khoi Railway and Lat Krabang ICD (such freights are sugar, petroleum, container transport after the completion of ICD).

The FIRR obtained for the whole of the five projects is low, that is 0.7%. When studying the results of each project, we know that the ratio of return of the Chachoengsao - Sattahip Railway and Lat Krabang ICD is high, so the income from transportation of containers of Laem Chabang Port is the core of the income of the railway network in the Eastern Seaboard. The FIRR of the five railway projects of this seaboard is low, but positive. Considering that SRT has been running an operating deficit for many years, the investment in the Eastern Seaboard rail network was – it can be rightly said – relatively effective[15]. The low FIRR rather reflects the overall SRT business performance. This analysis of the profitability and investment efficiency of the present projects also demonstrates that those who are concerned are recommended to be committed to improvement of the financial performance and business of SRT.

[15] This railway network is based upon the national development plan to industrialize the Eastern Seaboard. The SRT, that is the operating entity of the railway networks, is a state-owned enterprise, whose operation is in principle subsidized to some extent. Taking into these two facts into account, it is not appropriate to evaluate the investment efficiency solely by the FIRR that is the index to show the profitability from the financial viewpoint of the operating entity. For evaluating the investment efficiency from the national economic standpoint, the economic internal rate of return (EIRR) can be used. EIRR was not calculated for this evaluation (not calculated in the appraisal either), however. This is because, except for transportation cost reduction in comparison with road transportation, it is difficult to quantify the benefits (mitigation effect of road traffic congestion by diversified massive freight transportation modes other than road traffic, reduction of traffic stopping time at grade crossings in Bangkok due to the railway transportation bypassing Bangkok, industrial development effect, etc.). Considering the importance of the role played by the Eastern Seaboard railway network, the investment efficiency involving these benefits may be not necessarily low.