Performance Evaluation Report

PPE: THA 25345

Bangkok Urban Transport Project (Loan 1195-THA)

November 2005

Operations Evaluation Department
Asian Development Bank

CURRENCY EQUIVALENTS

Currency Unit – baht (B)

		At Appraisal (15 October 1992)	At Project Completion (28 August 2002)	At Operations Evaluation (12 April 2005)
B1.00	=	$0.0396	$0.0237	$0.0255
$1.00	=	B25.23	B42.14	B39.225

ABBREVIATIONS

ADB	–	Asian Development Bank
BECM	–	Bangkok Extended City Model
BMA	–	Bangkok Metropolitan Administration
BME	–	benefit monitoring and evaluation
BMR	–	Bangkok Metropolitan Region
CIDA	–	Canadian International Development Agency
DOH	–	Department of Highways
DOR	–	Department of Rural Roads
EA	–	executing agency
EIA	–	environmental impact assessment
EIRR	–	economic internal rate of return
ETA	–	Expressway and Rapid Transit Authority
ICB	–	international competitive bidding
IMAC	–	Intermodal and Coordination Study
JBIC	–	Japan Bank for International Cooperation
MOF	–	Ministry of Finance
MOSTE	–	Ministry of Science Technology and Environment
MTS	–	Megaprojects Technical Support
NESDB	–	National Economic and Social Development Board
OCMLT	–	Office of the Commission for the Management of Land Traffic
OED	–	Operations Evaluation Department
OEM	–	operations evaluation mission
OTP	–	Office of Transport and Traffic Policy and Planning
PCR	–	project completion report
PCU-hr	–	passenger car units-hour
PPER	–	project performance evaluation report
PWD	–	Public Works Department
RMMS	–	road maintenance and management system
RRP	–	report and recommendation of the President
SPURT	–	Seventh Plan Urban and Regional Transport Study
TA	–	technical assistance
TP3	–	Transport Planning and Policy Advice
UTDM	–	Urban Transport Database and Model Development
URMAP	–	Urban Rail Master Plan
VOC	–	vehicle operating costs

NOTES

(i) The fiscal year (FY) of the Government ends on 30 September.
(ii) In this report, "$" refers to US dollars.

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Operations Evaluation Department, PE-668

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The guidelines formally adopted by the Operations Evaluation Department (OED) on avoiding conflict of interest in its independent evaluations were observed in the preparation of this report. Philip Sayeg and Len Johnstone were the consultants. Mr. Johnstone, employed for one week, had been previously involved in consultancy services for transport data modeling. OED used his expertise mainly for calculations of traffic flows, as inputs to the economic analysis. He was not involved in assessments of the Project.

BASIC DATA
Bangkok Urban Transport Project (Loan 1195-THA)

PROJECT PREPARATION/INSTITUTION BUILDING

TA No.	Project Name	Type	Person-Months	Amount	Approval Date
1792	Establishment of an Environment Unit in Public Works Department	ADTA	12	250,000	24 Nov 1992
1793	Distributor Road Development	PPTA	32	250,000	24 Nov 1992

KEY PROJECT DATA ($ million)	As per ADB Loan Documents	Actual
Total Project Cost	211.20	148.52
Foreign Currency Cost	98.40	43.25
Local Currency Cost	112.80	105.27
ADB Loan Amount/Utilization	70.30	30.33
ADB Loan Amount/Cancellation		39.97

KEY DATES	Expected	Actual
Management Review		3 April 1992
Appraisal		13 May–2 June 1992
Loan Negotiations		17–20 August 1992
Board Approval		24 November 1992
Loan Agreement		28 July 1993
Loan Effectiveness	26 October 1993	23 December 1993
Project Completion	September 1997	September 2001
Loan Closing	31 March 1998	14 January 2002
Months (effectiveness to completion)	47	93

ECONOMIC INTERNAL RATES OF RETURN (%)	Appraisal	PCR	PPER
Project	45.0	20.1	28.0

BORROWER Thailand

EXECUTING AGENCY Public Works Department in Ministry of Interior[a]
Office of the Commission for the Management of Land Traffic[b]
National Economic and Social Development Board

MISSION DATA

Type of Mission	No. of Missions	Person-Days
Reconnaissance	1	114
Fact-Finding	1	54
Appraisal	1	66
Inception	1	10
Project Administration Review[c]	16	77

MISSION DATA

Type of Mission	No. of Missions	Person-Days
Project Completion	1	34
Operations Evaluation	1	28

ADB = Asian Development Bank, ADTA = advisory technical assistance, PCR = project completion report, PPER = project performance evaluation report, PPTA = project preparatory technical assistance, TA = technical assistance.

[a] The department was moved into the Ministry of Transport in October 2002.
[b] Formerly the Office of the Commission for the Management of Road Traffic.
[c] In conjunction with the review of other loans and related TAs. Few missions were devoted to the Project only.

EXECUTIVE SUMMARY

The Operations Evaluation Department (OED) of the Asian Development Bank (ADB) postevaluated the Bangkok Urban Transport Project (the Project). The Project had four components: (i) the Thonburi road extension (5.1 kilometers of dual three-lane highway, partly elevated, to improve traffic in the western sector of the city); (ii) institutional support to the then Office of the Commission for the Management of Land Traffic (OCMLT); (iii) the Bangkok Regional Structure Plan; and (iv) training.

The Thonburi road extension, described as a “missing link” in the city’s primary road transport network, was expected to foster efficient urban development. In view of the perception that a variety of agencies were handling Bangkok’s transport sector inefficiently, ADB’s institutional support aimed to enhance the planning and policy capacity of OCMLT, the newly created supervisory agency. OCMLT used consulting services to (i) develop a transport database, as well as transport planning and policy models for the Bangkok Metropolitan Region; (ii) provide policy advice, and help prepare the urban and regional transport component of the Eighth Plan (FY1997–FY2001); (iii) resolve conflicts among Bangkok’s megaprojects; and (iv) provide training. The Regional Structure Plan was to produce an overarching 20-year framework for transport and other infrastructure planning in Bangkok, as well as prepare feasibility studies for priority infrastructure projects. The training component was intended for agencies involved in the transport and traffic sector in Bangkok.

To help finance the $211.2 million project, ADB approved a loan for $70.3 million in November 1992. The executing agencies for the Project were the Public Works Department (PWD) of the Ministry of Interior for the road component, OCMLT for the institutional support component, and the National Economic and Social Development Board (NESDB) for the Regional Structure Plan. PWD and OCMLT were to handle the training component jointly. Implementation was expected to take about 5 years. The loan was to be closed by 31 March 1998.

Two technical assistance (TA) grants complemented the Project. The first was to support PWD's long-term institutional development by establishing an environmental unit. The second was to help PWD prepare an urban transport project focusing on the extension of the Thonburi road extension, and provision of an adequate distributor road network in the southwest of Bangkok.

Civil works started 3 years after the scheduled date of June 1994 due to delays in land acquisition, resettlement, and procurement. The road was completed by March 2001, 3 years later than the original date of March 1998.

ADB issued its project completion report (PCR) in December 2002, rating the Project as successful. This rating was based on the production and use of the physical and institutional outputs. However, the PCR rated the sustainability of the Project as less likely due to the lack of funds for maintenance.

The Operations Evaluation Mission (OEM) confirmed the PCR’s assessment that the construction quality of the road was satisfactory. The road provides valuable traffic relief to the western areas of Bangkok, and the beneficial effects extend to much of central Bangkok. The OEM reevaluated the road using the latest version of the transport model developed originally by the Project, and found that the road has a highly satisfactory economic internal rate of return of 28%. A secondary benefit of the Project was that the road’s alignment allowed for the

construction of an extension of the elevated railway, known as Skytrain, without land acquisition costs. Bus passengers received 45% of the project benefits through time savings, the dominant benefit. Urban transport investments that fill a missing link in the system can help to reduce poverty if buses are an important means of transport for the poor. Lower-income groups, which generally account for a large proportion of bus passengers, can enjoy significant time savings from such improvements.

The policy and capacity building components of the Project were implemented satisfactorily, except for the Regional Structure Plan with NESDB. The loan for the latter component was canceled. OCMLT, now called the Office of Transport Planning and Policy, strengthened its position, and improved the coordination of megaprojects. Although the training component started late, many government staff benefited from courses offered.

The PCR raised issues regarding resettlement, procurement processes, and maintenance budgets.

As a result of the construction of the road, 1,221 households were to be resettled, with an unknown number compensated for land. A relocation advisory unit, which was to have been established within PWD, was not created. Although the PCR indicated that a resettlement plan had not been prepared, the OEM found that a relocation plan had been prepared in December 1994, as required in the report and recommendation of the President. In line with standard practice in Thailand, the relocation of the households to be affected by the road construction was based on well-established compulsory purchase regulations. Landowners could apply for compensation to a unit in the Executing Agency, while others would be helped in moving to another location. ADB endorsed the relocation plan, although it did not include some of the measures that ADB later would make part of its Resettlement Policy of 1995. Although ADB did not receive a final report on the resettlement process, the available documentation indicates that resettlement followed the recommendations of the relocation plan. The OEM did not find any evidence of organized opposition, squatters on the site, or forced evictions. By September 2005, the Executing Agency provided information on the current circumstances of a sample of 50 resettled households that were interviewed regarding their socioeconomic status. Although the sample is small, it confirms the impression obtained by the OEM that most relocated households interviewed were reasonably satisfied with the new locations and were not encountering serious problems as a result.

The PCR noted the disagreement in 1995–1996 between bidders, PWD, and ADB regarding the validity of cross-contract discounts offered during the bidding for two sections of the road. While ADB approved bidding documents with such a clause, PWD subsequently removed the clause without notifying ADB. Although PWD notified contractors in a meeting, some contractors still offered the discounts. If the discounts had been taken into account, this would have led to one consortium implementing the two road sections against an overall lower cost (around $3 million less). In February 1996, ADB approved PWD's recommendation to award the two contracts to two consortia. Former staff of PWD and staff of the Ministry of Finance's Public Debt Management Office confirmed their preference for splitting up works to allow smaller contractors to gain experience with complex works. This also reduced the risk of one major contractor not performing, thereby jeopardizing overall progress. After studying the pertinent records, OEM found the decision regarding PWD's recommendation to be appropriate.

The PCR found that maintenance budgets for the road were insufficient. The Government's budget has increased in recent years, and OEM regards the funds available for maintenance as sufficient in the longer run. The Department of Rural Roads (DOR) plans on an

annual basis. Further, unlike the Department of Highways, DOR does not use a road maintenance and management system, which would help with planning future maintenance needs on a quantitative and timely basis. However, DOR is implementing a geographic information system for its road network.

The PCR reported the actual cost of the road component as equivalent to $136.6 million. When compared with the estimated cost of $194.8 million, this implied a cost underrun of $58.2 million equivalent. Almost $40.0 million, or 57%, of ADB's loan of $70.3 million was canceled. The Ministry of Finance viewed this as savings, not as a missed opportunity to access foreign currency funds or to commit available ADB finance to another project. However, the Ministry of Finance also noted that the loan had to be repaid at a less favorable exchange rate than when the loan was signed. Cost calculations in Thai baht present a different picture of the size of the cost underrun in dollar equivalent. While savings were realized on the construction contracts, land acquisition costs were larger than envisaged. In local currency, the total cost of the road remained about the level estimated at appraisal. Commitment charges for a net loan of $30.3 million were about $1.8 million. If the original loan of $70.3 million had been fully disbursed as planned in four equal installments between the second year and the fifth year of the Project, the commitment charges would have been around $500,000. Thus, the delays increased the commitment charges significantly.

Applying weights to the project components commensurate with their respective costs, OED rated the project as highly successful. This report, therefore, upgrades the rating given by the PCR. The road extension was rated highly successful; the traffic data model highly successful; the megaproject office successful; and the transport policy advice successful, bordering on partly successful. The training component was rated successful. The two attached TAs were rated unsuccessful, because (i) the environmental unit was not created in PWD, and does not exist today in PWD's successor, DOR; and (ii) neither the Bangkok Metropolitan Administration nor DOR implemented any of the TA's proposals on distributor roads.

PWD's performance was assessed as satisfactory, but marginally so, mainly because the Executing Agency did not prioritize the road in the first 3 years. As a result, works started almost 4 years after the planned date. ADB's performance was assessed as satisfactory, although more input in project administration would have optimized its results.

The OEM identified a number of issues, including (i) Government agencies concerned with road construction must take a more systematic approach to environmental management, land acquisition, and resettlement; (ii) the assessment of road maintenance budget requirements needs to be more systematic; and (iii) more attention must be paid to secondary and distributor roads in Bangkok.

Bruce Murray
Director General
Operations Evaluation Department


THAILAND
BANGKOK URBAN TRANSPORT PROJECT
(as implemented)
N
0 10 20 40 60
Kilometers
98°00'E
104°00'E
18°00'N
8°00'N
THAILAND
Bangkok
Andaman Sea
Project Location
Gulf of Thailand
100°00'E
102°00'E
14°00'N
12°00'N
Ang Thong
Saraburi
Suphan Buri
Phranakhon Si Ayutthaya
Banna
Kanchanaburi
Pathum Thani
Prachin Buri
Ban Pong
Nonthaburi
Nakhon Pathom
BANGKOK
Chachoengsao
Samut Sakhon
Samut Prakarn
Ratchaburi
PROJECT ROAD
Phanat Nikhom
Samut Songkhram
Chon Buri
Phetchaburi
Si Racha
Bang Lamung
Pattaya
Cha-am
Klaeng
Hua Hin
Rayong
MYANMAR
Prachuap Khiri Khan
Thap Sakae
Bang Saphan
Upper Central Region
Western Seaboard Region
Eastern Seaboard Region
National Capital
District Capital
City/Town
National Highway
Other Road
River
Bangkok Municipality Boundary
Bangkok Metropolitan Region Boundary
Extended Bangkok Metropolitan Region Boundary
International Boundary
Boundaries are not necessarily authoritative.

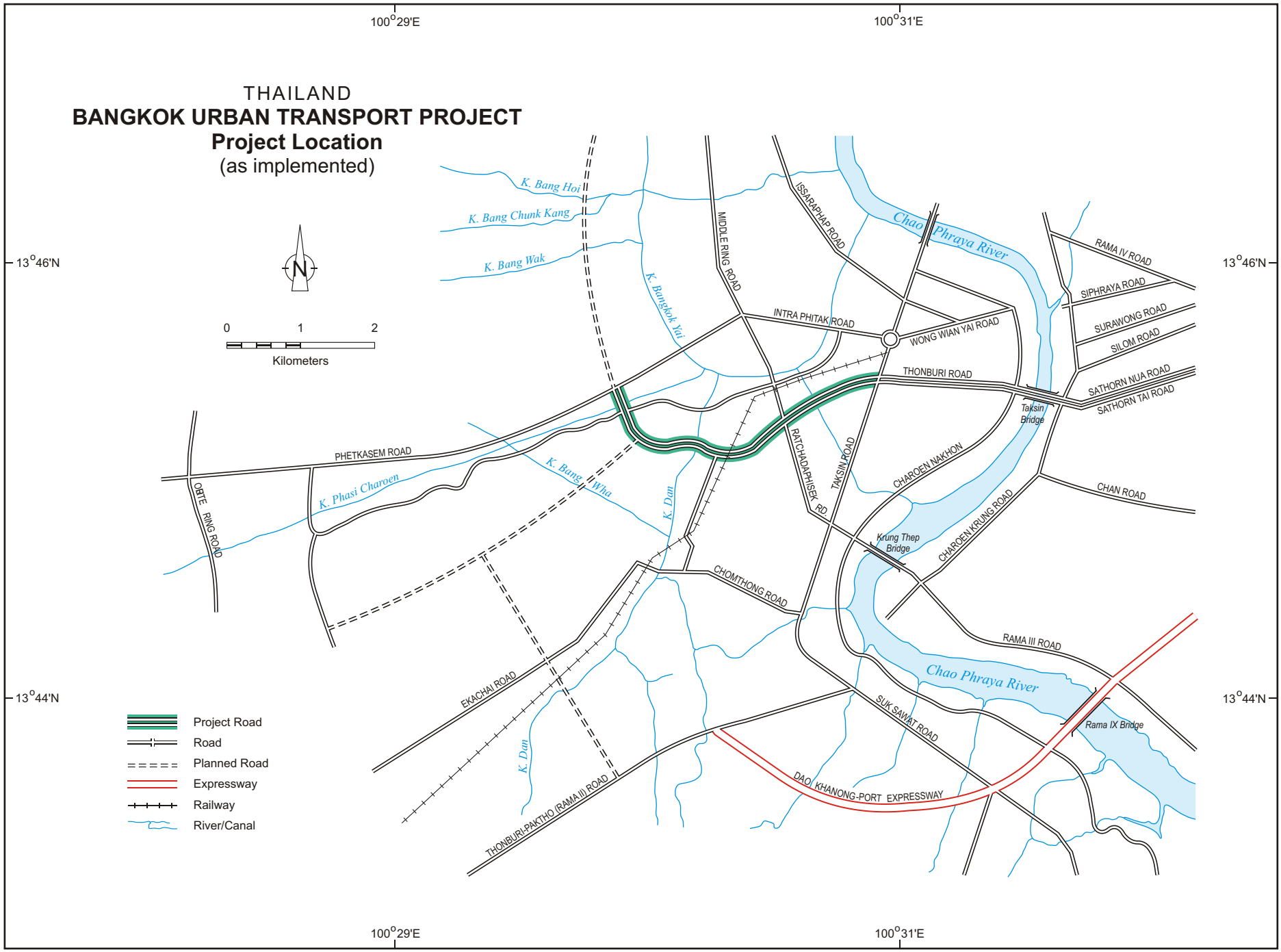
05-4288b HR

THAILAND

BANGKOK URBAN TRANSPORT PROJECT

Project Location

(as implemented)



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I. BACKGROUND

A. Rationale

1. In the early 1990s, Bangkok was notorious for having some of the world's worst traffic congestion. Having identified this as a key problem, the Government of Thailand (the Government) quadrupled the investment in the transport sector in Bangkok in its Seventh Plan (FY1992–FY1996). International funding organizations, including the Asian Development Bank (ADB), and the private sector were approached for the necessary financing.

2. ADB's assistance to the road sector had concentrated on roads outside the Bangkok Metropolitan Region (BMR) to that point. Sector projects had become ADB's predominant modality. Having recently undertaken a review of urban transport in Asia,[1] ADB responded positively to the Government's request. The Bangkok Urban Transport Project[2] (the Project) turned out to be one of ADB's few public sector urban transport projects.

B. Formulation

3. The scope of the Project emerged from extensive dialogue with Government in the context of ADB-supported highway sector projects, as well as private sector investments in expressways in Bangkok.[3] In May 1991, the Government asked ADB to provide financial support to construct an extension to Thonburi road in the western sector of Bangkok. Two feasibility studies had been conducted on the Project in the mid 1980s,[4] and the detailed design was completed in 1990. ADB fielded two reconnaissance missions, analyzed sector issues, and confirmed this road's high priority. The missions and analyses highlighted the urgency of having additional components focusing on mitigating bottlenecks in planning, coordination, and capacity. The development of distributor roads[5] within the area of influence of the Thonburi road extension and associated primary roads also was considered necessary. ADB fielded an appraisal mission between 13 May and 2 June 1992.

4. The Project involved building considerable institutional and human resource capacity, which was to be carried out through loan-funded consulting services, as well as two studies funded by technical assistance (TA) grants. One TA was to help prepare a plan and project for the provision of an adequate distributor road network in the suburban and peri-urban areas on the west side of Bangkok.[6] The other TA was to help establish an environmental unit in the Public Works Department (PWD).[7] Thus, the Project was notably ambitious, and potentially

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[1] ADB. 1989. *Review of the Scope for Bank Assistance to Urban Transport*. Manila.

[2] ADB. 1992. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan and Technical Assistance to the Kingdom of Thailand for the Bangkok Urban Transport Project.* Manila (Loan 1195-THA, for $70.3 million, approved 24 November 1992).

[3] In November 1990, ADB approved a loan of $30 million to, as well as an equity investment of $10 million in, the Bangkok Expressway Company for the Second Stage Expressway.

[4] Asian Engineering Consultants in 1985; and Pacific Architects and Engineers Company Ltd in 1987, funded by the Japan International Cooperation Agency (JICA).

[5] Distributor roads come in two types: (i) primary distributor roads, which form the major road network in the urban area; and (ii) secondary distributor roads, which form the major collector road system connecting local roads and primary distributor roads. The Project road and extensions planned (and subsequently built) are trunk roads, the highest level in the road hierarchy, which mainly cater to long distance traffic.

[6] ADB. 1992. *Technical Assistance to the Kingdom of Thailand for Distributor Road Development*. Manila (TA 1793-THA, for $250,000, approved 24 November 1992).

[7] ADB. 1992. *Technical Assistance to the Kingdom of Thailand for the Establishment of an Environment Unit in PWD*. Manila (TA 1792-THA, for $250,000, approved 24 November 1992).

could serve as a model for similar urban transport projects in megacities beset by infrastructure deficiencies and institutional problems. ADB's Board of Directors generally appreciated the comprehensiveness of the Project.

C. Purpose and Outputs

5. ADB's report and recommendation of the President (RRP) formulated an ambitious project objective "to be a catalyst in addressing several transport-related problems in Bangkok."[8] The project had four components: (i) the Thonburi road extension (5.1 kilometers of dual three-lane highway, partly elevated, to improve traffic in the western sector of the city); (ii) institutional support to the Office of the Commission for the Management of Land Traffic[9] (OCMLT); (iii) a Bangkok Regional Structure Plan; and (iv) training. The construction of the Thonburi road extension, which was described as a "missing link" in the city's primary road transport network, was expected to foster efficient development in areas close to central Bangkok, within 10 kilometers to the west of the Chao Phraya River. Given the perception that a variety of competitive agencies were managing Bangkok's transport sector inefficiently, with OCMLT as a weak coordinator, institutional support was deemed urgent. OCMLT was to engage consulting services to (i) develop a transport database, as well as transport planning and policy models for the BMR; (ii) provide policy advice, and help prepare the urban and regional transport component of the Eighth Plan (FY1997–FY2001); (iii) resolve conflicts among Bangkok's megaprojects; and (iv) provide training. The Bangkok Regional Structure Plan was to produce a 20-year overarching framework for transport and other infrastructure activities in Bangkok. The training component was intended for agencies involved in the transport and traffic sector in Bangkok.

D. Cost, Financing, and Executing Arrangements

6. The project cost was estimated at $211.2 million, including a foreign exchange component of $98.4 million. The Ministry of Finance (MOF) decided to fund only part of the foreign exchange component of the Project under the loan. ADB approved a loan of $70.3 million from its ordinary capital resources on 24 November 1992 to fund 71.4% of the foreign exchange costs—55% of foreign exchange costs for civil works, and 100% for consulting services and training. The executing agencies were (i) PWD in the Ministry of Interior for the road component; (ii) OCMLT for the institutional and training components;[10] and (iii) the National Economic and Social Development Board (NESDB) for the Bangkok Regional Structure Plan to guide land use, including preparation of feasibility studies for identified priority infrastructure projects. With preparation and construction of the road expected to take about 5 years, the loan was to be closed by 31 March 1998. The other components were expected to take the same time or less.[11] ADB approved the Government's proposal for advance action on procurement (prequalification of contractors and issuance of invitations to bid), as well as for selection of consultants. Such action was expected to enable the civil works, which were to be procured

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[8] See footnote 2. According to the appraisal report, the specific project objectives were to (i) enhance institutional effectiveness in transport planning and policy formulation and assessment, (ii) increase the efficiency of land utilization through improved accessibility and road development in the relatively less developed western sector of the city, (iii) develop a coherent road hierarchy west of the Chao Phraya River, and (iv) reduce traffic congestion in the corridor of the Thonburi road extension leading to the central business district.

[9] Originally, the project loan was to support the newly created Office of the Commission for the Management of Road Traffic. Subsequently, it was renamed the Office of the Commission for the Management of Land Traffic.

[10] OCMLT, which was created from a subdivision in the Ministry of Interior, was elevated to the status of a department under the Office of the Prime Minister in 1992.

[11] Support for OCMLT would take 3.5 years, the Bangkok Regional Structure Plan 1 year, and training 5 years.

under a single contract, to begin 4 months early, and OCMLT to expedite the selection of its consultants before the end of 1992. During loan negotiations, the Government requested that the Regional Structure Plan component ($2.46 million) be deleted from the loan. However, the total loan value of $70.3 million[12] was retained, as NESDB intended to obtain bilateral grant support from the Canadian International Development Agency (CIDA) for this component. ADB agreed to this on the condition that the Region Structure Plan remain an integral component of the Project.

E. Completion and Self-Evaluation

7. PWD failed to comply with the covenant on producing its own project completion report (PCR). PWD submitted the final reports of the construction supervision consultants. OCMLT provided ADB with a completion report, though this did not discuss all components. As a result, a full Government assessment of the Project is not on record. In December 2002, ADB issued its PCR,[13] which rated the Project as successful based on the production and use of the main outputs. The PCR, however, reported that the road was completed in March 2001, 3 years after the target date of March 1998. Civil works began 3 years after the scheduled date due to delays in land acquisition and splitting the road construction into two contract packages. The extended preparation and implementation process delayed the start of the Project's benefit stream, lowering the economic internal rate of return (EIRR) below the appraisal estimate. The PCR rated the Project's sustainability as less likely due to lack of maintenance funds.

8. The PCR did not take into account the institutional changes that occurred soon after the PCR Mission in August 2002. The report stated that the Department of Highways (DOH) became the new agency responsible for road operation and maintenance. However, after the Government's reforms of October 2002, the Department of Rural Roads (DOR) took over this responsibility. The reestimated EIRR of 20% (compared to the appraisal estimate of 45%) was tenuous. As the PCR acknowledged, it was not based on a suitably calibrated transport model for Bangkok, such the one used for the appraisal. The PCR reported that PWD had not prepared a relocation plan for households affected by the road construction. However, PWD had commissioned a consultant to prepare and implement a plan of suitable relocation activities from July 1993 to December 1994.

F. Operations Evaluation

9. An Operations Evaluation Department (OED) evaluation specialist and a staff consultant conducted the Operations Evaluation Mission (OEM) from 30 March to 8 April 2005.[14] The OEM visited the site of the project road. The OEM consulted DOR, Office of Transport and Traffic Policy and Planning (OTP), and NESDB; as well as the Expressway and Rapid Transit Authority (ETA) and various departments of the Bangkok Metropolitan Administration (BMA). Several consultants and contractors were contacted. A consultant involved with the development of the transport model—and who was still advising the Government on transport data—was engaged to estimate the traffic flows needed for the economic analysis, and to provide other information on transport developments in Bangkok. As a result, the OEM's economic analysis could be compared with that prepared at appraisal. Kickoff and wrap-up meetings were held with MOF

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[12] The Thai cabinet had limited the maximum loan to this amount, although it did not cover the entire estimated foreign exchange costs of the Project.

[13] Available: http://www.adb.org/Documents/pcrs/tha/pcr_tha_25345.pdf

[14] The project was selected randomly from the PCRs that ADB issued in 2002. The mission was prepared in ADB headquarters in Manila based on file study and interviews with staff involved at the time, who were still with ADB.

(the Public Debt Management Office). A draft of the report was distributed to DOR, OCMLT, and MOF in June 2005. MOF responded with no objections to the report. Comments from DOR, which stated that the report was mostly correct, were incorporated. OCMLT did not provide any comments. In September 2005, DOR submitted a benefit monitoring and evaluation report to OED, the findings of which were incorporated.

II. PLANNING AND IMPLEMENTATION PERFORMANCE

A. Formulation and Design

10. The Project was designed based on the recommendations of NESDB's Seventh Plan Urban and Regional Transport Study[15] (SPURT), which formulated an urban transport investment program for Bangkok and other major cities. A key recommendation was the establishment of a high-level body, reporting directly to the Prime Minister, to develop and implement transport policy, and to coordinate transportation line agencies. ADB's *Operational Program* (1991–1993) emphasized urban transport as one of the priorities of the country strategy, and the Project was listed in ADB's *Operational Program* for 1992–1994.

11. ADB recognized that this new high-level body, OCMLT, would need technical support to deal with the emerging conflicts between the many megaprojects planned, and to develop new planning capacity. Furthermore, ADB's appraisal mission regarded the preparation of a structure plan as necessary to provide an overall development framework for the Bangkok region, which also would propose packages of secondary infrastructure. Although these components were not directly linked to the Thonburi road extension, ADB project officers at the time concluded that the Government was unlikely to approve a separate loan for technical support to OCMLT and other agencies. Thus, the soft components were combined with the road component to create a project with indirectly linked objectives.

12. At the time, SPURT recognized the imbalance in road and mass transit investments. Investments were biased in favor of megaprojects at the expense of needed supporting investment in secondary roads, including distributor and local roads, and bus system improvements. Insufficient distributor and local roads had led to the development of "super blocks"—large tracts of uncoordinated urban development and vacant land parcels within the primary road network, but with few links to it.[16] One of SPURT's principal recommendations was to authorize PWD, which had not been involved in road construction in Bangkok,[17] to build distributor roads in city's suburbs. After accepting this recommendation, the Cabinet assigned the Thonburi road extension to PWD to speed up road construction in Bangkok and promote what it conceived to be healthy competition between agencies. Feasibility studies showed the road would have a high rate of return. The TA to plan packages of distributor roads would facilitate possible later investment by ADB, the Government, and other sources.

13. ADB commissioned a United States firm to prepare a summary environmental impact assessment (EIA) report,[18] which was submitted in December 1991 before appraisal. The report

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[15] Prepared by Halcrow Fox and PPK Consultants with Asian Engineering Consultants, Corp. Ltd. March 1991.

[16] The project appraisal report found that more than 70% of land converted to urban uses in 1985–1990 was more than 20 kilometers from the center of Bangkok.

[17] PWD had built some major bridges in Bangkok.

[18] Ballofet and Associates Inc. 1991. *Summary Environmental Impact Assessment Report*. Prepared for the Asian Development Bank, Manila. At the time, a summary EIA was a standalone report, not the executive summary of a full environmental impact assessment, as is the case nowadays.

noted that PWD could avoid carrying out a full EIA under Thai law, even though it was planning to build an expressway-like road. At the time, only ETA was required to prepare EIAs for toll roads. A full EIA might yet have been beneficial given that the 5.1-kilometer project road was being planned as part of a much larger primary road network of 22.9 kilometers to be constructed by PWD (cofunded later by the Japan Bank for International Cooperation [JBIC]), which was not fully envisaged at appraisal.

14. Although not an EIA, the summary EIA made some important recommendations to improve environmental and social impacts: (i) noise barriers; (ii) pedestrian bridges to link severed communities; (iii) preparation of a relocation plan to ensure that no family was left worse off; (iv) establishment of an environmental group (or officer) within PWD to monitor environmental issues; and (v) preparation, on voluntary basis, of an EIA as defined under Thai law. The first three recommendations were implemented, which significantly improved the processes of road construction and relocation, and later the road itself.

B. Achievement of Outputs

15. **Part A**. The Thonburi road extension is now part of Rajapreuk road. It is a primary arterial road with dual three-lane carriageways with a design speed of 80 kilometers per hour, and frontage roads. The daily capacity of the dual lane carriageways under normal traffic composition and flow characteristics is around 90,000 vehicles. The road connects to 17.8 kilometers of primary roads, which DOR recently completed. These include two sections that JBIC financed (northern extensions), and the southwestern extension (Kanchanapisek road) that the Government financed.

16. Civil works started 3 years later than expected at appraisal, mainly due to lengthy land acquisition and relocation processes. The contract for section 1 started on 1 June 1997 and was completed on 10 May 2000. The contract for the longer section 2 began on 1 June 1997 and was completed on 11 March 2001. The section 1 contract was extended by 180 days as the Asian financial crisis caused delays in obtaining local counterpart funding. Liquidity problems for the contractor, as well as counterpart funding difficulties, resulted in the section 2 contract being extended by 480 days. Both sections were under a 2-year warranty from the date of construction completion.

17. Section 1 extends from the east at Taksin road to Ratchadaphisek road (Middle Ring road). It consists of two three-lane overpasses across Taksin road, which connect to an at-grade road with dual three-lane main carriageways and two-lane frontage roads built on four small bridges across klongs (canals). In the last kilometer towards Rachadipisek road, it consists of a 10-lane carriageway, which rises to cross Rachadipisek road on a viaduct. Pedestrian bridges are provided across the road. The timing of the traffic signals at Taksin road was adjusted to handle the new traffic flow arrangement.

18. Section 2 starts at Ratchadaphisek road and finishes at Phetkasem road. The section continues from the viaduct crossing of Ratchadaphisek road to Mahachai Railway, Wutthakat road, and Klong Dan, where it comes back to grade for 800 meters. At this point, it connects to a free flow interchange that PWD built separately, facilitating access to associated primary roads to the north and south. One- or two-lane on and off ramps are provided where the viaduct crosses Ratchadaphisek, Wutthakat, and Phetkasem roads.

19. The PCR noted that that quality of road construction was satisfactory, achieving the normal good standard expected in Bangkok. The OEM concurred. DOR told the OEM that

signage along this road and adjacent sections, which was completed recently, is being reviewed to rectify poor directional signing. DOR also noted that some branches on street lighting masts were cracking. Two photographs of the completed road are in Appendix 1.

20. **Part B.** The institutional support to OCMLT comprised four outputs:

(i) a documented database and transport model for the BMR, accessible to all relevant agencies, as well as computer hardware and software, provided from December 1994 to March 1996;
(ii) progressive resolution of conflicts among megaprojects within a framework to integrate railway and expressway networks,[19] undertaken from January 1994 to June 1995;
(iii) policy advice on major transport issues in the extended BMR and main regional cities from March 1995 to May 1998, with detailed reports used to prepare the transport chapter in the Eighth Five-Year Plan; and some 18 comprehensive working papers coupled with workshops to discuss each of these; and
(iv) trained staff of OCMLT and concerned agencies who were involved as counterparts, or who received project-related training.

21. A list of key reports and working papers produced by this institutional support to OCMLT is presented in Appendix 2.

22. **Part C.** The appraisal report for the Project noted that Bangkok's pattern of urban development was inefficient, with development following roads and highways. The report also found that the system of urban planning and management was weak. The Project allocated almost $2.5 million of the loan funds for the preparation of a regional structure plan. NESDB was not comfortable with this loan amount, claiming during the OEM that ADB would not consider lowering it. For this reason, NESDB requested a grant from CIDA to fund 10 person-months of consultant services to do a strategic planning study. CIDA accepted this request. During loan negotiations, the Government canceled ADB's loan allocation for the component. However, only a small strategic study could be completed with the CIDA budget, not the intended feasibility studies.[20] The final report proposed a multicenter urban form for the Bangkok region with fast transport systems connecting these centers.

23. **Part D**. Training of OCMLT was provided very late, from March 1999 to September 2001. Following a program developed by the transport policy component of Part B, the training covered 1,100 students from 22 agencies. PWD did not pursue the opportunity to develop its own formal training using the ADB loan. However, PWD received some training through the training provided to OCMLT. The training was delivered through short courses. Ten Thai universities, DOH, and two Thai consulting firms delivered eight training courses, each 5–10 days long, on subjects relevant to urban transport, traffic engineering, and associated

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[19] Of the 33 identified conflict points, several involved the elevated railway and expressway project that Hopewell Holdings of Hong Kong, China proposed. This project was to comprise 57 kilometers of expressway and 60 kilometers of railway, but it did not proceed beyond the initial construction stage. Another conflict point, the 13-kilometer Klong Saen Saep Expressway, was canceled for environmental reasons. The Third Stage Expressway did not proceed at the time. Several projects also changed form quite substantially over time. Appendix 2 of the appraisal report describes key megaprojects as they existed in 1992.

[20] The feasibility studies were intended to identify and develop priority infrastructure projects, to be implemented by line agencies, with the aim of providing infrastructure on a timely basis to influence the creation of efficient urban development.

policy. Some of the training also was provided to transport staff working in regional cities. Two overseas technical visits were made by senior OCMLT staff to United States and Europe. Three visits to seminars and workshops in Bangkok were made by foreign experts. Memorandums of cooperation were signed with three leading US universities: Massachusetts Institute of Technology, University of Pennsylvania, and University of California. However, these remain largely inactive. Results of a questionnaire administered after the courses show that attendees viewed them favorably.

24. The TA to establish the environmental unit in PWD produced a thorough report weighing the alternatives. Detailed proposals were made regarding institutional arrangements of the unit, training of staff, and environmental management. The TA on distributor roads prepared a development plan of the study area, a feasibility study, and a list of prioritized subprojects.

C. Cost and Scheduling

25. The PCR estimated the completion cost at $148.52 million, with a foreign exchange component of $43.25 million (or 29.1%) and a local currency component of $105.27 million equivalent (or 70.9%). The cost underrun was $62.6 million, or almost 30% of the estimate. The costs of the project components at appraisal and project completion are summarized in Appendix 3.

26. The cost underrun as expressed in Thai baht was much less, however. The estimated civil works cost for the Thonburi road extension was B2,207.5 million. The contract price awarded was B1,491.8 million, or 65% of the original estimate. The relatively old design and cost estimate, combined with extremely competitive bids due to the lack of economic activity following the start of the 1997 Asian financial crisis, were the main reasons for this overestimate. The actual cost for the two packages was B1,580.4 million. The cost of land acquisition, which was estimated at B1,550 million at appraisal, was B2,254 million at project completion. The actual cost of consulting services for the road component was about 73% of the appraised cost.[21] Final expenditure on the road, at B3,657.4 million, was close to the appraisal estimate of B3,797.2 million. DOR does not consider this a cost underrun for this component. Large increases in land acquisition costs canceled out reduced civil works expenditures. Other project costs remained close to the appraisal estimates.[22]

27. Disbursements from ADB's loan totaled $30.3 million, or $40.0 million less than the $70.3 million available under the loan, due to six cancellations. The first two were the largest, totaling $31.5 million. MOF requested the cancellations on 29 August 1997 and 22 May 1998, respectively, due to the low contract amounts for the civil works and the depreciation of the baht in 1997. The final cancellation, on 14 January 2002, was for the undisbursed loan balance of about $3.9 million. The Public Debt Management Office viewed the unused loan amounts as savings, although it noted that the loan had to be repaid at a less favorable exchange rate than when the loan was signed. The savings were not viewed as a missed opportunity to access foreign currency funds, or to commit available ADB funds to another project.

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[21] Local consultants carried out these services, which were not paid from loan proceeds.

[22] The estimated and actual costs for institutional support to OCMLT were $10.80 million and $9.48 million, respectively. Payment for consulting services to provide training to OCMLT was disbursed from the training component instead of institutional support to OCMLT, thus reducing the actual cost. Estimated and actual costs for training were $2.50 million and $2.46 million, respectively.

28. The commitment charge on the loan was 0.75% per year, accrued during successive periods starting 60 days after the signing of the Loan Agreement on 28 July 1993, on (i) $10.55 million during the first year, (ii) $31.64 million during the second, (iii) $59.76 million during the third, and (iv) the full amount of the loan thereafter.[23] The RRP did not include a disbursement schedule, but the project duration was expected to be five years, a year longer than the period of the commitment charge schedule in the Loan Agreement. Given that disbursements started late, and parts of the loan were canceled beginning only in 1997, the Government paid about $1.8 million in commitment charges to ADB. If the loan of $70.30 million had been fully disbursed in four equal annual amounts, starting a year after the commitment charge commencement date of 26 September 1993, the charges would have been only $0.50 million (Table A4.1, Appendix 4). On the other hand, if the approved loan had been equal to the actual net loan amount of $30.30 million, the commitment charges would have been about $0.82 million, following the actual disbursements (Table A4.2, Appendix 4). In the hypothetical case of equal annual disbursements starting from the second project year onwards, the commitment charges would have totaled about $0.22 million (Table A4.3, Appendix 4). In all the alternative cases, the Government would have saved at least $1 million. Thus, the late start of disbursement and late loan cancellations were expensive in this sense. Additionally, the delayed disbursement pattern implied that the Government did not take advantage of 4–5 years of grace period.

D. Procurement and Construction

29. The procurement process for the road component encountered problems, causing a long delay. Civil works originally were to be bid in one contract package through international competitive bidding (ICB). Soon after loan approval, PWD sought ADB approval to split the civil works into two packages. As reasons for the request, PWD cited the increased competitiveness of bids with more potential bidders, and the positive effects on Thailand's mid-sized contractors. ADB approved this request on 27 October 1993, subject to PWD agreeing to two conditions: (i) the two contracts must be bid at the same time, and notices to proceed issued as soon as possible; and (ii) bidders, provided they were prequalified for both contracts, would be permitted to bid for both contract packages and to offer cross-contract discounts to secure both. The second condition reflected the considerable economies of scale that would obtain should one contractor execute both packages. Prequalification proceeded on this basis. ADB approved the prequalification evaluation on 22 June 1995. Of 55 applicants, 17 were prequalified. Concurrently with the prequalification exercise, ADB reviewed and approved the bidding documents, which contained the provision on cross-contract discounts. Since PWD had its own bidding procedures, considerable time was required. However, after ADB's approval of the bidding documents and before bids were invited, PWD removed the provision on cross-contract discounts without notifying ADB. ADB was informed later that potential bidders did not object to this during the pre-bid conference. The standard bid documents, nevertheless, retained the appendix stipulating that discounts could be offered. The bids were received on 26 September 1995. When they were opened, two bidders offered cross-contract discounts via a separate letter. One bidder would have won both contract packages had the cross-contract discount been considered, as the bidder offered the lowest overall price by $3 million. However, PWD recommended contract awards to two separate bidders on 25 January 1996. One of the bidders that offered cross-contract discounts complained in writing that it should have won. PWD then sought advice from Thailand's Judicial Council, which concurred that this type of discount should not be considered.

[23] When part of the loan was canceled, each portion of the loan would be reduced proportionally.

30. ADB reviewed the issue on 21 February 1996, taking into account that the cross-contract discounts were not offered in the appropriate appendix of the procurement documents. Rebidding would not have guaranteed that the price would be as low or lower. After studying the pertinent records, OEM considered the decision regarding PWD's recommendation appropriate. ADB approved PWD's request on 27 February 1996. The civil works contracts were signed on 14 March 1997 and notice to proceed given on 1 June 1997.

31. Recruitment of consultants was carried out in accordance with ADB's *Guidelines on the Use of Consultants.* The PCR rated the performance of the consultants who prepared the contract documentation for the civil works as partly satisfactory. The consultants were unfamiliar with the prequalification and bidding exercises contained in ADB's *Guidelines for Procurement*. Thus, the work to ensure that the documents were correct caused delays. The construction supervision consultants for Section 1 and Section 2 performed satisfactorily. ADB's loan did not fund these consultants. Overall, PWD had a smooth working relationship with the construction supervision consultants.

32. The consultants who provided institutional support to OCMLT varied by subcomponent. The OEM concluded all the subcomponent consultants performed satisfactorily.

33. Despite a start-up delay of almost a year, the training consultants performed their work satisfactorily. OCMLT told an ADB review mission in November 1999 that delays were caused by the concerned company having to select and contract 10 Thai universities.

34. The consultants for the TA to establish the environmental unit in PWD performed satisfactorily. The final report stated that such a unit would be crucial in implementing the environmental guidelines of the TA, and in building on the training it had provided.

35. The consultants for the TA to develop distributor roads performed satisfactorily. The TA outputs could be used to develop road networks in the northwest area of the project road. The final report of the TA (completed in September 1996) recommended a full road hierarchy on much of the western side of the Chao Praya river in the area between the river and surrounding the Outer Ring road.

E. Organization and Management

36. The project road and associated extensions represented a major task for PWD's Bridge Engineering Division, which was responsible for road construction. Even during the OEM, parts of the road extensions (not financed by ADB) were not completed. PWD did not establish a project management unit for the project. PWD assigned a senior project engineer, who was responsible for several projects, while a chief project engineer handled most of the day-to-day supervision. A committee made up of the heads of divisions within PWD supervised the engineers. Two PWD engineers supervised the project managers of the two construction supervision consultants. A construction supervision team included staff of the consultants and PWD counterparts, available part time for the Project. Due to the absence of management dedicated to specific projects, issues were not always dealt with in a timely manner when other projects in DOR required attention. This also affected coordination of the works on the two road sections. Project benefits would have increased if the second road section had become operational at the same time as the first. PWD's unsystematic approach to land acquisition and relocation contributed to further delays. However, the project management method increased the capacity of the Bridge Engineering Division. All key PWD staff involved with construction of

the road at the time worked with the new DOR in a similar capacity. Thus, experience and expertise have been retained.

37. OCMLT managed its consultants through four divisions, a method that generally worked satisfactorily. However, this might have contributed to the Urban Transport Database and Model Development (UTDM) contract starting late, and the transport planning and policy advice (TP3) starting 2 years too early. This affected the quality of latter's output. OCMLT maintained an informal Office of Megaprojects, which reported to a high-level executive with limited staff. In hindsight, a formal division of OCMLT would have maximized the institutional impact.

III. ACHIEVEMENT OF PROJECT PURPOSE

A. Operational Performance

38. **Road Construction for PWD.** The Thonburi road extension provides the missing link between Taksin road (and the main approach from the west to Taksin Bridge) and Phetkasem road. It also links to the new Kalpa Phruk road, which in turn is linked to the Western Outer Ring road. A detailed traffic count and associated traffic composition was not available for this project performance evaluation report (PPER) during the OEM. Using the most up-to-date transport model for Bangkok,[24] the PPER estimated that approximately 100,000 passenger car units (PCU) per day today use the through carriageways and service roads in the busiest section. The figure was later confirmed by the benefit monitoring and evaluation (BME) report of September 2005, which had conducted a survey on and around the road, and registered 107,471 PCUs on 21 June 2005. The BME report of 2005 noted that the average outbound travel speed during morning peak hour was 44 km, 3 km faster than predicted in the feasibility study of 1986, but inbound travel speed at 8 km much lower than the 19 predicted. Transport modeling confirmed that the road relieves nearby primary roads, including the major Wong Wien Yai junction, saving substantial vehicle-kilometers and vehicle-hours across a wide area of central Bangkok.

39. **Urban Transport Database and Model Development**. After UTDM completed its work in early 1996, OCMLT funded additional development of models and data on its own under three phases of the Transport Data Model Center. OCMLT's successor OTP has started a fourth phase. This OEM used the current version of the model, the Bangkok Extended City Model (BECM), to assess and quantify the benefits of the project road for the re-evaluation of its economic performance. OTP encourages the use of the model and database by all agencies and consultants in Bangkok for project development and evaluation. The model or close variants of it are used widely, and many government and private sector transport professionals in Bangkok have the skills to use it. The OEM interviewed consultants who stated that the Bangkok model is equal or better than transport models used in many major cities in developed countries and in other Asian countries. Additional details on UTDM and the development of Bangkok's new urban transport model are in Appendix 5.

40. **Megaprojects Technical Support (MTS)**. MTS within OTP has been instrumental in resolving conflicts and improving coordination between major infrastructure projects of different agencies. MTS's visualization of megaprojects at conflict points was a particularly valuable output. However, the duration of the support at 1.5 years was relatively short in terms of the needed capacity building. After contract completion in late 1995, the work was continued under

[24] The Bangkok Extended City Model, which is the latest version of the original model developed by UTDM.

a Government-funded contract using a local consultant as the lead firm. Although a different international firm provided support, it used the same expatriate project manager as before. Six locally funded phases of work on this subject (MTS 2–7) continued to 2003. In 2001, OTP used the same Thai firm with a Japanese firm to prepare the first Urban Rail Master Plan (URMAP1). This was finalized in 2002. Subsequently, OTP updated this using a local firm operating in house to create URMAP2, which recommended 296 kilometers of new urban rail network to be developed over 20 years. In late 2004, the Government announced plans to try to build this rail network within 5 years. The Bureau of Transport and Traffic Systems Development within OTP, which took over the functions of the informal Office of Megaprojects, is responsible for developing this network. The bureau is also responsible for the development of an agreed road plan for Bangkok. Overall, MTS along with TP3 helped institutionalize the OTP's master planning function. MTS also helped to create transport planning expertise among local consultants. Almost all of the megaprojects initiated at the time were completed, [25] and several conflict points between them were resolved or mitigated. The outcomes of MTS have to be seen in perspective: the new Government of 2002 reorganized the scattered transport agencies, which improved coordination within the transport sector in one strike.

41. **Transport Planning and Policy Advice**. TP3's work was limited to some extent by lack of access to the UTDM model at the start. Confusion over the needed outputs from the consultants also might have constrained TP3's work. The consultants interpreted the terms of reference as predominantly policy advice, while the Government preferred concrete project proposals. The preparation of the Eighth Plan Urban Transport Component (1997–2001), assisted by TP3, suffered from absence of the UTDM model.[26] Funds for implementation of some new megaprojects became unavailable due to the Asian financial crisis. TP3 produced many working papers and reports, some of which still have value for Bangkok and other cities. The final report of the study, while comprehensive with many recommendations, failed to address the key priorities in a way that Government decision makers could fully absorb. Although TP3 lasted for more than 3 years, a longer duration with lower density of outputs might have improved Government absorption.

42. **Training Services to OCMLT**. While the enduring value of this training could not be investigated easily, many of the OCMLT staff trained under the program are still working with its successor, OTP. Thai universities are using the materials developed under this contract as part of their own training. In FY2002, the Government allocated about $19,000 from its own budget for training with OTP. The training program could not be continued with Government funds. After the Government's organizational reforms of 1 October 2002, OTP's training bureau was disbanded. While the turnover of former OCMLT staff has been minimal in recent years, OTP absorbed the transport regional planning and inland waterways functions of the former Ministry of Transport and Communication. Training is needed to develop the absorbed staff, who do not have a background in urban transport planning. However, training can be provided only on an ad hoc basis under individual consultancies for feasibility and transport planning studies undertaken by OTP.

43. **Bangkok Regional Structure Plan**. The Bangkok Metropolitan Regional Structure Study did not achieve its intended objective of providing a better basis to align road development and urban land development. The study was not researched well enough, and was

[25] The Hopewell project was an exception. One of the megaprojects, the Southern Outer Ring Road, is now proceeding to construction, with ETA and DOH sharing the bridge crossing of the Chao Praya River.
[26] The contract for TP3 was completed in May 1998.

not complemented by detailed proposals in the relevant areas. This was partly due to the reduction of the budget for the study. At a higher level, the failure of the structure plan to seriously influence development was the result of the absence of a dominant planning agency in the city, combined with very strong private interests.

44. **TA on an Environmental Unit.** The PWD management was not motivated to establish a unit with responsibilities for implementing efficient and fair land acquisition and mitigating environmental impacts. At the time, PWD stated that the Ministry of Science Technology and Environment (MOSTE) already had a unit with the functions proposed by the TA. The Government, therefore, did not approve the establishment of the unit, although a Cabinet resolution on 9 July 1985 required that all Government agencies implementing projects in environmentally sensitive sectors set up their own units. Three environmental agencies (Pollution Control Department, Office of Environmental Policy and Planning, and Office of the National Environmental Board) reported to MOSTE[27] and to the National Environment Board. However, none was intended to do the necessary environmental planning, impact assessment, and mitigation works normally required by a line infrastructure agency. The DOH established an environmental unit around 1996 within the Section of Planning and Highways under the Planning Division. DOH also has formalized procedures for land acquisition and relocation, which complement national laws on the subject. PWD never established an environmental unit, even though such a unit would appear to have benefits in assisting with the mitigation of negative impacts of new bridge and road construction. While OEM concluded that DOR would benefit from having an environmental unit, DOR did not concur.[28]

45. **TA on a Distributor Road Development.** PWD did not act on the recommendations of the study. PWD proceeded to implement its trunk or primary roads. With one or two minor exceptions, however, PWD or the successor DOR did not build distributor roads in other parts of Bangkok. DOR staff, who were the counterparts for the ADB-funded Distributor Roads Study, commented that they did not proceed with the recommended road packages due to their low rates of return. However, almost all recommended packages had rates of return greater than 12%. The Asian financial crisis, which started in 1997, also might have influenced PWD's decision not to proceed with implementation at the time.

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[27] As part of major reforms of the public sector announced 1 October 2002, a new Ministry of Natural Resources and Environment was created to oversee environmental management. The National Environment Board continued as the high-level decision making body.

[28] Major reforms in the transport sector were announced on 1 October 2002, bringing all key transport agencies under the auspices of the new OTP. OTP reports to the Commission for Management of Land Transport, chaired by the Prime Minister, through the Minister of Transport. The former PWD also was restructured. Its Bridge Engineering Division, which executed the construction of the road component, was combined with the Accelerated Rural Development Office to create the new DOR, reporting to the Minister of Transport. DOR took over some responsibilities within Bangkok. Remaining sections of the PWD were combined with the Department of Town and Country Planning to create the new Department of Public Works and Town and Country Planning, which still reports to the Minister of Interior. These institutional changes, while strengthening the coordination of urban and national transport activities, had no identifiable positive or negative impact on DOR's ability to undertake road and bridge functions.

B. Performance of the Operating Entity

46. The PCR noted that PWD's maintenance of the road was an issue in 2002.[29] The OEM found that PWD's successor, DOR, had allocated a budget of B8 million (for FY2005) to maintain all 22.9 kilometers of new road construction, including Thonburi road. On a pro-rata basis, this means that the Government allocated a budget of B1.8 million for FY2005, which is more than the budget of B0.5 million in 2002 prices for annual routine maintenance the PCR assumed to be needed in its economic reevaluation. However, the PCR also noted that significant periodic maintenance (B23 million in 2002 prices) should be planned for every 5 years. DOR did not provide the OEM with answers to questions about budgeting for periodic maintenance. DOR's annual routine maintenance budget, while adequate overall, might be spent largely addressing problems with construction quality of the southwestern extension (Kanchanapisek road) financed by the Government, although it is under warranty until June 2005. Some of this budget also might be used to rectify minor problems with signage and lighting along all new roads. Unlike DOH, DOR does not use a comprehensive operational road maintenance and management system (RMMS) for its roads in the country to determine future periodic maintenance and rehabilitation works. The OEM, which regards the use of such a system as beneficial, was informed that an RMMS recently had been developed. DOR maintains some 36,000 kilometers of road throughout Thailand.

47. The PCR Mission asked PWD to undertake the required follow-up surveys on environmental and social impacts of the Project by the end of September 2002 and December 2002, respectively, to ensure that the necessary measures would be taken to mitigate any adverse impacts. The Government furnished a BME report to this effect, which the OEM found inadequate.[30] In accordance with the Loan Agreement, DOR commissioned a consultant in April 2005 to prepare the last required BME report for the Project. Completed in September 2005, this BME covered (i) traffic counts; (ii) measures of air and noise emissions; (iv) changes in development and accidents in and around the road; (v) survey of 100 households within 100 meters of the road to assess associated socioeconomic impact; and (vi) a survey of 50 households that were relocated due to road construction.

C. Economic Reevaluation

48. The Project's reestimated EIRR is in Appendix 6. In the appraisal report and the PCR, the benefits were calculated over 25 years. The benefits—vehicle operating costs (VOC) and time savings—were held constant at 2010 and after when traffic usage of the project road will be close to capacity. The reestimated project road EIRR is 28%, compared with 20% in the PCR, 21% in the BME report of 2005, and 45% in the appraisal report. The PCR's EIRR was not based on a transport model, and the BME report was based on the PCR's methodology, which does not take into account the effect on traffic flows all over Bangkok. As such, the reestimated EIRR is more comparable to that calculated at appraisal, which used a transport model. The differences between the EIRR at appraisal and completion are due to (i) revised

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[29] A covenant with respect to maintenance was included in the loan agreement. The PCR stated that the budget for operation and maintenance of the project road was not allocated to PWD in fiscal year 2000. However, there was a two-year warranty period in which the contractors had to maintain the road. Section 1 was completed 10 May 2000 and Section 2 on 11 March 2001.The PCR stated that the budget for the maintenance works was also not allocated to PWD in fiscal year 2002 (starting October 1, 2001). Thus, the short period of the financial year for Section 1 after the warranty period had expired was not covered by a dedicated maintenance budget.

[30] The September 2002 BME report included a table on attitudes of existing people living in the area, which seemed to indicate no serious environmental issues. Traffic forecasts were taken from the 1986 feasibility study.

economic costs derived from actual costs; (ii) delays in implementation, which delayed the start of the benefit stream; (iii) higher estimates of passenger car unit-hour (PCU-hr) reduction;[31] and (iv) slightly lower values of economic parameters, as well as different estimated levels of reductions in vehicle kilometers and vehicle hours. Table A6.5 in Appendix 6, which compares principal input parameters, shows that this PPER uses lower values of VOC (in constant prices) and travel time than the PCR and the appraisal report.

49. An additional benefit that has not been quantified is that a large stretch of the recently constructed elevated structure to carry the western extension of the elevated railway, known as Skytrain, was built within the acquired right of way of the project road. BMA, the Skytrain project owner, incurred no cost for this land. Since the land does not have any practical alternative use, the opportunity cost is regarded as zero.

D. Sustainability

50. The warranty period for the two sections of the project road has passed, meaning DOR must fund routine maintenance from the normal Government budget process. Maintenance budgets, which are handed down year by year, have been sufficient recently for the roads in Bangkok. DOR is not certain to receive the higher budget allocation for periodic maintenance of the Thonburi road extension, which might be needed every 5 years or so. Overall, DOR is short of maintenance funds for its huge road network in Thailand. Adopting an RMMS would strengthen DOR's ability to persuade the Budget Bureau to commit maintenance budgets for 2–3 years. However, DOR has opted to implement a project establishing a geographic information system for its road network. This system intends to incorporate options to assist with the allocation of the road maintenance budget.

51. The 2002 reforms of the transport sector strengthened OTP's sector coordination capacity. OCMLT and later OTP continually improved the UTDM model, and the current BECM model is widely used. Other institutional support to OCMLT might have had fewer lasting effects. Nevertheless, as OCMLT staff appear to have low turnover, the new OTP continues to benefit from these trained and experienced staff.

IV. ACHIEVEMENT OF OTHER DEVELOPMENT IMPACTS

A. Socioeconomic Impact

52. The OEM concluded that the resettlement process needed for the construction of the road, by and large, has taken place without major incident. Relocation, which encountered no organized opposition, did not require any forced evictions or squatter settlement after clearance of the site. Due to the absence of a final report on the resettlement process, the only information available on the present situation of the families that were resettled, their housing and economic status, is in the 2005 BME report. This is based on a survey of 50 relocated households, some of whom within the area around the road. Although the information is patchy, the main conclusion is that the relocation has not improved the lives of the relocated people, with increased travel distances to work and separation from relatives, but has not had a serious negative impact either. For the people living around the project road, the more convenient travel

[31] The estimates of PCU-hr reduction made at appraisal are 28.8% of that made for this PPER. As the current transport model is superior to that used at appraisal, its estimate of PCU-hrs reduction is considered robust.

opportunities were noted, but income had not changed and noise and dust pollution had risen. More details on the relocation process and the effects are in Appendix 7.

53. Recommendations of the ADB-funded summary EIA, which provided input to the project design, reduced adverse social impacts in two key ways. They improved PWD's handling of the relocation process, and limited the environmental impact of the road when operational on neighboring communities through installation of appropriate mitigation measures.

54. Time savings constitute the equivalent of 94% of the benefits of the road. Bus passengers[32] in central Bangkok received 45% of the estimated time savings that accrued to occupants of all vehicles. Lower-income groups and the poor, on average, account for a larger proportion of bus passengers than car drivers or car passengers. The UTDM database shows that bus passengers value time for travel decisions on average about 50% lower than car drivers and passengers. This suggests that their incomes are on average less than half of car drivers. Savings in travel times for bus passengers are likely to benefit them by providing greater opportunity to access employment opportunities and activities of personal importance.

55. As cities grow and expand, traffic speeds tend to remain stable with moderate to high congestion in the central area. However, the congestion spreads outward geographically and temporally to the off-peak periods, including weekends. The transport modeling undertaken by the PPER shows that benefits of the project road are experienced by the area in the vicinity of the project road, as well as in Bangkok's central area. The project road is expected to have an ongoing positive benefit on Bangkok's traffic, as described in Appendix 8.

56. The Project road increased network vehicle speeds in Bangkok slightly, though not to the extent that would change the number or type of accidents (Appendix 9, para. 23).[33]

B. Environmental Impact

57. The securing a new dedicated right–of-way for the new road construction reduced the negative environmental impacts during construction. Traffic disruptions were negligible, thus limiting the impact on traffic and resultant air and noise pollution and accidents. Several small slums and other housing developments adjacent to the road right-of-way might have been adversely affected during construction and afterwards. However, as the BMA's Thonburi District Office staff stressed, they also benefited from improved travel on the road. Property owners have seen land values rise due to enhanced accessibility. The surveys in the 2002 and 2005 BME reports indicated a modest degree of annoyance with noise and dust effects from the road. The 2005 BME report noted that pollution effects of the road remained well within the admissible limits; noise effects for instance upon schools nearby the road surpassed the limits (70 decibels) occasionally.

58. Aerial photographs taken in 1996 and 2002 (the most recent series) show little difference in the extent of urban development in 2005 in the Thonburi road extension area compared with 1996. This can be attributed in part to the fact that the project road was not completed until 2001. The land use effects of road construction, and the technical support to OTP and NESDB, still might not have materialized fully. Other sections of Rajapreuk road were completed only

[32] Of every 100 vehicles on the roads that benefit from the project road, 45% of the persons in them are estimated to be bus passengers.
[33] Higher speeds tend to mean a greater likelihood of accidents and a greater occurrence of fatality and injury.

recently. Moreover, ADB's interventions were overshadowed by the 1997 Asian financial crisis, which put newly proposed megaprojects on hold and slowed new development. Residential areas within 500 meter of the road decreased from 58.3% in 1996 to 54.6% in 2005, green area decreased from 10.8% to 8.7%, and commercial area increased from 9.4% to 10.1%.

59. The project road and the associated primary roads that were completed recently can be expected to accelerate the rate of urbanization of western Bangkok (Appendix 8). Development of the road opened up land less than 10 kilometers from the river that had been relatively inaccessible. This land is suitable for more intense urban residential development. Future super blocks might develop on the western side of the river, with local traffic congestion on the roads, due to the failure of (i) PWD to pursue distributor road development; and (ii) BMA, which has the responsibility for non-primary road construction, to build sufficient distributor and local roads. However, having these super blocks close to Bangkok, near a network of primary roads, is arguably better than in more distant locations served by a single highway, which has been the norm.

60. The in-use vehicle fleet has been growing at 5.5% per year from 1994 to 2003 (Appendix 9). Estimates of future growth are currently revised upwards. Despite this growth in vehicle use, the available data on ambient pollution in Bangkok, as comprehensively monitored by Thailand's Pollution Control Department, shows that the concentration of key pollutants generally has remained stable or has declined from 1996 to 2005. The Government's stringent measures to limit emissions from new vehicles are responsible for this. However, a recent pickup in economic activity might cause pollution to rise again in step with sharper increases in vehicle growth, associated congestion, and expanded industrial activity. The project road would reduce emissions by a small amount through its contribution to the overall increase in vehicle speeds.

C. Impact on Institutions and Policy

61. Despite its inadequate performance, particularly in the early years of the Project, PWD completed the road project to a satisfactory standard. In addition, PWD's capacity was enhanced. Responsibility for PWD's Bridge Engineering Division was transferred to DOR, with minimal consequences for staff. Most of the PWD staff involved at the time are still in DOR. Transfer of Government staff, or brain drain of engineers to the private sector, seem to be less of an issue than in many other countries in Asia.

62. The impact on the class of medium-sized contractors in Thailand—a justification for using two contract packages rather than one—was minimal. The largest Thai contractor was selected for one section of the road, while a joint venture led by a company from the Republic of Korea was chosen for the other. Since the outturn quality of the Government-funded and locally bid portion, implemented by local contractors, was lower than the internationally bid ADB- and JBIC-funded portions, DOR now uses ICB for all primary road projects.

63. The Project's institutional support has continued with Government funding, and all project functions have been mainstreamed within the OTP structure. Since October 2002, when the new Government consolidated under the Ministry of Transport all key relevant transport agencies (except BMA and the police, which report to the Ministry of Interior), OTP has played a more significant coordinating role within the transport sector. This generally has improved coordination in the sector.

V. OVERALL ASSESSMENT

A. Relevance

64. The Project is assessed as relevant to the Government's and ADB's strategy at the time. Institutional, planning, and training components were relevant to the Government's efforts to address traffic issues, planning, and coordination issues, particularly in the early and mid-1990s. In retrospect, PWD was not the most suitable executing agency as it has no other road construction or maintenance responsibilities within Bangkok. Similarly, its successor, DOR, is not the logical agency for creating or maintaining major roads in the Bangkok area. DOH or BMA, which have much larger responsibility for roads in Bangkok, would have been more suitable.

B. Efficacy

65. The constructed road is assessed as highly efficacious. It is good quality, has good utilization, and few negative impacts. The transport model component similarly is assessed as highly efficacious. The components of transport planning, megaprojects coordination, and training were useful. However, while they served their immediate purposes, they could have had bigger, more catalytic impacts with more involvement of OCMLT and ADB. They are assessed as efficacious. Overall, the Project is assessed as highly efficacious.

C. Efficiency

66. The road component has an EIRR of 28%, indicating high efficiency of investment. However, the efficiency of process could have been even better. Inefficiencies were evident in land acquisition, procurement, and construction, which delayed implementation and prevented the Project from achieving an even higher EIRR. These inefficiencies also caused loan funds to be committed for longer than necessary, and higher commitment charges for the Government. While the transport model component was efficient, delays in the planning and training components made them less so. The MTS was regarded as less efficient in terms of capacity building due to its short duration and position in an informal office, rather than a more structural unit in OCMLT. Overall, due to the weight of the road component and the high EIRR, the Project is assessed as highly efficient.

D. Sustainability

67. Although medium- and long-term maintenance planning for the road is somewhat lacking, the road component is assessed as sustainable given the Government's growing financial resources. The effects of the transport modeling component and the megaproject coordination component are assessed as highly sustainable. The reforms in the transport sector in 2002, which created new roles for various agencies, have reduced the utility of the transport planning outputs. As such, these are assessed as less sustainable. The effects of the training are assumed to be sustainable since staff transfers in the transport sector in Thailand seem to be fairly limited. Overall, the Project is assessed as sustainable.

E. Institutional Development and Other Impacts

68. The road had some impact on poverty reduction, while also lowering significantly the potential cost of the Bangkok Skytrain expansion. The transport modeling component, the megaprojects office, and TP3 had substantial impacts beyond those on OTP or the transport

sector at the time. These included informing public discussion on transport alternatives and business decisions. Overall, the Project is assessed as having had significant other impacts.

F. Overall Project Rating

69. Giving due weight to the project costs per component, the overall rating of the Project is highly successful, upgrading the rating given by the PCR. The rating is based on weighing the five ratings discussed in the previous section by the dollar cost incurred per component.[34]

70. The two attached TAs are rated as unsuccessful, even though both were assessed as highly relevant and the quality of the consultants' outputs was satisfactory. The ratings are based on the fact that (i) the environmental unit was not created in PWD, and does not exist today in its successor, DOR; and (ii) neither BMA nor DOR has implemented any of the TA's proposals on distributor roads.

G. Assessment of Asian Development Bank and Borrower Performance

71. PWD's performance is rated as satisfactory, if marginally so. The relocation process, by and large, was managed adequately. Once construction started, PWD's supervision was adequate and the attention paid by contractors to mandatory testing contributed to the good quality of the road. However, PWD did not prioritize the road in the early years and lacked a systematic approach to land acquisition. PWD inadvertently delayed the Project by deciding to adopt a two-package approach to construction after agreeing to one contract package. Further delays resulted when PWD prohibited cross-contract discounts after initially adopting ADB's recommendation to allow them. In retrospect, both decisions did not produce the benefits expected. Environmental and social impact reports due at the end of 2002 were not submitted on time, and their quality was inadequate.

72. OCMLT's performance is rated as satisfactory. It worked closely with the consultants, attempted to make use of the many outputs produced by the Project, and often was able to obtain Government funding for their follow-up. The failure of OCMLT to contract the UTDM consultants before TP3 reduced the latter's effectiveness (para. 40).

73. ADB's performance is rated as satisfactory. Its preparation of the Project was thorough. ADB added considerable value to the completed road designs through (i) their upgrading to meet international standards for bridge and road engineering design, (ii) environmental mitigation measures, and (iii) the requirement for a relocation plan. ADB's project administration focused on implementing the road construction component. ADB's review missions were helpful in speeding up implementation. ADB thoroughly and appropriately reviewed the proposals made by PWD for first splitting the road contract into two packages, and the subsequent award of the contracts. Resettlement issues received far too little attention, although this might have been partly because ADB approved its resettlement policy in 1995[35] after most of the resettlement process had taken place. The institutional components of the Project also received less than optimal attention. While the RRP regarded the planning component as central to the Project, ADB did not visit NESDB after project approval and the shift to financing by CIDA. ADB did not communicate with OCMLT very often, although more than $10 million was invested in various

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[34] This weighing has the advantage of being transparent, although the real impact of a small component might not always be commensurate with the cost incurred, and might depend on other components.

[35] ADB. 1995. *Involuntary Resettlement*. Manila.

consulting services. ADB did not assign sufficient project administration staff to the Project to add significant value beyond the procurement and construction process.

VI. ISSUES, LESSONS, AND FOLLOW-UP ACTIONS

A. Key Issues for the Future

74. DOR does not have a systematic approach to environmental management, land acquisition, and resettlement. This is probably in part a result of their mixed mandate to cover rural as well as some urban areas, and both small and some very large roads.

75. Maintenance budgets are not allocated to individual roads on an annual basis. Rather, funds are applied to address problems as they occur. DOR's use of an RMMS, such as the one developed recently by Chulalongkorn University, would lower routine and periodic maintenance costs due to timely and appropriate intervention.

76. Agencies operating in Bangkok are more focused on primary roads than secondary and distributor roads. The problem of super blocks has remained, increasing traffic congestion. The large number of agencies that still are responsible for road construction and management compounds the problem and increases the focus on large projects. Constrained by a lack of funds, BMA's attempts are confined to addressing missing links, such as connecting two *sois* (backstreets). BMA has a plan to create minor roads over the next 20 years, though its budget for new road construction in FY2005 is only B238 million.

77. BMA's ability to manage land use and development, while improving, is still weak. The former Department of Town and Country Planning prepared the first Bangkok City Plan (Zoning Plan), which was published in 1992. This was handed over to BMA, which created a new division to administer the plan. Updated in 1997, the plan has been extended from 2002 until 2006, when a new BMA zoning plan will be enforced. Although BMA now has a Department of City Planning, the plan has had little impact in practice on the type of developments in each of BMA's 13 zones. BMA can impose controls on individual buildings in terms of (i) set backs along specified roads and within specified areas, (ii) gross floor area and proportion of a site to be occupied, and (iii) parking requirements. A drawback is that BMA does not approve subdivisions.[36] The Department of Lands, which also administers a system of annual land tax, handles subdivision approvals. Other Government agencies have a significant influence on the direction and pace of development through major road building and other infrastructure provision. Thus far, the BMA City Plan has seemed to follow, rather than guide, developments and plans of other agencies.

78. The Government has not made much headway in tapping some of the considerable wealth created by public investments in new or upgraded public roads and other transport facilities, which have increased the value of nearby privately owned land.

B. Lessons Identified

79. Projects that mix infrastructure investments for certain agencies with large institutional development components for other agencies would work better if ADB were to devote sufficient staff resources to project administration. One of the risks is that administration will focus on the

[36] Divisions of land parcels for housing or other urban development.

direct and pressing problems of procurement and construction supervision. Resettlement and capacity building components need specialized support from ADB to optimize their effects.

80. Legal action by households affected by a project should be avoided as much as possible by engaging those households in resettlement planning early, and by determining the compensation and relocation options.

81. Urban highway investments focusing on missing links can help create opportunities, thereby reducing poverty by saving time for bus passengers in the city. They are a suitable investment category for ADB, provided specific attention is paid to the poverty reduction aspect. The size of the effect depends on the number of buses and vans relative to the total number of vehicles on the road. Equally important are bus ticket prices and the number of poor people traveling by bus.

82. The potential adverse effects of new roads on environment and traffic accidents are less dependent on road expansion per se than on specific measures taken to mitigate these effects (para. 50 and Appendix 9).

83. To optimize the benefits of projects, primary road construction in urban areas must be assessed carefully in the context of needed supporting distributor roads and comprehensive land use management.

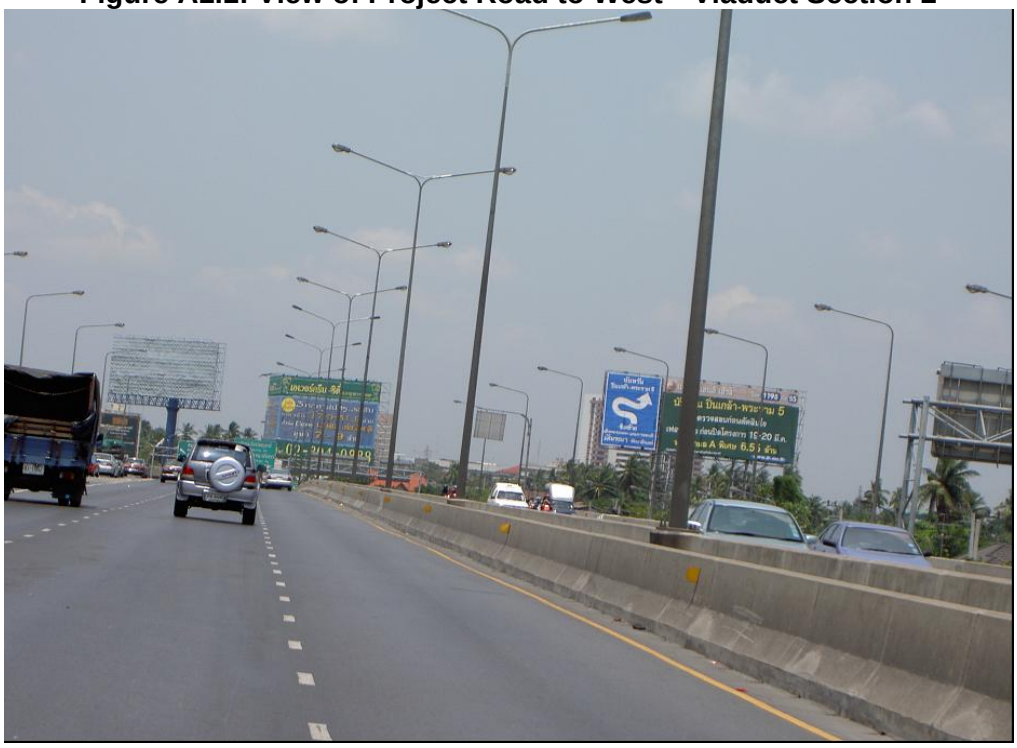
84. Projects with a large advisory component should space the advice carefully to enable the Government to absorb the outputs at its own pace. When advice on various issues is clustered, the risk that some will not be acted upon increases, especially if the relevant Government agency is small.

C. Follow-Up Actions

85. There are no follow-up actions required.

PHOTOS

Figure A1.1: View of Project Road to West—Viaduct Section 2



Source: Operations Evaluation Mission, April 2005.

Figure A1.2: View of Project Road to West—Viaduct Section 2

Source: Operations Evaluation Mission, April 2005.

LIST OF DOCUMENT OUTPUTS OF THE COMPONENTS DEALING WITH TRANSPORT PLANNING AND MEGAPROJECTS SUPPORT

Consultant's Services for Megaprojects, Technical Support to OCMRT Bangkok Urban Transport Project, completed May 1995

1. Final Report, May 1995
2. Sectorial Report No. 1, Megaproject Integration, June 1995
3. Sectorial Report No. 2, Land Use and Development, June 1995
4. Sectorial Report No. 3 Environmental Mitigation, June 1995

UTDM, by MVA Consultants, Comsis, and Asian Engineering Consultants Corp Ltd, for OCMLT, completed March 1996

1. WP D1 Review of Existing Demographic and Planning Data
2. WP M3 Software Recommendation
3. WP D3 Brief Explanation of the Survey Programme
4. WP D5 Base Year Demographic and Planning Data
5. WP M1 Review of Existing Models
6. WP D5 Bangkok's Mid 1995 Population
7. WP M3 Software Recommendation (Revised)
8. WP M3 Software Recommendation (Revision 2)
9. WP M2Framework of Transport Models
10. WP D7 Demographic Projections 2001 and 2011
11. WP D2 Agency Interviews – Data Review
12. WP T1 Selection of Traffic Engineering Software
13. WP T2(A) Demonstration of Traffic Management Models A-Bangkapi Local Area Model
14. WP M4 BMR ECM Model Development and Validation
15. WP M4 BMR ECM Model Development and Validation (Revised)
16. WP T2 Demonstration of Local Area Models
17. WP M5 Validation of Korat ECM
18. WP M5-1 Validation of National Model (NAM)
19. TM1 Selection of Second City (Revised)
20. TM2 Travel Time Surveys
21. TM3 Mid Block Traffic Counts (Revised)
22. TM4 BMR ECM Base And Future Year External Trip Matrices
23. TM5 Bus Occupancy Surveys (Revised)
24. TM7 Turning Movement Counts (Revised)
25. TM10 Home Interview Survey (Revised)
26. TM11 Development of Model Trip Rates
27. TM12 Summary Description of UTDM Document
28. TM13 Technical Addendum-Database and Models
29. Final Report, March 1996

Transport Planning & Policy Project, by Dorsch Consult, Louis Berger International, Epsilon, Tesco, MVA Asia, and Sofretu, for OCMLT, completed May 1996

Intermediate Reports

1. Inception Report (June 1998)
2. Immediate Action Plan Report (January 1996)
3. Report on 8th Plan Transport Components (June 1996)
4. Report on Long Term Transport Strategy (October 1997)
5. Final Report May 1998
6. Completion Report, April 1998

Working Papers

1. WP1: Institutional Arrangements
2. WP2: Status of 7th Plan Components
3. WP3: 7th Plan Environmental Achievements
4. WP4: Traffic Management in Bangkok
5. WP5: Public Transport in Bangkok
6. WP6: Land Use Controls
7. WP7: Regional Cities
8. WP8: Review of Traffic Action Plan
9. WP9: Project Evaluation
10. WP10: Funding Options
11. WP11: Thailand's Freight Transport System
12. WP12: Evaluation of Highway Projects in the BMR
13. WP13: Review of Economic and Population Projections
14. WP14: Traffic Restraint and the Role of Public Transport
15. WP15: Proposals for High Occupancy Vehicles
16. WP16: Three Busway Proposals for Bangkok
17. WP17: Traffic and Transport in Singapore and Hong Kong, China
18. WP18: Background Papers for the Training Component

Provision of Training Services to OCMLT: Final Report, Prepared by Dorsch Consult, completed September 2001

1. Completion Report, September 2001

Distributor Road Study Thailand (TA 1793), for PWD, completed September 1996

1. Final Report (Volume 1: Main Report & Volume II, Annexes). Prepared by Trans-Asia Engineering Associates Inc, Epsilon in association with Sindhu Pike Bodell and Sindhu Maunsell, September 1996

Establishment of an Environmental Unit in the Public Works Department, Thailand (TA 1792), completed September 1995

1. Final Report (Volume 1: Main Report & Volume II, Annexes). Prepared by Seatech International Co. Ltd., September 1995

Construction Supervision of the Thonburi road extension Project, Section II, Ratchadapisek – Phetkasem, for PWD, completed June 2001

1. Final Report, Submitted by Epsilon Co. Ltd., Universal Engineering Consultants Co. Ltd., June 2001

Construction Supervision of the Thonburi road extension Project, Section I, Taskin – Ratchadapisek, completed July 2001

1. Final Report, Submitted by MAA Consultants Co. Ltd. and SEA Consult Engineering Co. Ltd., July 2001

Chao Phraya Multipolis Structure Plan (Metropolitan Regional Structure Plan Study), completed May 1995

1. Final Report, May 1995. Prepared by Lehman Group Inc., UMA Engineering Ltd., Wilbur Smith Associates, Team Consulting Engineers Co. Ltd. and TA and E Consultants Co. Ltd.

Study and Analysis and Solutions for Solving Environmental Problems and Managing Relocation Due to Construction Project Taksin to Phetkasem Rd, December 1993

1. Report on Progress with Relocation; Analysis of Social Impacts & Appendix. Prepared by Team Consultants. (Thai language; English language summary)

BMR = Bangkok Metropolitan Region, Co. = company, ECM = Extended City Model, Inc. = Incorporated, Ltd. = Limited, MVA, OCMLT = Office of the Commission for the Management of Land Traffic, OCMRT = Office of the Commission for the Management of Road Traffic, PWD = Public Works Department, TA = technical assistance, UTDM = Urban Transport Database and Model Development Project, WP = working paper.

ESTIMATED AND ACTUAL COST
($ million)

Project Components	Appraisal			Actual		
	Foreign Exchange	Local Currency	Total	Foreign Exchange	Local Currency	Total
A. Thonburi Road Extension						
1. Civil Works	62.5	25.8	88.3	29.4	12.8	42.3
2. Land Acquisition	0.0	62.2	62.2	0.0	86.8	86.8
3. Consultant Services for Construction Supervision	0.0	3.4	3.4	0.0	2.7	2.7
4. Consultant Services for Environmental and Social Impact Activities	0.0	0.3	0.3	0.0	0.0	0.0
5. Contingencies						
Physical	6.2	5.8	12.0	0.0	0.0	0.0
Price Escalation	9.5	11.1	20.6	0.0	0.0	0.0
Subtotal	**78.2**	**108.6**	**186.8**	**29.4**	**102.3**	**131.7**
B. Institutional Support for OCMLT	**8.0**	**2.8**	**10.8**	**6.5**	**3.0**	**9.5**
C. Bangkok Regional Structure Plan	**1.5**	**0.9**	**2.4**	**—**[a]	**—**[a]	**—**[a]
D. Training	**2.0**	**0.5**	**2.5**	**2.5**	**0.0**	**2.5**[b]
E. Interest during Construction	**8.7**		**8.7**	**4.9**	**0.0**	**4.9**
Total	**98.4**	**112.8**	**211.2**	**43.3**	**105.3**	**148.5**

— = not available, OCMLT = Office of the Commission for the Management of Land Traffic.

[a] The Canadian International Development Agency (CIDA) financed this component, and information on actual project costs could not be obtained from CIDA headquarters.

[b] The consulting services for the training programs for OCMLT, which were supposed to be disbursed from the institutional support to OCMLT component, were disbursed from the training component.

Source: Asian Development Bank estimates.

COMMITMENT CHARGES

Table A4.1: Computation of Commitment Charges - Case 1

Assumption: The loan was disbursed in four equal amounts starting year 2.

LN1195-THA		Staggered Commitment Charge:	%	Amount
Loan Amount	70,300,000.00	26-Sep-93	15%	10,545,000.00
Signing date	28-Jul-93	26-Sep-94	30%	21,090,000.00
Commitment Charges commencement	26-Sep-93	26-Sep-95	40%	28,120,000.00
Effective Date	23-Dec-93	26-Sep-96	15%	10,545,000.00
LSP: 1 Jun/1 Dec			100%	70,300,000.00

		Undisbursed Balance for LSP			
Transaction	**Value date**	**NOT Subject to CC**	**Subject to CC**	**No. of days**	**Commitment Charge (CC)**
Loan Effectiveness	23-Dec-93	59,755,000.00	10,545,000.00		
Accrual - effective	26-Sep-93 to 31-May-94			245	53,823.44
Balance	01-Jun-94	59,755,000.00	10,545,000.00		
Accrual - focal	1-Jun-94 to 30-Nov-94			180	39,543.75
Transfer subject to CC (30%)	26-Sep-94	(21,090,000.00)	21,090,000.00	65	28,559.38
Disbursement	26-Sep-94		(17,575,000.00)	65	(23,799.48)
Balance	01-Dec-94	38,665,000.00	14,060,000.00		
Accrual - focal	1-Dec-94 to 30-Nov-95			360	105,450.00
Transfer subject to CC (40%)	26-Sep-95	(28,120,000.00)	28,120,000.00	65	38,079.17
Disbursement	26-Sep-95		(17,575,000.00)	65	(23,799.48)
Balance	01-Dec-95	10,545,000.00	24,605,000.00		
Accrual - focal	1-Dec-95 to 30-Nov-96			360	184,537.50
Transfer subject to CC (15%)	26-Sep-96	(10,545,000.00)	10,545,000.00	65	14,279.69
Disbursement	26-Sep-96		(17,575,000.00)	65	(23,799.48)
Balance	01-Dec-96	—	17,575,000.00		
Accrual - focal	1 Dec 96 to 30 Nov 97			360	131,812.50
Disbursement	26-Sep-97		(17,575,000.00)	65	(23,799.48)
Balance	01-Dec-97	—	—		500,887.50

— = not available, LSP = loan service payment, no. = number.

Source: Controller's Department.

Table A4.2: Computation of Commitment Charges - Case 2

Assumption: The approved loan amount was equal to the net loan amount. The loan followed the actual disbursement schedule.

LN1195-THA		Staggered Commitment Charge:	%	Amount
Loan Amount	30,329,381.72	26-Sep-93	15%	4,549,407.26
Signing date	28-Jul-93	26-Sep-94	30%	9,098,814.52
CC commencement	26-Sep-93	26-Sep-95	40%	12,131,752.69
Effective Date	23-Dec-93	26-Sep-96	15%	4,549,407.26
LSP: 1 Jun/1 Dec			100%	30,329,381.72

		Undisbursed Balance for LSP			
Transaction	**Value date**	**NOT Subject to CC**	**Subject to CC**	**No. of days**	**Commitment Charge (CC)**
Loan Effectiveness	23-Dec-93	25,779,974.46	4,549,407.26		
Accrual - effective	26-Sep-93 to 31-May-94			245	23,220.93
Balance	01-Jun-94	25,779,974.46	4,549,407.26		
Accrual - focal	01-Jun-94 to 30-Nov-94			180	17,060.28
Disbursement	24-Aug-04 to 30-Aug-04		(257,283.47)	97	(204.84)
Transfer subject to CC (30%)	26-Sep-94	(9,098,814.52)	9,098,814.52	65	12,321.31
Disbursement	05-Oct-94 to 27-Oct-94		(204,315.48)	56	(41.87)
Balance	01-Dec-94	16,681,159.95	13,186,622.82		
Accrual - focal	01-Dec-94 to 31-May-95			180	49,449.84
Disbursement	17-Jan-95 to 30-May-95		(424,584.46)	134	(366.56)
Balance	01-Jun-95	16,681,159.95	12,762,038.36		
Accrual - focal	01-Jun-95 to 30-Nov-95			180	47,857.64
Disbursement	01-Jun-95 to 31-Aug-95		(663,376.92)	180	(299.08)
Transfer subject to CC (40%)	26-Sep-95	(12,131,752.69)	12,131,752.69	65	16,428.42
Disbursement	24-Oct-95 to 30-Nov-95		(316,709.41)	37	(169.94)
Balance	01-Dec-95	4,549,407.26	23,913,704.72		
Accrual - focal	01-Dec-95 to 31-May-96			180	89,676.39
Disbursement	22-Dec-95 to15-May-96		(873,648.75)	159	(109.39)
Balance	01-Jun-96	4,549,407.26	23,040,055.97		
Accrual - focal	01-Jun-96 to 30-Nov-96			180	86,400.21
Disbursement	27-Jun-96 to 26-Sep-96		(729,233.17)	154	(36.32)
Transfer subject to CC (15%)	26-Sep-96	(4,549,407.26)	4,549,407.26	65	6,160.66
Disbursement	15-Oct-96 to 16-Oct-96		(638,465.90)	46	(100.71)
Balance	01-Dec-96	—	26,221,764.16		
Accrual - focal	01-Dec-96 to 31-May-97			180	98,331.62
Disbursement	06-Dec-96 to 15-May-97		(1,003,431.26)	175	(891.86)
Balance	01-Jun-97	—	25,218,332.90		
Accrual - focal	01-Jun-97 to 30-Nov-97			180	94,568.75
Disbursement	17-Jun-97 to 07-Oct-97		(5,391,413.09)	164	(1,051.07)
Balance	01-Dec-97	—	19,826,919.81		

Transaction	Value Date	Undisbursed Balance for LSP		No. of days	Commitment Charge (CC)
		NOT Subject to CC	Subject to CC		
Accrual - focal	01-Dec-97 to 31-May-98			180	74,350.95
Disbursement	08-Dec-97 to 27-May-98		(1,950,707.47)	173	(122.90)
Balance	01-Jun-98	—	17,876,212.34		
Accrual - focal	01-Jun-98 to 30-Nov-98			180	67,035.80
Disbursement	11-Jun-98 to 16-Nov-98		(2,228,627.85)	170	(237.38)
Balance	01-Dec-98	—	15,647,584.49		
Accrual - focal	01-Dec-98 to 31-May-99			180	58,678.44
Disbursement	09-Dec-98 to 14-May-99		(2,500,019.84)	172	(1,075.46)
Balance	01-Jun-99	—	13,147,564.65		
Accrual - focal	01-Jun-99 to 30-Nov-99			180	49,303.37
Disbursement	16-Jun-99 to 22-Nov-99		(3,494,083.51)	165	(306.76)
Balance	01-Dec-99	—	9,653,481.14		
Accrual - focal	01-Dec-99 to 31-May-00			180	36,200.55
Disbursement	03-Dec-99 to 22-May-00		(3,166,754.85)	178	(934.39)
Balance	01-Jun-00	—	6,486,726.29		
Accrual - focal	01-Jun-00 to 30-Nov-00			180	24,325.22
Disbursement	12-Jun-00 to 14-Nov-00		(2,340,452.42)	169	(563.77)
Balance	01-Dec-00	—	4,146,273.87		
Accrual - focal	01-Dec-00 to 31-May-01			180	15,548.53
Disbursement	08-Dec-00 to 30-May-01		(2,100,661.72)	173	(37.47)
Balance	01-Jun-01	—	2,045,612.15		
Accrual - focal	01-Jun-01 to 30-Nov-01			180	7,671.05
Disbursement	26-Jun-01 to 18-Oct-01		(1,910,700.55)	155	(299.64)
Balance	01-Dec-01	—	134,911.60		
Accrual - focal	01-Dec-00 to 31-May-01			180	505.92
Disbursement	13-Dec-01 to 14-Jan-02		(134,911.60)	168	(222.98)
Balance	01-Jun-02	—	0.00		818,717.44

— = not available, LSP = loan service payment, no. = number.

Note: This is an extract from a detailed computation which is on file.

Source: Controller's Department.

Table A4.3: Computation of Commitment Charges - Case 3

Assumption: The loan was disbursed in four equal amounts starting year 2.

LN1195-THA		Staggered Commitment Charge:	%	Amount
Loan Amount	30,329,381.72	26-Sep-93	15%	4,549,407.26
Signing date	28-Jul-93	26-Sep-94	30%	9,098,814.52
CC commencement	26-Sep-93	26-Sep-95	40%	12,131,752.69
Effective Date	23-Dec-93	26-Sep-96	15%	4,549,407.26
LSP: 1 Jun/1 Dec			100%	30,329,381.72

		Undisbursed Balance for LSP			
Transaction	**Value date**	**NOT Subject to CC**	**Subject to CC**	**No. of days**	**Commitment Charge (CC)**
Loan Effectiveness	23-Dec-93	25,779,974.46	4,549,407.26		
Accrual - effective	26-Sep-93 to 31-May-94			245	23,220.93
Balance	01-Jun-94	25,779,974.46	4,549,407.26		
Accrual - focal	1-Jun-94 to 30-Nov-94			180	17,060.28
Transfer subject to CC (30%)	26-Sep-94	(9,098,814.52)	9,098,814.52	65	12,321.31
Disbursement	26-Sep-94		(7,582,345.43)	65	(10,267.76)
Balance	01-Dec-94	16,681,159.95	6,065,876.34		
Accrual - focal	1-Dec-94 to 30-Nov-95			360	45,494.07
Transfer subject to CC (40%)	26-Sep-95	(12,131,752.69)	12,131,752.69	65	16,428.42
Disbursement	26-Sep-95		(7,582,345.43)	65	(10,267.76)
Balance	01-Dec-95	4,549,407.26	10,615,283.60		
Accrual - focal	1-Dec-95 to 30-Nov-96			360	79,614.63
Transfer subject to CC (15%)	26-Sep-96	(4,549,407.26)	4,549,407.26	65	6,160.66
Disbursement	26-Sep-96		(7,582,345.43)	65	(10,267.76)
Balance	01-Dec-96	—	7,582,345.43		
Accrual - focal	1-Dec-96 to 30-Nov-97			360	56,867.59
Disbursement	26-Sep-97		(7,582,345.43)	65	(10,267.76)
Balance	01-Dec-97	—	—		216,096.84

— = not available, LSP = loan service payment, no. = number.

Source: Controller's Department.

MODELS FOR TRANSPORT AND TRAFFIC ANALYSIS IN BANGKOK

1. This appendix discusses (i) transport models developed in the early 1990s in Bangkok, (ii) the transport model developed under the Bangkok Urban Transport Project (1995–1997), (iii) the Bangkok Transport Model in 1997–2005, (iv) population projections and the number of trips and road space, and (v) the future of the Bangkok Transport Model IMAC[1] and TDMC4.[2]

A. Transport Models in the early 1990s

2. Before the establishment of the first multimodal transport model in the mid-1990s, several transport models[3] were available as tools to assist transport planners in the development and evaluation of transport infrastructure projects in and around Bangkok.[4]

3. In 1990, a new transport model was developed to evaluate road projects for the Seventh National Plan. This model was based on the Seventh Plan Urban and Regional Transport Study (SPURT). It had limited capabilities to estimate public transport characteristics. Nevertheless, SPURT was the only tool available and was modified to evaluate public transport projects. It used data developed from a Japan International Cooperation Agency (JICA)-funded home interview survey completed in 1989. This model was developed using the proprietary software, TRANPLAN.

4. The United States Agency for International Development (USAID) staff at the time recognized the need for a transport model to be used by all planners in Bangkok. In this context, USAID proposed the formation of a USAID-supported Bangkok Transport Planning Unit (BTPU), and the development of a BTPU transport model in 1990.

5. The BTPU model developed addressed the issue of public transport in more detail. It was first used in the Office of Megaprojects (OMEGA) for the Office of the Commission for the Management of Land Traffic (OCMLT). It also was used in the development of the Conceptual Mass Transit Implementation Plan for Bangkok (1995), a forerunner of the 2001 Urban Rail Mass Transit Master Plan[5] (URMAP) that currently is being implemented.

B. Urban Transport Database and Model Development Project

6. In November 1993, OCMLT issued invitations for the provision of technical support for the development of a new urban transport database and transport model for Bangkok and the wider region. The BTPU model was the property of Bangkok's local government, the Bangkok

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[1] The IMAC project (the Intermodal Services Integration for the improvement of Mobility, Accessibility, Sustainability and Livelihood for Bangkok Metropolitan Region [BMR] and Surrounding Area project) is an ongoing project at the Office of Traffic Policy and Planning (OTP) of the Ministry of Transport.

[2] The TDMC4 project is the fourth in a series of projects designed to update the Bangkok transport model and associated databases.

[3] An example of an earlier transport model is the one developed by Halcrow Fox and Associates for the Short Term Strategic Review (STTR) in 1985. Only the trip matrices were available for further work, not the actual input planning data to develop the matrices.

[4] Since the 1975 Bangkok Transport Study evaluated mass transit projects, some multimodal tool appears to have been used in the route evaluation.

[5] Pacific Consultants International completed URMAP Mass Transit: Urban Rail Transportation Master Plan (BMA and Surrounding Areas) for OTP in December 2001.

Metropolitan Administration (BMA[6]), not the central Government. The BTPU model was developed from existing data rather than data collection especially designed for the development of a transport model. The project was a component of the ADB-supported Bangkok Urban Transport Project. Contract award and negotiations took longer than expected, and the technical support commenced by January, 1995. The assistance became known as the Urban Transport Database and Model Development Project (UTDM). The model has evolved and is currently known as the Bangkok Extended City Model (BECM).

7. BECM is a classic transport model, which includes four steps that aim to simulate trip-making behavior: (i) trip generation, (ii) trip distribution, (iii) modal split, and (iv) trip assignment. The trip generation step estimates the number of trips that start and finish in each traffic zone. Trip distribution determines a person's destination on a trip. For example, a person traveling to several destinations on a shopping trip will take into account the difficulty or ease of travel to alternative locations. The process applied to all trip purposes and all zones determines the distribution of trips between zones.

8. The third step is mode choice. Using the example in para. 7, a person must choose to walk, take a car, or ride public transport when traveling from home to a particular shopping area. This step in the transport model estimates the number of person-trips by mode.

9. The final step for the traveler is to decide the travel path. For example, a person can choose to travel to a destination quickly using a tollway, or less quickly on a non-toll road. If traveling by public transport, a person can choose a bus, train, or both. This is known as trip assignment.

10. The existing BECM model was developed using TRIPS, a proprietary software package. The underlying parameters of the BECM transport model are derived from the home interview survey conducted jointly in 1995 by the UTDM project and the JICA-funded Study on Urban Environment Improvement Program in Bangkok Metropolitan Area (BEIP) undertaken for BMA in 1996. The combined home interview survey size was 7,800 households, a sample of about 0.3%. The recommended sample size is 1%. However, the sample was the best available and was achieved only by combining the survey resources of two projects. The travel characteristics data are used to develop behavioral relationships between making trips and income level. The resultant sample size was adequate for this purpose. The Institute of Population Studies at Chulalongkorn University, in association with the National Statistics Office, undertook the associated sampling framework.

11. In addition to the transport model for Bangkok, three other significant transport models were developed as part of ADB's project: (i) a transport model for Korat, a provincial city; (ii) a local area model; and (iii) a national transport model.

12. The National Transport Model was the forerunner of more detailed planning studies, particularly the one developed for the Department of Highways. It has been replaced by analytical tools designed to evaluate individual projects.

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[6] BMA may refer to the local government the Bangkok Metropolitan Administration (BMA) or the area administered by the BMA, the city of Bangkok.

C. The Bangkok Transport Model 1997–2005

13. After completion of UTDM in 1997, OCMLT made the transport model and its associated database freely available to all practitioners associated with transport planning in Bangkok. It is now widely used.

14. The BECM was used to evaluate road and rail transport infrastructure. OCMLT initiated a project known as the Transport Database Management Centre (TDMC), which was extended into a phase II and subsequently III (TDMCII and TDMCIII). As envisaged, a project team would maintain and regularly update the transport model and its databases. The updates were to be made available to all practitioners. However, this was not undertaken in a timely fashion, which led to agencies and consultancies developing their own versions of the BECM without reference to a central database. During this period, different groups have tended to change the number of traffic zones, as well as the structure of the transport model.

15. In recent months, some of the input parameters have converged. This is a result of the availability of new planning data following the completion of the Population Census in 2000 by the National Statistics Office (NSO). NSO said this data, unlike the earlier census of 1990, includes the irregularities associated with Bangkok's transient population.

16. Before the establishment of the UTDM project, a consensus population estimate for Bangkok was not available. After reviewing conflicting registration and census data, the UTDM project team estimated the population of BMA in 1995 at 8.5 million. For example, the registration data showed an upward trend from 1983 to 1989, followed by a sudden reversal. NSO was included in the many discussions with the UTDM staff. From these discussions, an understanding emerged of the differences between registration and census data. The discrepancy in estimates apparently has been resolved in NSO with the release of the 2001 census data.

17. An updated transport model incorporating these NSO databases was used for the recently completed Northern Railway project, NTBR.[7] It was revalidated against existing traffic counts in 2003. This version of the model is directly traceable to the original UTDM version of BECM. Following the Asian financial crisis of 1997, it underwent an intermediate update with new planning data during the URMAP project. This model or its derivatives now tends to be used for the evaluation of transport infrastructure models.

18. One problem associated with the updates of the transport model by the TDMC series of projects is that the number of traffic zones increased to more than 1,500 from the original 500. Although this provides a fine level of detail, planning data predictions are not readily available at this level. Even with high speed computers, this model would take days of computer time for project evaluation.

19. Today, the major use of the transport model in Bangkok is to evaluate the impact of infrastructure projects. The model can provide data on (i) vehicle usage and number of persons traveling, (ii) revenue estimates for toll roads or mass transit, and (iii) economic parameters.

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[7] IMAC recently completed the Northern Railway Bang Sue to Rangsit Feasibility Study (NTBR) for OTP.

D. Population Projections and the Number of Trips and Road Space

1. Population

20. The revised population data statistics, which were the basis for the revised model results used in NTBR, are presented in Table A5.1.

Table A5.1: Future Population in Bangkok Metropolitan Region

Province	2003	2007	2012	2017	2022
Bangkok (BMA)	6,502,000	6,796,000	7,382,000	8,066,000	8,368,000
Samut Prakan	1,025,000	1,098,000	1,180,000	1,347,000	1,436,000
Nonthaburi	906,000	1,011,000	1,132,000	1,346,000	1,488,000
Pathum Thani	702,000	824,000	969,000	1,211,000	1,401,000
Nakhon Pathom	800,000	845,000	895,000	1,007,000	1,059,000
Samut Sakhon	446,000	480,000	517,000	592,000	633,000
Total	**10,381,000**	**11,054,000**	**12,075,000**	**13,569,000**	**14,385,000**

BMA = Bangkok Metropolitan Area.
Source: Northern Railway Bang Sue to Rangsit Feasibility Study Project, Office of Transport and Traffic Policy and Planning.

21. Following their original publication, the census data were revised. This resulted in a 3% increase in the population estimate of the BMR to 10.6 million.

22. Historically, the population of the BMR has generated much discussion. The different data sources from the NSO, as well as the registration data of the Minister of the Interior, always made estimating the population difficult. Earlier projections prepared by project teams were higher than those currently used. Following the Asian financial crisis, research of water consumption and electricity consumption records, undertaken as part of the URMAP project, indicated a decline in the transient[8] population of Bangkok after 1997. When they could not find work in Bangkok, people returned to their families in the provinces. More recent research indicates that this decline has reversed, probably as a result of the economic upturn.

23. During the UTDM project, the total population (i.e., registered plus transient population) of the BMR was estimated at 11.5 million people in 1995. This was forecast to grow to 18.3 million in 2011. The UTDM team's estimate was the first real attempt to reconcile the data available from the Ministry of Interior and the NSO Census projections from 1990 onwards. In retrospect, the forecast for 2011 appears to have been high compared to the current forecasts (Table A5.1). However, the transport model was calibrated against these data and the traffic counts, allowing the model to reproduce existing traffic flows well. For forecasting purposes, the relationships derived from the home interview survey data are applied in conjunction with the appropriate planning data to produce the forecasts. Hence, the current BECM model uses the latest population projections when making forecasts.

24. The current IMAC projection for the population of the BMR in 2025 is about 13.5 million with a higher economic growth, and encompassing the stated government policy of

[8] This applies to short-term migrants who work in Bangkok for several months of the year, but also return to their home for several months to assist with rice harvesting and so on.

decentralization and subcenter development. This implies that the level of transport infrastructure needed is significantly less than that proposed under the UTDM scenario.

2. Number of Trips

25. NTBR estimates that 14.5 million linked mechanized[9] trips per day were taken in 2003, as well as 21 million unlinked mechanized trips. The NTBR project estimates that 22 million linked mechanized trips and 37.5 million unlinked trips[10] will be taken in 2022.

26. Private transport accounts for 50% of all mechanized person trips. This high level[11] of private vehicle trips would be maintained even with the substantial investment in public transport that the new Government recently proposed.

27. The new IMAC study projection for the BMR is based on a lower population growth than in the new national forecasts.

28. The model also estimates the number of linked commercial vehicle and linked external trips from and to the BMR.

3. Road Space

29. As of 2000, the BMR had 4,700 kilometers (km) of public roads. This was subdivided into three categories during the URMAP project: (i) minor roads[12] (4,057 km), (ii) major roads (290 km), and (iii) expressways (406 km).

30. A link is being developed between the transport model and the Geographic Information System (GIS) database, as part of the IMAC project and TDMC4. This will enable the roads in Bangkok to be broken down more thoroughly by categories, such as road width and number of lanes. Further, this will enable the planner to immediately develop statistics of road infrastructure by category.

E. The Future of the Bangkok Transport Model IMAC and TDMC4

31. The transport model currently used most frequently is a derivative of the BECM model developed under the ADB-financed UTDM project. As the same team of OTP staff and consultants is working on the Government-funded TDMC4 and IMAC projects, resources will be combined as necessary to improve and produce a new generation transport model before awarding the Government-funded TDMC5 project, expected by early 2006. The TDMC5 project is expected to include sufficient funds for a major new transport data collection within the BMR.

32. Recently a new version of the CUBE software has become available from the Citilabs[13] Corporation. This new version includes a complete transport model programming language,

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[9] A mechanized trip has one or more segments using a mechanical mode of transport, as opposed to one which has all segments using non-mechanized modes, such as walking or riding a bicycle.

[10] A linked trip often consists of multiple segments. For example, a person traveling to work might take a motorcycle to reach a bus, and then travel the last leg by taxi. This example shows three unlinked trips, which combine to form a single three-segment linked trip.

[11] For example in another megacity, such as Cairo, the percentage of private vehicle trips today is 30%. However, this is expected to increase as the country becomes wealthier.

[12] Minor roads are defined as two lanes, while major roads have more than two lanes.

known as the Voyager software suite of programs. Over time, this new software likely will replace the TRIPS software for the BECM model.

33. During these projects, the TRIPS software code will be replaced with the Voyager code, essentially a standard programming language. Cube Voyager is designed to be an integrated modeling system for transportation planning applications, allowing full integration with GIS.[14] At the heart of the Cube Voyager system is a flexible control language, referred to as a scripting language. This establishes a flexible environment, which grants control over all aspects of the modeling process.

34. The existing model structure essentially is split into eight modules: (i) project and year specification, (ii) trip generation, (iii) input and network preparation, (iv) trip distribution, (v) mode split, (vi) special trip generation, (vii) daily assignment, and (viii) peak hour assignment. These modules are explained further below.

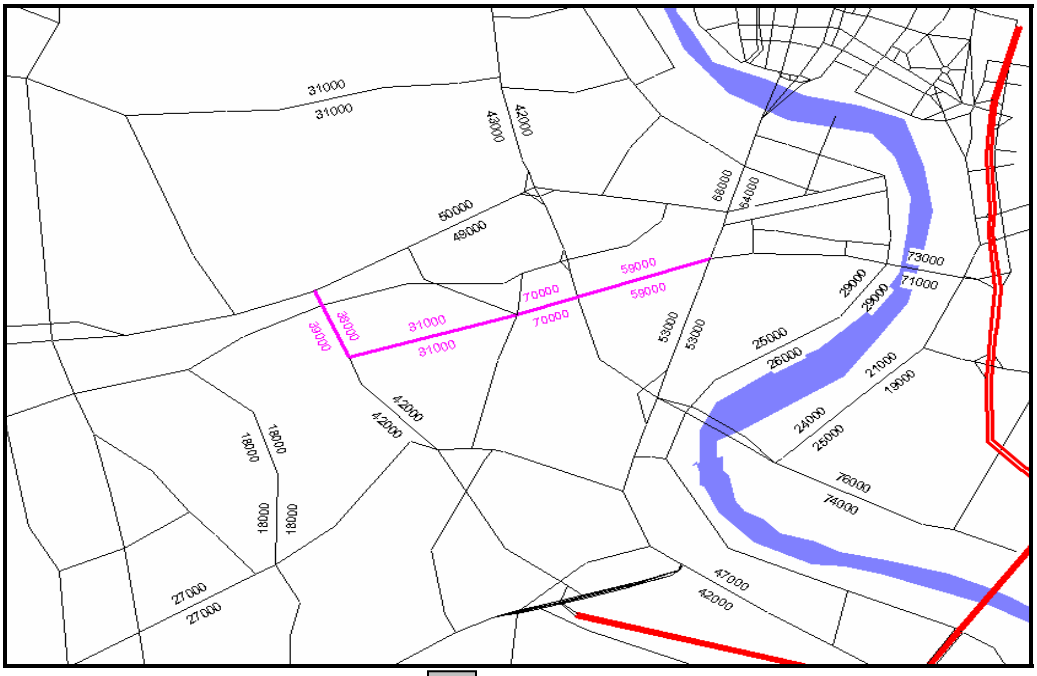
35. The new structure for the Bangkok Transport Model has nine modules, with the latter six modules forming a dynamic loop between trip distribution and assignment, as with the earlier model. The nine modules are: (i) input parameter specification, (ii) regional model, (iii) trip generation, (iv) network update, (v) trip distribution, (vi) mode split, (vii) special trip generation, (viii) daily assignment, and (ix) peak hour assignment. The regional model is used to estimate the external traffic in and out of the BMR. As such, the regional trip matrices are added into the daily and peak hour assignment for the Bangkok model.

36. For the project investigation, the traffic volume on links in the vicinity of the Project is shown in Figure A5.1 in units of passenger car equivalents. A bandwidth diagram of traffic is presented in Figure A5.2.

[13] Citilabs is the corporation responsible for the development and distribution of the CUBE suite of transport modeling software, including TRIPS. The latest version of the CUBE suite of software programs, CUBE 3.2.1, released in October 2004, is used for this project.

[14] Citilabs and ESRI, the developer of ARCINFO GIS software, have established a strategic partnership to ensure such integration.

Figure A5.1: Traffic Volumes in Vicinity of Project in 2017

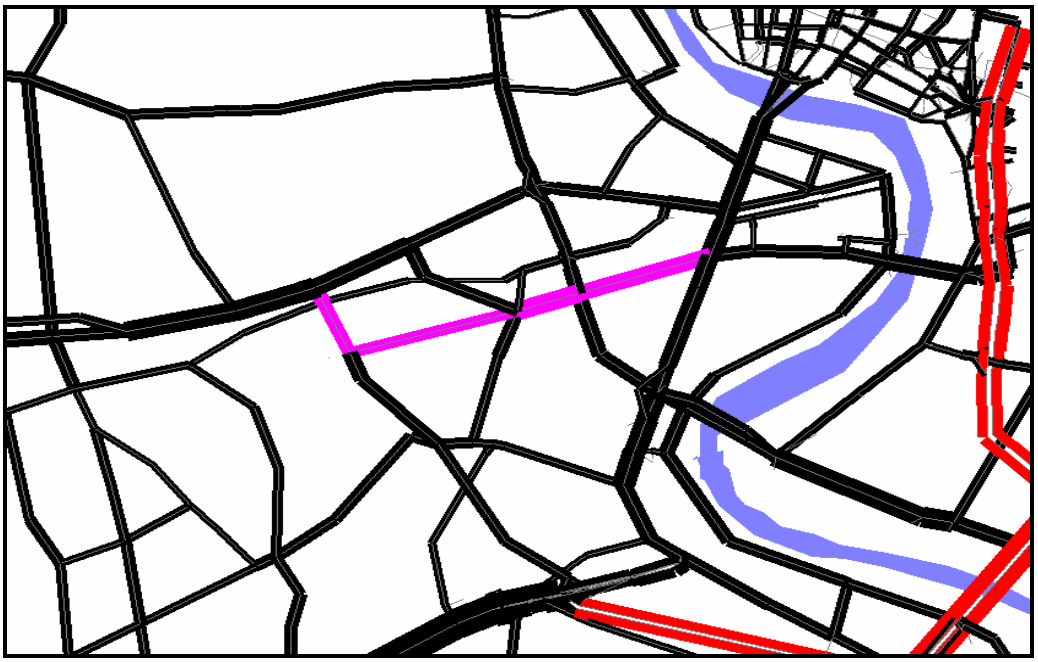


Legend: Bangkok Expressway Chao Phraya River
Asian Development Bank Project

Note: Numbers on this figure are the daily traffic volume in 2017.

Source: The Intermodal Services Integration for the Improvement of Mobility, Accessibility, Sustainability and Livelihood for Bangkok Metropolitan Region and Surrounding Area Project, at Office of Transport and Traffic Policy and Planning.

Figure A5.2: Bandwidth Traffic Volumes in Vicinity of Project in 2017



Legend: Bangkok Expressway Chao Phraya River
Asian Development Bank Project

Note: Thickness of the line is proportional to the traffic volume on the road link.

Source: The Intermodal Services Integration for the Improvement of Mobility, Accessibility, Sustainability and Livelihood for Bangkok Metropolitan Region and Surrounding Area Project, at Office of Transport and Traffic Policy and Planning.

ECONOMIC REEVALUATION

A. Introduction

1. The Operations Evaluation Department of the Asian Development Bank (ADB) used an economic reevaluation methodology that was similar to the one used at appraisal and in the project completion report (PCR). However, it was modified to take into account the most recent data on economic parameters for Bangkok and the availability of an up-to-date traffic modeling capability. Such modeling capability was not available to the PCR reevaluation.

2. With- and without-project scenarios were compared to determine the effects of introducing the project road. The Project's economic benefits consisted of savings in vehicle operating costs (VOC), personal (non-work time) and work time savings, and savings in road maintenance costs. Some of the assumptions in the PCR were modified based on updated information.

3. Much of the data used in the evaluation were taken from standard evaluation parameters used in Bangkok by the Office of Transport and Traffic Policy and Planning (OTP).

4. The benefits of the project road were reevaluated over 25 years, which was the same period used at appraisal and in the PCR. The analysis is considered conservative, because the life of the Project probably would be much longer. The financial costs and benefits were converted to economic costs and benefits by applying a standard conversion factor[1] of 0.9228 to the non-traded cost and benefit components, and by deducting all taxes and duties.

5. All costs and benefits in the analyses were based on constant 2002 prices, as in the PCR. This was necessary as the Operations Evaluation Mission (OEM) reevaluation did not have any better information on project capital costs or maintenance costs, which the PCR team had converted to 2002 prices. Accordingly, the reestimated benefits—the focus of this OEM reevaluation—also were converted to 2002 prices.

6. Following sections of this report describe (i) the base case and project case in more detail; (ii) the costs associated with each of these cases; (iii) the benefits of the project case by comparison with the base case; and (iv) the results of the evaluation, including sensitivity tests.

B. Methodology

7. Because of the complex nature of movements throughout an urban highway network, the assessment of the impact on traffic of introducing changes to the network normally requires the use of a computer simulation—traffic model. The most up-to-date transport model for Bangkok[2] was used to prepare a base year estimation of transport demand with and without the Project for 2003—the base year for which the model was calibrated. Estimates of annual benefits were made for each of these years and other values from 2002 to 2026, as in the PCR. The evaluation method, which is conventional, is similar to that used at appraisal and typically used in Bangkok for evaluation of road projects.

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[1] OTP provided this factor of 0.9228. It is similar to that which would be achieved by removal from all prices the value-added tax of 7%, which as prevails in Thailand—this factor would be 1/1.07 or 0.9348.

[2] This is the current version of the transport model developed under the ADB-supported Urban Transport Project. OTP uses the current model for the assessment of all projects. It is called the Bangkok Extended City Model (BECM). Bangkok has an advanced and mature transport planning and modeling capability, which is on a par with those in many major cities in the developed world.

8. The transport model uses a detailed computer representation of the Bangkok Metropolitan Region road system, and assigns a trip table (representing daily vehicle movements between each of the 520 origin and destination zones) to the road network system.

C. Costs

1. Construction Costs

9. Data on construction costs were taken from the PCR. In the PCR, the economic construction costs were derived primarily from the financial costs of civil works and consulting services. For the purpose of evaluation, the final costs of Section 1 (Taksin–Ratchadaphisek) and Section 2 (Ratchadaphisek–Phetkasem) were combined to obtain the capital costs for the project road as a whole. The costs of consultant supervision were disaggregated based on the actual consultant costs incurred for the road sections. Land, property, and resettlement costs also were included for each civil works package to arrive at the final cost of the project road. These costs were not disaggregated in the records of Public Works Department (PWD); and the cost of land, resettlement, etc. could not be examined separately. The actual implementation period was used as the basis for allocating annual capital costs.

2. Maintenance Costs

10. Data on the overall maintenance costs also were taken from the PCR, as the OEM team could not obtain better estimates from the Project's owner, the Department of Roads (DOR).[3] For the PCR, the Mission obtained updated routine maintenance costs with and without the Project from the PWD and Department of Highways. Periodic maintenance costs vary depending on the treatment undertaken. In the with-project scenario, the periodic maintenance would be undertaken every 5–6 years. The unit costs of different types of maintenance are shown in Table A10.1 of the PCR.

3. Vehicle Operating Costs

11. OTP provided VOC for each vehicle type by vehicle speed. Pacific Consultants International (2005) recently updated these VOC estimates for the Intermodal and Coordination Study (IMAC) being carried out at OTP. The Bangkok Extended City Model (BECM) traffic model assigns traffic to the road network passenger car units[4] (PCU), which measure the impact of different vehicle types on traffic congestion. VOC was aggregated, based on the vehicle composition, to reflect the composition of the vehicle fleet utilizing the road network over time. Table A6.1 presents composite VOC in financial prices at various traffic speeds. These VOC estimates need to be converted to economic values using the 0.9228 conversion factor.

12. Savings in VOC accounted for some of the benefits estimated for the Project. The VOC, the distance-based resource costs of vehicle operation, are conservative as they do not take into account the externalities imposed by the motor vehicle above VOC. These include additional accidents, road wear and tear, noise and air pollution created by vehicle operation.

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[3] The DOR allowed B1.8 million per year for maintenance for FY2005, and expects to allocate a similar amount for FY2006. While this is almost four times the annual routine maintenance the PCR estimated would be needed, the PCR also allocated 23 million for periodic maintenance every 5 years. DOR could not provide appropriate levels of periodic maintenance.

[4] A passenger car unit expresses the effect of each vehicle type on traffic flow in terms a single passenger car unit. Hence, a standard passenger car is one PCU and a large bus is three PCUs. A complete definition of PCU factors for each vehicle type is shown in Table A7.1. The BECM model produces traffic flow estimates in PCUs, PCU-hours, and PCU-kilometers.

Estimates from Australia on the additional value of these externalities[5] compared to VOC suggests road wear and tear costs, accidents, and environmental pollution are around A$0.13 (1996 prices) compared to A$0.28 for VOC—or almost an additional 50%. However, this reevaluation did not use VOC estimates which take into account such externalities as there is no guarantee the value of externalities in Thailand follows a similar relationship to that in Australia. However, externalities of vehicle travel in Thailand are highly likely to be significant, which means this reevaluation is conservative. The final VOC per PCU derived on this basis was B3.41 per PCU-kilometer.[6]

13. Estimated savings in VOC (i.e., a project benefit) were later deflated to 2002 prices for the evaluation.

Table A6.1: Vehicle Operating Costs and Traffic Characteristics (Baht - financial costs at early 2005 prices)

Speed Range[a]	Motor-cyle	Samlor/ Tuk Tuk	Taxi	Car	Medium Bus	Heavy Bus	Large Truck	Medium Truck	Heavy Truck	
0–5 kph	1,476.65	3,178.45	9,343.31	4,527.96	12,186.11	18,075.16	6,590.18	9,187.07	15,306.31	
5–10 kph	1,362.97	2,131.92	6,419.59	4,050.28	9,180.71	13,719.01	4,962.45	7,121.61	12,780.79	
10–15 kph	1,239.82	1,761.10	5,256.77	3,640.02	7,967.51	11,653.34	4,247.95	6,251.53	11,647.16	
15–20 kph	1,158.11	1,564.51	4,677.21	3,353.12	7,308.42	10,555.34	3,874.14	5,767.42	11,002.64	
20–25 kph	1,097.72	1,439.72	4,314.29	3,135.08	6,838.72	9,873.30	3,632.82	5,479.60	10,625.13	
25–30kph	1,050.35	1,356.14	4,314.29	3,135.08	6,838.72	9,873.30	3,468.39	5,479.60	10,625.13	
30–35 kph	1,017.19	1,298.46	3,897.68	2,834.55	6,350.63	9,017.49	3,358.38	5,131.13	10,144.76	
35–40 kph	988.77	1,257.25	3,751.40	2,723.38	6,188.29	8,716.65	3,279.12	5,029.68	10,000.32	
40–45 kph	967.46	1,225.47	3,647.71	2,632.29	6,069.25	8,463.60	3,216.42	4,981.15	9,929.19	
45–50 kph	952.06	1,201.93	3,582.90	2,564.15	6,001.06	8,242.05	3,178.57	4,929.32	9,858.06	
50–55 kph	936.67	1,188.98	3,536.61	2,506.77	5,965.35	8,154.08	3,144.26	4,897.34	9,815.39	
55–60 kph	927.20	1,185.45	3,497.72	2,506.77	5,933.97	8,082.40	3,119.42	4,767.22	9,793.50	
60–65 kph	933.12	1,190.15	3,469.95	2,508.92	5,944.79	8,022.67	3,100.49	4,878.60	9,805.54	
65–70 kph	929.57	1,199.57	3,444.03	2,511.07	5,901.50	8,050.90	3,088.67	4,888.52	9,828.52	
70–75 kph	930.75	1,212.52	3,434.77	2,519.68	6,002.15	8,066.11	3,088.67	4,923.81	9,891.99	
75–80 kph	936.67	1,231.36	3,436.62	2,531.16	6,074.66	8,124.76	3,095.76	5,002.11	10,024.39	
Traffic mix – vehicle %	7.0	0.2	14.0	67.0	1.0	4.0	3.0	1.8	2.0	100.0

[5] For example, Bray and Tisato (Bray, David and Peter Tisato. 1997. Broadening the Debate on Road Pricing. Proceedings for the *21st Australasian Transport Research Forum*, pp. 599–616. Adelaide, South Australia) estimated the average non-time resource cost of car use at in Australia in 1996 at A$0.281 per vehicle-kilometer in 1996 prices, comprising: (i) A$0.155 per vehicle-kilometer for variable vehicle costs (A$0.038 per vehicle-kilometer for fuel, A$0.09 per vehicle-kilometer for tires, A$0.066 per vehicle-kilometer for maintenance, and A$0.042 per vehicle-kilometer for half of vehicle capital costs that are related to vehicle use); (ii) A$0.031 per vehicle-kilometer for road wear and tear costs; (iii) A$0.050 per vehicle-kilometer for accident costs; and (iv) A$0.045 per vehicle-kilometer for environmental impact costs.

[6] Derived from *Intermodal and Coordination Study* (Pacific Consultants International, et al. 2005. Intermodal and Coordination Study. Bangkok). Figures in bold used for analysis. Based on traffic survey and model data.

Speed Range[a]	Motor-cyle	Samlor/ Tuk Tuk	Taxi	Car	Medium Bus	Heavy Bus	Large Truck	Medium Truck	Heavy Truck	
PCU equivalent	0.5	0.8	1	1	2	3	2	2	3	—
Total PCUs[b]	3.5	0.2	14.0	67.0	2.0	12.0	6.0	3.6	6.0	114.3

— = not available, kph = kilometers per hour, PCU = passenger car units.

[a] Speed range highlighted used for analysis

[b] For the assumed average traffic composition across the network 100 vehicles = 114.3 PCUs.

Source: The Intermodal Services Integration for the improvement of Mobility, Accessibility, Sustainability and Livelihood for Bangkok Metropolitan Region and Surrounding Area project, at Office of Transport and Traffic Policy and Planning.

4. Time Costs

14. Time costs (economic) in early 1995 prices were calculated for each vehicle type. Savings in travel time represent a significant benefit as the primary objective of the Project was to relieve congestion. OTP provided the value of time for each vehicle type, which were aggregated to give a cost per PCU in baht per hour. For commercial vehicles (taxis, trucks, buses), the OTP estimates included time cost of crew at working time rates. Table A6.2 shows the value of time calculated at 2005 prices. The OTP estimates of time cost for buses did not include the time values of passengers. These had to be added for this reevaluation. Average passenger loads for buses were assumed as shown in Table A6.1. Values for bus passengers[7] were applied to obtain a final time cost per PCU of B91.19 per PCU-hour. The time values of bus passengers were based on their actual behavior when making travel choices, thus reflecting their willingness to pay. A value of time for bus passengers of B33 per hour in 2005 prices was used, updated from the values reported by Urban Transport Database and Model Development (UTDM). Table A6.2 shows that only 45% of the time savings accrue to bus passengers. While generally not the absolute poor, bus passengers are on average more likely to be drawn from lower-income groups than car drivers or car passengers. The UTDM database shows that bus passengers, when making travel decisions, on average value time at around 50% or less of car drivers and passengers. These figures reflect relative income levels.

15. Use of an equity value approach, for example, valuing bus passengers' time the same as car drivers and passengers (or at B60/hr in 1995 prices) would have increased the final time cost per PCU/hour by 30%.

16. Savings in time costs (i.e., a project benefit) were later deflated to 2002 prices for the evaluation.

[7] Behavioral values of time were used reflecting willingness to pay.

Table A6.2: Derivation of Value of Travel Time by Passenger Car Unit
(Baht - Economic Costs in Early 2005 Prices)

Item	Motorcycle	Samlor	Taxi	Car	Pickup	Med Bus	Heavy Bus	Med Truck	Heavy Truck	Total
% of vehicles (veh)	7.0%	0.2%	14.0%	47.0%	20.0%	1.0%	4.0%	4.8%	2.0%	100.0%
% in PCUs	3.1%	0.2%	12.2%	41.1%	17.5%	1.7%	10.5%	8.4%	5.2%	100.0%
Financial VOC at 27.5 kph (per veh-km)	1.05	1.36	4.31	3.14	6.84	9.87	3.47	5.48	10.63	46.14
Financial VOC at 27.5 kph for all veh (per veh-km)	0.07	0.00	0.60	1.47	1.37	0.10	0.14	0.26	0.21	4.24
Economic VOC at 27.5 kph (per PCU-km)	Divide by 114.30 PCUs per 100 vehicles and multiply by factor 0.9228 to convert to economic values									
						Crew Cost	**Crew Cost**	**Crew Cost**	**Crew Cost**	
Value of time 2004/05 (from OTP) - except bus pax not included	42.34	42.37	127.10	50.08	50.08	**38.15**	**38.15**	**81.06**	**104.90**	
Additional pax for bus						15.00	28.00			
Value of time for bus pax[a]						495.00	924.00			
Subtotal time value (per veh-hr)	42.34	42.37	127.10	50.08	50.08	533.15	962.15	81.06	104.9	
Economic time value for all vehs	2.96	0.10	17.79	23.54	10.02	5.33	38.49	3.89	2.10	104.22
Economic time value (per PCU-hr)							Divide by 114.3 PCUs per 100 vehicles			**91.19**
Average persons per veh type	1.37	1.29	1.43	1.93	1.93	15.00	30.00	1.00	1.00	NA
Total persons by vehicle type	9.59	0.31	20.02	90.71	38.6	15.00	120.00	4.80	2.00	301.03
% of persons	**3.19%**	**0.10%**	**6.65%**	**30.13%**	**12.82%**	**4.98%**	**39.86%**	**1.59%**	**0.66%**	**100.00%**

km = kilometer, kph = kilometers per hour, OTP = Office of Transport and Traffic Policy and Planning, PCU = passenger car units, VOC = vehicle oper costs.

[a] Using behavioral time values for bus passengers (i.e., B33/hour in 2005 prices) not equity values, which would value pax time as the same as car drivers/pax at B60/hour (1995 prices).

Source: Project Performance Audit Report Team using data from Office of Transport and Traffic Policy and Planning.

5. Summary of Time and VOC per PCU

17. To apply the VOC and time savings parameters information to the transport model outputs, these parameters were converted to a value per PCU kilometer or hour (in 2005 prices) as summarized in Table A6.3.

Table A6.3: Values for Aggregated Time and Vehicle Operating Cost per Passenger Car Unit (Economic Prices at Early 2005)

Parameter	Value (baht)
VOC (economic) per PCU-km	3.42
Time savings value (economic) per PCU-hour	91.9

km = kilometer, PCU = passenger car units, VOC = vehicle operating costs.

Note: VOC per PCU derived from Table A6.2, VOC at 25–30 kph and traffic composition—resultant financial values per PCU were converted to economic values using the factor 0.9228.

Source: Project Performance Evaluation Report team using data from the Intermodal Services Integration for the improvement of Mobility, Accessibility, Sustainability and Livelihood for Bangkok Metropolitan Region and Surrounding Area project at Office of Transport and Traffic Policy and Planning.

D. Benefits

18. The Project's main quantifiable benefits are (i) VOC savings for existing traffic due to faster vehicles speeds resulting from less congestion and shortened travel distances, and (ii) time cost savings due to shorter trips. The modeling shows that in 2003 the project road reduced PCU-km and PCU-hours by 226,000 and 136,000 per day, respectively. These savings are estimated to be 0.1% of total transport activity in Bangkok.

1. Savings in Vehicle Operating Costs

19. VOC savings were estimated based on the unit VOC data in Table A6.3, as well as the appropriate transport model outputs and their growth rates on the project road.

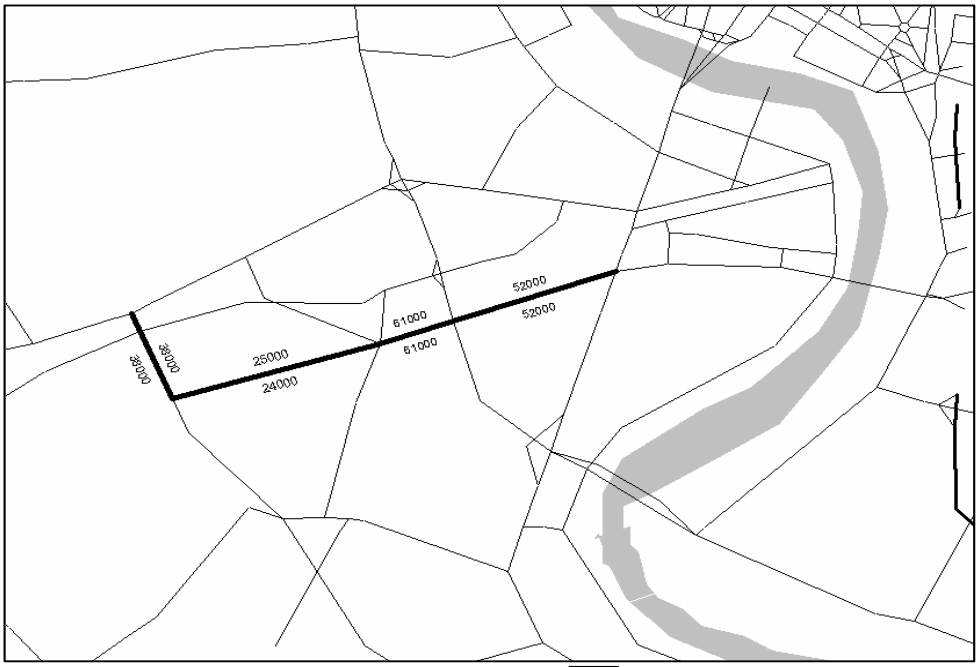
2. Savings in Vehicle Time Costs

20. The benefit or savings in passenger time costs is the difference between the time spent traveling on the without-project network and the time spent on the with-project network, using the values in Table A6.3.

3. Traffic Forecast

21. BECM, a full transport model used in Bangkok by OTP and other agencies (Appendix 5), was used to prepare forecasts of travel on the entire Bangkok road network with and without the project road. This model is calibrated for 2003, which is 2 years after the project road was opened. The forecasts, therefore, were made for 2003 (but with the prevailing 2001 road network, which therefore excluded the western and northern extensions of the project road that the Department of Rural Roads completed more recently). The associated travel parameters were modified to reflect the likely situation when the Project was completely opened to traffic in 2001. The forecast use of the road in 2003 (Figure A6.1) shows the heaviest usage of 122,000 PCUs per day, representing total traffic on the through carriageways and frontage roads. This is approximately equivalent to 100,000 vehicles per day. Figure A6.2 shows that the catchment of vehicles using the road extends over a large subregion of western and central Bangkok, east of the river. With the recent completion of the extensions of the project road to the west and north, the catchment of vehicles using the road is likely to have expanded, especially in the northwest and west of Bangkok.

Figure A6.1: Forecast Daily Use of the Road in 2001

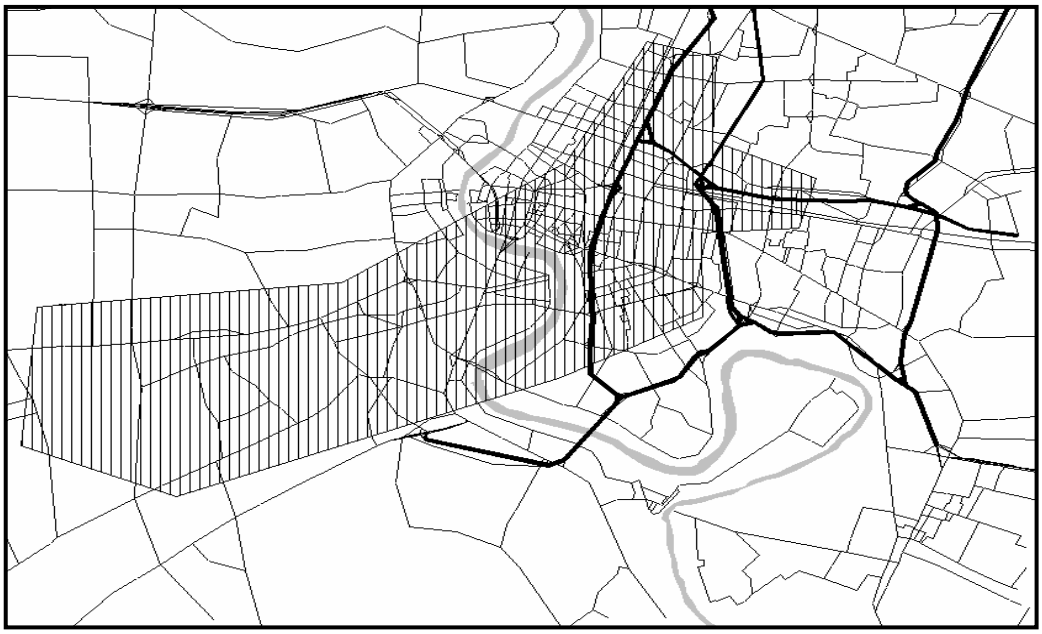


Legend: Asian Development Bank Project Chao Phraya River

Note: Numbers on this figure are the daily traffic volume in 2001

Source: The Intermodal Services Integration for the Improvement of Mobility, Accessibility, Sustainability and Livelihood for Bangkok Metropolitan Region and Surrounding Area Project, at Office of Transport and Traffic Policy and Planning.

Figure A6.2: Catchment of Vehicles Using Road in 2001



Legend: Catchment area

Note: The hatched area is the catchment area defining the general influence area for daily traffic in 2001.

Source: The Intermodal Services Integration for the Improvement of Mobility, Accessibility, Sustainability and Livelihood for Bangkok Metropolitan Region and Surrounding Area project, at Office of Transport and Traffic Policy and Planning.

22. To be conservative and consistent with the reevaluation in the PCR, the same methodology was used for forecasting traffic growth. For the economic reevaluation, traffic growth was based on the expected growth of gross domestic product (GDP). As for the PCR, GDP growth was assumed to average 5% per year, which was used for the economic reevaluation. The forecast traffic was based on the transport demand elasticity and expected GDP growth. The transport demand elasticity used has been set to unity, which can be considered conservative, as it assumes that traffic will grow at the same rate as GDP.

E. Economic Internal Rate of Return Estimates

23. The Project's economic internal rate of return (EIRR) was reestimated, as shown in Table A6.4. The benefits—VOC and time savings—were held constant from 2010 onwards, when traffic volume on the project road will be close to capacity. The reestimated project road EIRR is 28.0%, compared with 20.1% in the PCR and 45.0% at appraisal. The reestimated EIRR of 28.0% is more comparable to the appraisal calculation, because both used a transport model that was not available to the PCR team.

24. Time savings constitute 94% of the project benefits. Bus passengers[8] in central Bangkok received 45% of the estimated time savings benefits that accrued to occupants of all vehicles. Bus passengers, while not generally the absolute poor, are on average more likely to be drawn from lower-income groups than car drivers or car passengers. The UTDM database shows that bus passengers, when making travel decisions, on average value time at around 50% or less of car drivers and passengers. This suggests that their incomes on average are less than half of those of car drivers. Savings in travel times are likely to benefit bus passengers by providing them with greater opportunity to access jobs and other activities of personal importance.

25. Several factors were responsible for the differences between the latest reevaluation and the one at appraisal: (i) revised economic costs derived from actual costs; (ii) longer construction periods caused by delays in implementation; and (iii) slightly lower values of economic parameters, as well as different estimated levels of reductions in vehicle kilometers and vehicle hours. Table A6.5 compares principal input parameters to the evaluation, which shows that this project performance evaluation report (PPER) reevaluation uses lower values of VOC and Vehicle Time Traveled than at PCR and appraisal when expressed in constant prices. The PPER estimates of these principal parameters were based on the most up-to-date parameters in use by Thailand's OTP. These PPER parameters (2002 constant prices) were 55% and 39% of VOC and value of time parameters used in the PCR, respectively. However, they were 70% and 62%, respectively, (2002 constant prices) of those used at appraisal. Part of the difference in the lower time values used in this PPER compared to appraisal is that real incomes declined after 1997 compared to the forecast in 1992. Further, the appraisal evaluation appears to use equity values of time for bus passengers, which would provide a higher estimate of time value per PCU, although the details of these equity values and how they were applied were not shown.

26. An additional benefit, which has not been quantified, is that the elevated structure to carry a future extension of the Skytrain elevated railway to the western part of Bangkok was built recently within the acquired right-of-way of the project road over much of its length. The Bangkok Metropolitan Administration, the Skytrain project owner, did not incur any costs for this

[8] Of every 100 vehicles on the roads that receive beneficial effects of the project road, 45% of the persons in them are estimated to be bus passengers.

land. As the land has no obvious practical alternative use, the opportunity cost can be considered zero.

27. Another difference is the estimated level of reductions in PCU-km per day and PCU-hrs per day due to the project road, as shown in Table A6.5. While estimates of PCU-hr reductions for all three evaluations are similar, the estimated reduction in PCU-hrs shows major differences. The PCR made manual estimates of PCU-hrs reduction, which is not comparable to those estimates made at appraisal and PPER by using a transport model. The estimates of PCU-hr reduction made at appraisal are 28.8% of that made for this PPER. The current transport model is superior and more detailed to that used at appraisal. As such, the current estimate of PCU-hrs reduction is considered robust. However, a sensitivity test was carried out using a reduced estimate of PCU-hrs to be comparable with the evaluation undertaken at appraisal.

Table A6.4: Economic Cost and Benefits of the Thonburi Road Extension
(B Million)

	Net Costs			Benefits		
Year	**Capital**	**Maintenance**	**Periodic Maintenance**	**VOC Savings**	**Time Savings**	**Net Benefit**
1992	(183.0)			0.0	0.0	(183.0)
1993	(197.0)			0.0	0.0	(197.0)
1994	(1,149.0)			0.0	0.0	(1,149.0)
1995	(129.0)			0.0	0.0	(129.0)
1996	(388.0)			0.0	0.0	(388.0)
1997	(283.0)			0.0	0.0	(283.0)
1998	(336.0)			0.0	0.0	(336.0)
1999	(521.0)			0.0	0.0	(521.0)
2000	(466.0)			0.0	0.0	(466.0)
2001	(311.0)			0.0	0.0	(311.0)
2002		(0.5)		207.0	3,307.0	3,514.0
2003		(0.5)		217.9	3,481.1	3,698.9
2004		(0.5)		228.8	3,655.1	3,883.4
2005		(0.5)		240.2	3,837.9	4,077.6
2006		(0.5)	(23.0)	252.3	4,029.8	4,258.5
2007		(0.5)		264.9	4,231.2	4,495.6
2008		(0.5)		278.1	4,442.8	4,720.4
2009		(0.5)		292.0	4,664.9	4,956.4
2010		(0.5)		306.6	4,898.2	5,204.3
2011		(0.5)	(23.0)	306.6	4,898.2	5,181.3
2012		(0.5)		306.6	4,898.2	5,204.3
2013		(0.5)		306.6	4,898.2	5,204.3
2014		(0.5)		306.6	4,898.2	5,204.3
2015		(0.5)		306.6	4,898.2	5,204.3
2016		(0.5)	(23.0)	306.6	4,898.2	5,181.3
2017		(0.5)		306.6	4,898.2	5,204.3
2018		(0.5)		306.6	4,898.2	5,204.3
2019		(0.5)		306.6	4,898.2	5,204.3
2020		(0.5)		306.6	4,898.2	5,204.3
2021		(0.5)	(23.0)	306.6	4,898.2	5,181.3
2022		(0.5)		306.6	4,898.2	5,204.3

	Net Costs			Benefits		
Year	Capital	Maintenance	Periodic Maintenance	VOC Savings	Time Savings	Net benefit
2023		(0.5)		306.6	4,898.2	5,204.3
2024		(0.5)		306.6	4,898.2	5,204.3
2025		(0.5)		306.6	4,898.2	5,204.3
2026		(0.5)	(23.0)	306.6	4,898.2	5,181.3
					NPV	EIRR
				Best Estimate	9,126	28.0%

EIRR = economic internal rate of return, NPV = net present value, VOC = vehicle operating cost.
Source: This study based on data of the Project Completion Report and Office of Transport and Traffic Policy and Planning.

Table A6.5: Comparison of Key Inputs at Appraisal, PCR, and PPER

Economic Inputs	VOC	Time Value
Parameters at current prices	**VOC Baht/PCU at 25–30kph**	**Aggregate Time Value per PCU hr**
1992 Appraisal (1991 prices)	2.99	90.30
2002 PCR (2002 prices)	5.78	218.86
2005 PPER (2005 prices)	3.42	91.19
Parameters at 2002 constant prices	**VOC Baht/PCU at 25–30kph**	**Aggregate Time Value per PCU hr**
1992 Appraisal	4.57	138.28
2002 PCR	5.78	218.86
2005 PPER	3.21	85.62
Benefits - basic units		
	Millions of PCU-km/ day	**Millions of PCU-hrs/ day**
Reductions		
1992 Appraisal	0.21	0.04
2002 PCR	0.26	0.02
2005 PPER	0.23	0.14
Annual benefits current prices	**VOC Saving (B million per year)**	**Time Saving (B million per year)**
1992 Appraisal (1991 prices)	281	1,618
2002 PCR (2002 prices)	456	1,215
2005 PPER (2005 prices)	232	3,707
Annual benefits 2002 constant prices	**VOC Saving (B million per year)**	**Time Saving (B million per year)**
1992 Appraisal	430	2,478
2002 PCR	456	1,215
2005 PPER	218	3,481

hr = hour, km = kilometer, PCR = project completion report, PCU = passenger car units, PPER = project performance evaluation report, VOC = vehicle operating costs.
Sources: ADB. 1992. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan and Technical Assistance to the Kingdom of Thailand for the Bangkok Urban Transport Project*. Manila; and ADB. 2002. *Project Completion Report on the Bangkok Urban Transport in Thailand*. Manila.

F. Sensitivity Analysis

28. Although the Project is complete, a conventional sensitivity analysis was undertaken to examine the effect of a 20% decrease in benefits. Other key variables were also examined. One was the expected future GDP growth, which affects the growth of passenger and freight traffic. GDP growth has been forecast to be around 5% over the medium term. If this growth rate does

not materialize, future traffic growth will be reduced. A sensitivity test examined the effect of reducing future GDP growth to 2.5% per year, i.e., a 50% reduction in the estimated forecast growth. In addition, another test was carried out in which the estimated PCU-hr reduction was reduced by 70% to approximate that at appraisal. The results of the sensitivity analysis are shown in Table A6.6. All tests confirmed that the project exceeds by a comfortable margin the EIRR cutoff of 12%.

Table A6.6: Results of Sensitivity Analysis

Assumption	**EIRR** (%)
Best estimate	28.0
Decrease benefits by 20%	25.5
Decrease in time benefits (i.e., PCU-hrs saved) by 70% to match time saving estimated at appraisal	16.8
Reduction of GDP forecast by 50%	27.9

EIRR = economic internal rate of return, GDP = gross domestic product, hr = hour, PCU = passenger car units.
Source: Operations Evaluation Department estimates based on reports and recommendations of the President and project completion reports.

NOTES ON THE RELOCATION PROCESS

1. A social impact study at appraisal in 1992 showed that 1,220 households would have to be relocated as some buildings were in the right-of-way. A follow-up mission by the Asian Development Bank (ADB) in March 1993 confirmed the need for a relocation plan that specifies replacement housing, schooling, and alternative employment opportunities. Many people were unhappy with the initial compensation that the Preliminary Compensation Setting Committee offered in accordance with the Immovable Property Expropriation Act (1987). Others were uncertain about alternative housing, school, and employment options. To identify relocation opportunities, the Public Works Department (PWD) initially told affected people to obtain advice from the Housing Department of the Ministry of the Interior.

2. In October 1993, the relocation consultants submitted an initial report covering the socioeconomic characteristics of a 10% sample of affected households, and barriers for all families faced with relocation. It recommended workshops and dissemination of information on alternative housing, as well as educational and job opportunities. At the end of the consultants' 15-month contract, almost 96% of households had accepted the compensation offered and agreed to relocate. The final report documented 54 households (4% of the total) that could not move by December 1994. Of these 54, only 13 families were not ready to move by the expected start of construction.

3. The consultants named all 54 families in its report. Of the 41 families willing to move by the expected start of construction, but after December 1994, (i) 14 were building houses and had to wait until the contracts were completed before they could move; (ii) 7 could not afford to move without assistance; and (iii) 20 "long-term" tenants wanted to use up the lump sum they had paid in advance for rent and get their bond back, and requested PWD assistance to talk to their landlords.

4. The 13 remaining families were waiting for the results of their appeal for higher compensation based on quickly rising land prices in Bangkok. The report recommended that PWD assist these people in moving. After the 13 families won the appeal and were offered a higher level of compensation, they agreed to relocate in 1997, allowing construction to start.[1] Although PWD did not submit a final report on the resettlement process, the Operations Evaluation Mission (OEM) did not find any evidence of organized opposition, forced evictions, or squatter settlement after clearance of the site. Hence, the OEM concluded that the resettlement process, by and large, took place without major incidents and in accordance with the conditions in the Loan Agreement and report and recommendation of the President.

5. Commissioned by the Department of Rural Roads, Epsilon issued a benefit monitoring and evaluation report in September 2005 which incorporated two socioeconomic surveys, one of 104 households in the vicinity of the road held in June, and one of 50 households that had resettled as a result of construction of the road, held in July.

6. Along the road, 84% of the respondents were found to have resided already before the road development started. They were self employed (31%), entrepreneur/trader (28%), private sector employee (25%), and government officer (16%). The average income was B18,886 per

[1] PWD advised the Project Completion Review Mission that compensation payments to all affected people were made in compliance with section (iii) of this covenant. The consultants' report documents several relocation activities, which are largely in accordance with the requirements identified at appraisal.

month ($450).The average household expense was B14,732 per month. Seventy-seven percent of the respondents thought the community was nice to reside; 19% thought that the community was not nice because of high density, and the environment perceived as dirty and bad. Main problems seen in the community were the flooding in the rainy season (37%), lack of public buses (34%), inconvenient travel (29%), robbery (28%) slum (16%), and distance from community or commercial zone (15%). Overall, 63% of the respondents thought that their community had improved in the period after the road construction; 10% thought it had changed to a worse condition. Most people, however, thought that the improvement was unrelated to the road as such.

7. Regarding the resettled people, an unreported percentage had relocated within the neighborhood of the road, in the same community; others had moved to other areas. Of the 50 responses received, most were from government officers (44%), followed by entrepreneurs (25%). The possible bias in response from government officers as respondents may have compromised the survey results. Certainly the incomes of the respondents of the resettlement surveys seem higher than those of the community along the road. But the figures presented in the benefit monitoring and evaluation report cannot be fully compared, as the household income categories are different. Thirty-three percent of the respondents lived in a better environment than before whereas 21% had a worse environment. 67% thought the new community was nice. Very few respondents had problems with electricity (3%), water supply (3%), drinking water (11%), and telephone connection (3%). There were indications that a portion of the resettlers had become worse off: 49% had economic problems, and 44% took more time to travel, with only 9% taking less time.

DISTRIBUTOR ROADS AND WESTERN BANGKOK URBANIZATION CHALLENGES

1. The objectives of the Asian Development Bank's (ADB) Bangkok Urban Transport Project (the Project) included (i) increasing the efficiency of land utilization through improved accessibility and road development in the relatively less developed western sector of the city, and (ii) developing a coherent road hierarchy west of the Chao Praya River.

2. The Project provided financing for the Public Works Department (PWD) to build the project road following the Cabinet's endorsement of PWD as the responsible entity for construction of major primary roads in western Bangkok. The Cabinet also supported the provision of a technical assistance (TA) grant to develop a proper long-term road hierarchy in western Bangkok. This would assist in planning a balanced network of distributor roads to complement the primary roads that PWD and the Department of Highways were developing. The TA was designed to support "area" planning rather than "corridor" development, whereby new land subdivisions and other urban development tended to occur in an uncoordinated way and along major road corridors. The appraisal report found that 70% of residential land subdivisions in 1985–1990 had occurred at distances greater than 20 kilometers from central Bangkok, which contributed to traffic congestion in the region. The TA was designed to complement the Project's Structure Plan component, which also was designed to support the efficient development in the region.

3. Development of a road hierarchy aimed to ensure proper development of the western sector, most of which was proximate to central Bangkok, while avoiding the problem of "super blocks"[1] found in eastern Bangkok.

4. Despite the accessibility of this western sector of Bangkok, the 1992 Bangkok City Plan identified much of the northern part of the western sector of the Bangkok Metropolitan Administration (BMA) area as "agriculture" (west of Outer Ring road) or "reserved rural use" (east of Outer Ring road).

5. The Department of Town and Country Planning (DTCP) had prepared the 1992 BMA City Plan in the early 1980s. During the delay in enactment until 1992, significant urban encroachment occurred. By that time, the credibility of the plan's designation of these areas, which were highly accessible to Bangkok, as "agriculture" or "reserved rural use" was in doubt. In 1994, BMA's Department of City Planning hired the Massachusetts Institute of Technology (MIT) to advise on the revisions of the 1992 plan for enactment in 1996. MIT proposed that almost all the western sector of Bangkok be zoned for residential purposes.

6. The TA's final report, submitted in September 1996, recommended distributor roads throughout the western sector of Bangkok, east of the Outer Ring road. At that time, the "reserved rural use" zone was expected to be changed to a residential zone.

7. The revised BMA City Plan was enacted in 1997. In the western sector, the former "reserved rural use" area was renamed the "rural use and agriculture" zone. The northeastern tip of this new zone is shown as "low density residential". In this new rural use and agriculture zone, only 10% of the land area of individual parcels of land is supposed to have buildings constructed on them. However, the Department of Lands, a national Government agency,

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[1] A super block is a large land area locked in by several highways without proper or sufficient access road connections into or out from the land area.

handles approvals for subdivision of land, not the BMA. Continued subdivision of land parcels would permit progressive construction of new buildings, while observing the 10% maximum coverage rule enforced by BMA through their control of building approvals.

8. Comparison of satellite photographs taken in 1996 and 2002 shows that southern sections of the rural use and agriculture zone had extensive urban development encroachment, especially along major road corridors at densities of more than 10% of that zone's land area. This means that the integrity of this zone has been lost. The extent of urban development shown in the 2002 photograph is little different from in 1996, perhaps because the 1997 Asian financial crisis slowed new development significantly. Moreover, the project road was not completed until 2001. The benefit monitoring and evaluation report issued by Epsilon for the Department of Rural Roads in 2005 confirms that few land use changes have taken place within 500 meters of the Thonburi extension. Residential use had decreased from 58% to 54% between 1996 and 2005, commercial land use had increased from 9 to 10%.

BANGKOK VEHICLE FLEET, TRAFFIC SPEEDS, AIR QUALITY, AND ACCIDENTS

A. Fleet and Speeds

1. Bangkok's in-use[1] national motor vehicle fleet was about 2.94 million in 2003, as shown in Table A9.1. From 1994 to 2003, the Bangkok vehicle fleet grew at a rate of 5.5% per year. The number of cars grew at a similar rate. A high proportion of total fleet growth was due to pickups, almost all which are diesel powered, which are widely used as personal vehicles. With a short average life of 4 years, the in-use motorcycle fleet has remained fairly constant. Large numbers of new motorcycles were sold in the 1990s, before the onset of the Asian financial crisis in 1997, which resulted in rapid motorcycle fleet growth. However, motorcycle sales declined steeply after the 1997 crisis, and the number of new motorcycles entering the fleet was only sufficient to replace those being retired or transferred up-country. Despite the very high growth rate of vehicles in Bangkok, an estimated 44.5% of all households in 1995 did not have a vehicle (i.e., a car or motorcycle).

Table A9.1: Number of In-Use Vehicles by Type (Bangkok, 1994–2003)

Type	1994	2003	Type of Fleet (%)	Annual Growth Rate (%)
Car	716,591	1,162,704	39.60	5.50
Microbus and Passenger Van	241,120	149,613	5.19	(5.20)
Van and Pickup	245,942	583,045	19.90	10.10
Urban Taxi	22,256	63,228	2.20	12.30
Motorcycle Taxi (Tuk Tuk)	3,645	7,394	0.25	8.20
Motorcycle	851,853	857,460	29.20	0.07
Truck	73,145	75,800	2.60	0.40
Bus	17,457	26,225	0.90	4.60
Other	13,220	11,248	0.40	3.30
Total	2,185,229	2,936,717	100.00	5.52

Note: Other includes vehicles such as tractors. Non-motorized vehicles excluded.
Source: Land Transport Department.

2. Available data from Office of Transport and Traffic Policy and Planning on vehicle speeds (Table A9.2) show that average speed on major roads in July 2003 was 15.5 kilometers per hour (kph) during the morning rush hour in the peak direction of traffic flow, which is inbound to the central business district, and 22.6 kph in the evening rush hour in the peak direction (outbound) of traffic flow. Speeds in the non-peak direction were likely higher. Speeds in the off-peak period were not reported, though they also were likely higher.

Table A9.2: Average Speed for Private Cars on Major Roads in Bangkok (July 2003)

Direction	Distance (km)	Average Speed (km/hr) 06:00–09:00	Average Speed (km/hr) 16:00–19:00
Paholyothin Rd. – Phayathai Rd.	17.25	13.90	18.10
Viphavadee Rungsit Rd.	14.32	30.60	54.40

[1] These in-use data available from unpublished data sets of Thailand's Department of Land Transport are about half of the cumulative vehicle registration figures normally published, which fail to account for almost all vehicles that are scrapped or which no longer operate.

Direction	Distance (km)	Average Speed (km/hr) 06:00–09:00	16:00–19:00
Prachachun Rd. – Rama 5 Rd.	15.59	16.50	19.40
RamRamkhamhaeng Rd. - Rama 9 Rd.	12.70	18.10	18.90
Srinakarin Rd. – Petchburi Rd.	13.13	19.60	43.00
Rama 4 Rd.	8.89	15.10	15.10
Sukumvit Rd. – Rama 1 Rd.	14.07	15.50	14.60
Ladphao Rd.	11.00	17.80	14.80
Sirintorn Rd. – Rachavitee Rd.	16.23	19.70	27.90
Boromrachchonnanee Rd. – Rachadumnun Glang Rd.	6.84	17.30	23.90
Pechkasem Rd. – Charansanitwong Rd.	16.19	15.30	24.00
Taksin Rd. – Rama 2 Rd.	5.02	14.00	28.50
Sathorn Rd. – Krung Thonburi Rd.	5.87	15.00	29.10
Mahisawan Rd. – Chareon Krung Rd.	5.38	7.10	10.20
Overall Average		**15.50**	**22.60**

hr = hour, km = kilometer, km/hr = kilometers per hour, Rd. = road.
Source: Office of Transport and Traffic Policy and Planning, 2003.

3. These speeds are typical of other major cities, although comparisons are difficult. Historical data on traffic speeds in Bangkok for the early 1990s are very limited, which makes valid comparisons to the 2003 data shown in the table difficult. However, anecdotal information suggests that in 1990–1995 (and even through to 1997) traffic speeds were very slow and associated pollution severe, mainly due to construction of road and rail systems along or intersecting major roads in Bangkok's central business district.

4. In 1995, as part of the calibration of the Bangkok Transport Model during the Urban Transport Database and Model Development (UTDM) project, travel time surveys were undertaken on 30 routes. The average morning peak speed was 22.8 kph and 20.3 kph in the evening. The 1995 travel speeds on the same or similar routes to those surveyed in 2003 are in Table A9.3.

5. Since 1996, most of the construction projects have been completed. Some, such as Stage B of the Second Stage Expressway, completed a ring around central Bangkok and eased congestion. Two railway systems also were opened: the elevated Bangkok Transit System in 1999 and the Blue Line Subway in 2004. These offer many motorists an alternative, providing a "relief valve" when congestion is high. In addition, the decline in economic activity after 1997 generally was felt until 2001, which improved traffic speeds.

6. A comparison of the 2003 and 1995 survey results appear to show that morning peak hour speeds inbound declined by a third over the 7-year period to 2003, while outbound peak hour speeds increased by a tenth. The time period and method of the surveys are not known. The results, while not conclusive, might mean that speeds in 2003 had declined since 1996, at least in the morning peak hour.

7. Traffic congestion appears to be rising due to increased economic activity and the growth in the vehicle fleet.

Table A9.3: Average Speed for Private Cars on Major Roads in Bangkok, 1995

Direction	Distance (km)	Average Speed (km/hr) AM Peak	Average Speed (km/hr) PM Peak
Paholyothin Rd. - Phayathai Rd. – NB		16.5	17.6
Paholyothin Rd. - Phayathai Rd. – SB	3.8	11.1	17.6
Viphavadee Rungsit Rd.	—	—	—
Prachachun Rd. - Rama 5 Rd. -NB		19.4	14.8
Prachachun Rd. - Rama 5 Rd. -SB	3.8	14.4	18.9
RamRamkhamhaeng Rd. - EB		22.2	13.4
RamRamkhamhaeng Rd. - WB	5.9	22.0	11.3
Rama 9 Rd. - EB		18.7	13.9
Rama 9 Rd. - WB	4.6	23.1	11.2
Srinakarin Rd. – NB		25.0	16.1
Srinakarin Rd. – SB	3.1	9.9	18.9
Rama 4 Rd. –EB		18.5	11.4
Rama 4 Rd. –WB	3.8	10.8	19.4
Sukumvit Rd. – EB		26.3	15.7
Sukumvit Rd. – EB	4.8	12.0	4.8
Ladphao Rd.-EB		20.2	13.9
Ladphao Rd.-WB	8.8	15.2	11.2
Sirintorn Rd. - Rachavitee Rd.	—	—	—
Boromrachchonnanee Rd. - Rachadumnun Glang Rd.	—	—	—
Pechkasem Rd. – EB		19.8	30.0
Pechkasem Rd. – WB	16.0	40.2	29.0
Charansanitwong Rd.-NB	9.9	9.3	18.8
Charansanitwong Rd.-SB		22.5	25.1
Rama 2 Rd. –EB		20.3	20.7
Rama 2 Rd. - WB	21.4	45.0	46.1
Sathorn Rd. – EB		9.4	9.5
Sathorn Rd. - WB	5.9	31.2	17.5
Chareon Krung Rd.-NB	5.3	4.1	14.3
Chareon Krung Rd.-NB	9.0	12.4	15.3
Overall Average		**22.8**	**20.3**

— = not available, EB = East Bound, hr = hour, km = kilometer, NB = North Bound, Rd. = road, SB = South Bound, WB = West Bound.
Source: Urban Transport Database and Model Development, 1996.

8. The effects due to construction and the interruption to normal economic growth mask the effects of urban area expansion, whereby traffic speeds tend to remain stable at around 10–20 kph (i.e., moderate to high congestion) in the central area. However, the congestion spreads outward geographically and temporally to the off-peak periods, including weekends.

9. The transport modeling undertaken by the project performance evaluation report shows that much of Bangkok's central area experienced beneficial effects of the project road. By filling a missing transportation link, and relieving major sections of the nearby road network in western Bangkok, the project road is expected to have an ongoing positive impact on Bangkok's traffic. Without the road, traffic speeds can be assumed to have been lower.

10. The project road and associated primary roads can be expected to accelerate the urbanization of western Bangkok. Without new distributor roads, the problems of super blocks will emerge. However, new super blocks near central Bangkok, close to a network of primary roads, is arguably better than in more distant locations served by a single highway, which has tended to be the norm.

B. Air Pollution

11. Cars are major sources of carbon monoxide (CO), hydrocarbons (HC), and nitrogen oxides (NOx). Two-stroke motorcycles are a dominant source of HC, and also contribute significantly to particulate matter (PM) and CO emissions. Diesel trucks, heavy and light duty, are responsible for high emissions of PM, NOx, HC, and CO. As described by the Thailand Air Quality Monitor 2002,[2] very fine particulate matter below 10 microns in size, which can penetrate deep into the lungs and is known as PM_{10} (or finer such as $PM_{2.5}$), pose the most severe threat to human health. Aging bus fleets in urban areas, including Bangkok, are large emitters of such PM. Lead in ambient air is not an issue in Thailand anymore, having being phased out from gasoline in January 1996.

12. Thailand's Pollution Control Department has a comprehensive air quality monitoring network in Bangkok. Average ambient measurements of PM_{10} have declined steadily in recent years (1996–2001) for Bangkok to just under 50 $\mu g/m^3$, which is well below the standard of 120 $\mu g/m^3$. Data on average ambient PM_{10} for May 2005, available from the Pollution Control Department, indicates that average ambient PM_{10} remains below 50 $\mu g/m^3$. Nitrogen dioxide levels were stable over 1996–2001 at around 20 $\mu g/m^3$, which is well below the standard of 170 $\mu g/m^3$.

13. In 2000, measurements of ambient ozone in Bangkok showed that, while average concentrations were low at all monitoring stations, maximum values exceeded the standards significantly and frequently. Similar results are being observed in 2005.

14. Automobiles are the largest source of CO emissions. Roadside measurements from 1988 to 2001, reported by the Air Quality Monitor, showed a steady reduction in CO over the 13-year period to an average of below 3 $\mu g/m^3$. This is below the standard for CO (8 hours) of 9 $\mu g/m^3$. In May 2005, CO (8 hours) averaged around 1 $\mu g/m^3$.

15. Greenhouse gases are directly related to fuel use, which is increasing despite recent higher world oil prices.

16. The air quality monitor showed that overall average ambient concentrations of key pollutants, which were well below prevailing ambient air quality standards due to some of the strictest regulations in Asia, had declined over time or remained constant. However, notable transgressions of the air quality standards were evident for PM, ozone, and most of the other pollutants.

17. Improved control measures for fuel quality and new vehicle emission standards, as well as the Asian financial crisis of 1997, contributed to the decline reported by the air quality monitor over 1996–2001. Although 2005 pollution data indicates pollution levels have remained stable since 2001, continued rapid economic growth, along with sharp increases in vehicle growth and increased industrial activity, might increase ambient pollution levels in the future. The Government's control measures will mitigate the growth of pollution to some extent. However, increases in average ambient concentrations and roadside concentrations are likely, as well as an increased incidence of standards being exceeded.

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[2] World Bank. 2002. *Thailand Environment Monitor 2002 – Air Quality*. Bangkok: The World Bank.

18. Improved traffic flow resulting from the project road probably contributed to a reduction in emissions from vehicles, which emit less when operating at moderate speeds and not stuck in traffic jams. Taking advantage of traffic flow improvements to give greater priority to buses could enhance emission reductions and fuel efficiency.

C. Traffic Accidents

19. The project road increased network vehicle speeds slightly, though this is unlikely to have caused a change in the number and type of accidents. In 2001, the International Finance Corporation's study of the external benefits of the Bangkok Skytrain[3] analyzed vehicle accident data, including (i) aggregate injury accident data for the Bangkok Metropolitan Region in 2000 from Royal Thai Police statistics; and (ii) total accident data (i.e., injury plus non-injury) by mode for the region. These data are in Table A9.4.

20. Transport modeling output for the region yielded the amount of travel by selected modes, as shown in Table A9.5.[4]

Table A9.4: Total Reported Accidents in Bangkok Metropolitan Region in 2000

Vehicle Type	No. of Accidents	Percent
Private Car, Van, Pickup	38,001	54.4
Motorcycle	17,814	25.5
Bus	2,428	3.5
All Other	11,637	16.6
Total	**69,880**	**100.0**

Source: Royal Thai Police as reported by Policy Appraisal Services et al. (2001).

Table A9.5: Estimated Distribution of Fatality and Injury Accidents by Mode in 2000 (Bangkok Metropolitan Region)

Vehicle Type	Fatalities	Serious Injury	Injury	Total
Private Car, Van, Pickup	296	900	7,823	9,019
Motorcycle	277	844	7,342	8,463
Bus	9	29	250	288
All Other	91	276	2,406	2,773
Total	**673**	**2,049**	**17,821**	**20,543**

Source: Policy Appraisal Services et al. (2001).

21. Table A9.5 shows that motorcyclists were involved in an estimated 8,463 injury and fatal accidents from a total reported accidents involving motorcyclists of 17,814. This means that 47.5% of all motorcycle accidents are likely to involve injury.

22. Because occupancy rates of bus and the Bangkok Skytrain are much higher than private car, the most satisfactory way of comparing modes is to use the amount of person-kilometers of travel. The derived accident rate for these modes plus Skytrain is shown in the Table A9.6.

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[3] Prepared by Policy Appraisal Services and Economic and Policy Services (2001).

[4] All model output is in terms of passenger car units. This output is distributed among modes based on roadside classification counts.

Table A9.6: Derived Accident Rates Per 100 Million Person-Km (Bangkok Metropolitan Region)

Vehicle Type	Annual Million Person-km	Accident rate per 100 million person-km			
		Fatality	Serious Injury	Injury	Total
Private Car, Van, Pickup	20,100	1.50	4.50	39.0	45.0
Motorcycle	13,090	2.10	6.40	56.0	65.0
Bus	16,000	0.06	0.18	1.6	1.8
Skytrain	392[a]	—	—	< 1.6	< 1.6

— = not available, < = less than, km = kilometer.

[a] Obtained by this calculation: daily weekday patronage (215,000) x 300 days per year x average trip length (6.08 km).

Source: Policy Appraisal Services et al. (2001).

23. Based on these statistics in 2000, taking a bus was about 25 times safer than a car and 55 times safer than a motorcycle.

24. A comparison between reported accidents for the BMR in 2000 and in 1994 (before the project road started construction) can be based on Table A9.7, although the data is incomplete. In 1994, total reported accidents for car (and pickup and van) plus motorcycles were 72,395, which is 38.5% higher than the 55,815 reported accidents in 2000 (Table A9.4) for the same categories. Hence, even though the vehicle fleet increased by around 5.5% per year—or 38% from 1994 to 2000—the number of accidents declined. The number of reported fatalities and injuries (serious and minor) in 2000 was reported as 20,543, compared to 20,135 reported in 1994. This means that accidents declined on a per-in-use vehicle basis. The reduction in reported accidents from 1994 to 2000 might be due to reduced vehicle usage (i.e., km operated) as a result of the economic recession from 1997 to 2000. The per-in-use vehicle decline in fatalities and injuries appears due to increases in safety of new vehicle designs, as well as new regulations introduced in 1993 and 1994 and the subsequent requirement that seat belts be worn in the front seat of vehicles and that motorcycle riders wear helmets. The project road might have contributed in a small way to increased safety by making bus transport more attractive. More importantly, the construction of major new public roads does not seem to have increased the number of traffic accidents. More significant factors influence the growth and reduction of traffic accidents.

Table A9.7: Reported Accidents in Bangkok Metropolitan Region in 1994

Vehicle Type	No. of Accidents	Percent
Private Car, Van, Pickup	27,218	37.6
Motorcycle	45,177	62.4
Bus	—	—
All Other	—	—
Total	**72,395**	**100.0**

— = data not reported, BMR = Bangkok Metropolitan Region.

Source: Royal Thai Police (undated).

Table A9.8: Reported Fatality and Injury Accidents in Bangkok Metropolitan Region in 1994

Vehicle Type	Fatalities	Injury	Total
Total	**1,290**	**18,845**	**20,135**

Source: Royal Thai Police (undated).