

Document of
The World Bank

Report No: ICR2287

IMPLEMENTATION COMPLETION AND RESULTS REPORT
(IBRD-75110)

ON A

LOAN

IN THE AMOUNT OF US\$ 200 MILLION

TO THE

PEOPLE'S REPUBLIC OF CHINA

FOR A

ANHUI HIGHWAY REHABILITATION AND IMPROVEMENT PROJECT

December 12, 2012

China and Mongolia Sustainable Development Unit
Sustainable Development Department
East Asia and Pacific Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective June 30, 2012)

Currency Unit = RMB (Chinese Yuan Renminbi)

RMB 1.00 = US\$ 0.1581

US\$ 1.00 = RMB 6.3249

FISCAL YEAR

January 1-December 31

ABBREVIATIONS AND ACRONYMS

ADRC = Anhui Development and Reform Commission
AHAB = Anhui Highway Administration Bureau
APAO = Anhui Provincial Audit Office
APCD = Anhui Provincial Communications Department
APFB = Anhui Provincial Finance Bureau
CNAO = China National Audit Office
CPS = Country Partnership Strategy
CPMS = Chinese Pavement Management System
CQS = Selection Based on Consultant's Qualifications
DA = Designated Account
EA = Environmental Assessment
EASTE = World Bank East Asia and Pacific Region Transport, Energy and Mining Sector Unit
EIA = Environmental Impact Assessment
EIRR = Economic Internal Rate of Return
EMP = Environmental Management Plan
FM = Financial Management
FMS = Financial Management Specialist
FSL = Fixed-Spread Loan
FYP = Five Year Program
HDM = Highway Design and Maintenance Model
IC = Individual Consultant Selection
ICB = International Competitive Bidding
ICR = Implementation Completion Report
ITC = International Tendering Company
LIBOR = London Interbank Offered Rate
MBD = Model Bidding Document
MOC = Ministry of Communications
MOF = Ministry of Finance
Mu = Chinese measure of land area (15 mu/hectare)
NCB = National Competitive Bidding
NDRC = National Development and Reform Commission
NPV = Net Present Value
PAD = Project Appraisal Document
PCMO = Project Construction Management Office
PEO = Project Executing Office
PFM = Project Financial Management
PMS = Pavement Management System
PQI = Pavement Quality Index
QBS = Quality-Based Selection
QCBS = Quality- and Cost-Based Selection
RAP = Resettlement Action Plan

RIOH = Research Institute of Highway
RONET = Road Network Evaluation Tools
ROW = Right of Way
RPF = Resettlement Policy Framework
SBD = Standard Bidding Documents
SOE = Statement of Expenditures
SWAp = Sector-wide Approach
VOC = Vehicle Operating Cost
VSL = Variable-Spread Loan

Vice President: Pamela Cox, EAPVP
Country Director: Klaus Rohland, EACCF
Sector Manager: Mark A. Lundell, EASCS
Project Team Leader: Mitsuyoshi Asada, EASIN
ICR Team Leader: Mitsuyoshi Asada, EASIN

People's Republic of China
Anhui Highway Rehabilitation and Improvement Project

CONTENTS

Data Sheet

- A. Basic Information
- B. Key Dates
- C. Ratings Summary
- D. Sector and Theme Codes
- E. Bank Staff
- F. Results Framework Analysis
- G. Ratings of Project Performance in ISRs
- H. Restructuring
- I. Disbursement Graph

1. Project Context, Development Objectives and Design.....	1
2. Key Factors Affecting Implementation and Outcomes	5
3. Assessment of Outcomes	8
4. Assessment of Risk to Development Outcome.....	13
5. Assessment of Bank and Borrower Performance	14
6. Lessons Learned	15
7. Comments on Issues Raised by Borrower/Implementing Agencies/Partners	16
Annex 1. Project Costs and Financing.....	18
Annex 2. Outputs by Component	19
Annex 3. Economic and Financial Analysis	20
Annex 4. Bank Lending and Implementation Support/Supervision Processes	22
Annex 5. Beneficiary Survey Results	24
Annex 6. Stakeholder Workshop Report and Results.....	25
Annex 7. Summary of Borrower's ICR and/or Comments on Draft ICR.....	26
Annex 8. Comments of Cofinanciers and Other Partners/Stakeholders	38
Annex 9. List of Supporting Documents	39
MAP	40

A. Basic Information			
Country:	China	Project Name:	Anhui Highway Rehabilitation and Improvement Project
Project ID:	P099112	L/C/TF Number(s):	IBRD-75110
ICR Date:	12/03/2012	ICR Type:	Core ICR
Lending Instrument:	SIL	Borrower:	PEOPLE'S REPUBLIC OF CHINA
Original Total Commitment:	USD 200.00M	Disbursed Amount:	USD 200.00M
Revised Amount:	USD 200.00M		
Environmental Category: A			
Implementing Agencies: Anhui Provincial Transport Department (Former Anhui Provincial Communications Department)			
Cofinanciers and Other External Partners:			

B. Key Dates				
Process	Date	Process	Original Date	Revised / Actual Date(s)
Concept Review:	10/17/2006	Effectiveness:	11/06/2008	11/06/2008
Appraisal:	04/23/2007	Restructuring(s):		
Approval:	04/22/2008	Mid-term Review:	10/20/2010	10/11/2010
		Closing:	06/30/2012	06/30/2012

C. Ratings Summary	
C.1 Performance Rating by ICR	
Outcomes:	Moderately Satisfactory
Risk to Development Outcome:	Moderate
Bank Performance:	Moderately Satisfactory
Borrower Performance:	Satisfactory

C.2 Detailed Ratings of Bank and Borrower Performance (by ICR)			
Bank	Ratings	Borrower	Ratings
Quality at Entry:	Moderately Satisfactory	Government:	Satisfactory
Quality of Supervision:	Satisfactory	Implementing Agency/Agencies:	Satisfactory
Overall Bank Performance:	Moderately Satisfactory	Overall Borrower Performance:	Satisfactory

C.3 Quality at Entry and Implementation Performance Indicators			
Implementation Performance	Indicators	QAG Assessments (if any)	Rating
Potential Problem Project at any time (Yes/No):	No	Quality at Entry (QEA):	None
Problem Project at any time (Yes/No):	No	Quality of Supervision (QSA):	None
DO rating before Closing/Inactive status:	Satisfactory		

D. Sector and Theme Codes		
	Original	Actual
Sector Code (as % of total Bank financing)		
Roads and highways	99	99
Sub-national government administration	1	1
Theme Code (as % of total Bank financing)		
Infrastructure services for private sector development	100	100

E. Bank Staff		
Positions	At ICR	At Approval
Vice President:	Pamela Cox	James W. Adams
Country Director:	Klaus Rohland	David R. Dollar
Sector Manager:	Mark R. Lundell	Junhui Wu
Project Team Leader:	Mitsuyoshi Asada	Aurelio Menendez
ICR Team Leader:	Mitsuyoshi Asada	
ICR Primary Author:	Xiaoke Zhai	

F. Results Framework Analysis

Project Development Objectives (from Project Appraisal Document)

The project aims to increase the effective use of the road infrastructure in the Anhui Province to support its social and economic development, as evidenced by the increase in the flows of passenger and freight traffic along key corridors across the province at lower costs and with improved safety.

Revised Project Development Objectives (as approved by original approving authority)

None

(a) PDO Indicator(s)

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
Indicator 1 :	Freight/passenger tariff (Corridor G104) RMBs/ton-km			
Value quantitative or Qualitative)	0.45	0.38	None	0.47 in nominal terms and 0.39 in real terms
Date achieved	12/31/2006	12/31/2011	12/31/2011	12/31/2011
Comments (incl. % achievement)	The actual value achieved 86% of the targeted reduction in real terms, though fuel and labor prices increased about 59.5% and 82.9% respectively due to the global financial crisis and domestic stimulus package.			
Indicator 2 :	Freight/passenger tariff (Corridor S105) RMBs/ton-km			
Value quantitative or Qualitative)	0.52	0.43	None	0.56 in nominal terms and 0.47 in real terms
Date achieved	12/31/2006	12/31/2011	12/31/2011	12/31/2011
Comments (incl. % achievement)	The actual value was less than the target value but achieved 56% of the targeted reduction in real terms, though fuel and labor prices increased about 59.5% and 82.9% respectively due to the global financial crisis and domestic stimulus package.			
Indicator 3 :	Freight/passenger tariff (Corridor Caijiaqiao-Tanjiaqiao-Tangkou-Tunxi) RMBs/ton-km			
Value quantitative or Qualitative)	0.38	0.30	None	0.45 in nominal terms and 0.375 in real terms
Date achieved	12/31/2006	12/31/2011	12/31/2011	12/31/2011
Comments (incl. % achievement)	The actual value achieved 6% of the targeted reduction in real terms, though fuel and labor prices increased about 59.5% and 82.9% respectively. The corridor connected Anhui with Jiangxi, a less developed province.			
Indicator 4 :	Average travel time on rehabilitation roads: Average increase in travel speeds from initial km/hr values (passenger car)			
Value quantitative or Qualitative)	49.2	15.9%	None	16.0%
Date achieved	12/31/2006	12/31/2011	12/31/2011	12/31/2011
Comments (incl. % achievement)	The average increase in travel speed achieved 100.6% of the target value.			
Indicator 5 :	Average travel time on improvement roads: Average increase in travel speeds from initial km/hr values (passenger car)			
Value quantitative or Qualitative)	42.0	34.8%	None	25.0%
Date achieved	12/31/2006	12/31/2011	12/31/2011	12/31/2011
Comments	The average increase in travel speed was less than the target value but achieved			

(incl. % achievement)	72% of the targeted increase. To reduce accidents, traffic police enforced more speed control along the roads, which slowed down travel speed.
-----------------------	--

(b) Intermediate Outcome Indicator(s)

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
Indicator 1 :	Traffic volume on roads rehabilitated: Average % increased from before the initiation and one year after the completion of the works			
Value (quantitative or Qualitative)	3,021	5.1%	None	7.50%
Date achieved	12/31/2006	12/31/2011	12/31/2011	12/31/2011
Comments (incl. % achievement)	Traffic volume on rehabilitated roads grew very fast and achieved 147% of the target value.			
Indicator 2 :	Traffic volume on roads improved: Average % increased from before the initiation and one year after the completion of the works			
Value (quantitative or Qualitative)	3,361	4.5%	None	7.31%
Date achieved	12/31/2006	12/31/2011	12/31/2011	12/31/2011
Comments (incl. % achievement)	Traffic volume on improved roads grew very fast and achieved 162% of the target value.			
Indicator 3 :	Accident rate on roads rehabilitated: Reduction in the number of accidents per thousand of vehicle-km-year			
Value (quantitative or Qualitative)	0.32	0.20	None	0.28
Date achieved	12/31/2006	12/31/2011	12/31/2011	12/31/2011
Comments (incl. % achievement)	The accident rate decreased less than the target value. The other factors offset the impact of infrastructure improvements as drunk-driving, overloading, weak safety awareness, insufficient safety education and new driver training.			
Indicator 4 :	Accident rate on roads improved: Reduction in the number of accidents per thousand of vehicle-km-year			
Value (quantitative or Qualitative)	0.34	0.18	None	0.32
Date achieved	12/31/2006	12/31/2011	12/31/2011	12/31/2011
Comments (incl. % achievement)	The accident rate decreased less than the target value. The other factors offset the impact of infrastructure improvements as drunk-driving, overloading, weak safety awareness, insufficient safety education and new driver training.			
Indicator 5 :	Application of recycling mechanisms in road rehabilitation: Milestones to be completed by the end of each calendar year			
Value	n/a	3 cases	None	5 pilots

(quantitative or Qualitative)				
Date achieved	12/31/2006	12/31/2011	12/31/2011	12/31/2011
Comments (incl. % achievement)	Five roads were piloted with different recycling technologies. A Technical Guideline for Anhui Highway Asphalt Pavement Recycling Design and Construction was completed and applied.			
Indicator 6 :	Installation of new (enhanced) CPMS: Number of kilometers with specified milestones completed by the end of each calendar year			
Value (quantitative or Qualitative)	n/a	11,100 km	None	9,501 km
Date achieved	12/31/2006	12/31/2011	12/31/2011	12/31/2011
Comments (incl. % achievement)	The CPMS was applied to the entire highway network in Anhui. The total length of the highway networks was less than the target value due to the highway network adjustment.			
Indicator 7 :	Alternative contractual mechanisms applied for road maintenance: Cumulative number of km with maintenance contracts			
Value (quantitative or Qualitative)	0	120 km	None	120 km
Date achieved	12/31/2006	12/31/2011	12/31/2011	12/31/2011
Comments (incl. % achievement)	Two performance-based contracts with a total length of 120 km were completed.			
Indicator 8 :	Enhanced balance of budgetary resources towards appropriate upkeep of road assets: % of AHAB budget allocated to maintenance and rehabilitation			
Value (quantitative or Qualitative)	57.0%	62%	None	55.1%
Date achieved	12/31/2006	12/31/2011	12/31/2011	12/31/2011
Comments (incl. % achievement)	The percentage of funds allocated to maintenance was less than the target value because China introduced fuel tax in 2009 that completely changed the anticipated fund growth pattern.			
Indicator 9 :	Environmental manuals completed and applied: Milestones to be completed by the end of each calendar year			
Value (quantitative or Qualitative)	n/a	main-streamed	None	Manual completed and applied
Date achieved	12/31/2006	12/31/2011	12/31/2011	12/31/2011
Comments (incl. % achievement)	A Manual for Highway Construction & Environmental Protection in Anhui was completed and applied in the province.			
Indicator 10 :	Evaluation of training (based on survey): % of positive evaluation			
Value (quantitative or Qualitative)	n/a	70%	None	82.55%
Date achieved	12/31/2006	12/31/2011	12/31/2011	12/31/2011
Comments	The satisfactory rate of feedbacks on training exceeded the target value.			

(incl. % achievement)	
-----------------------	--

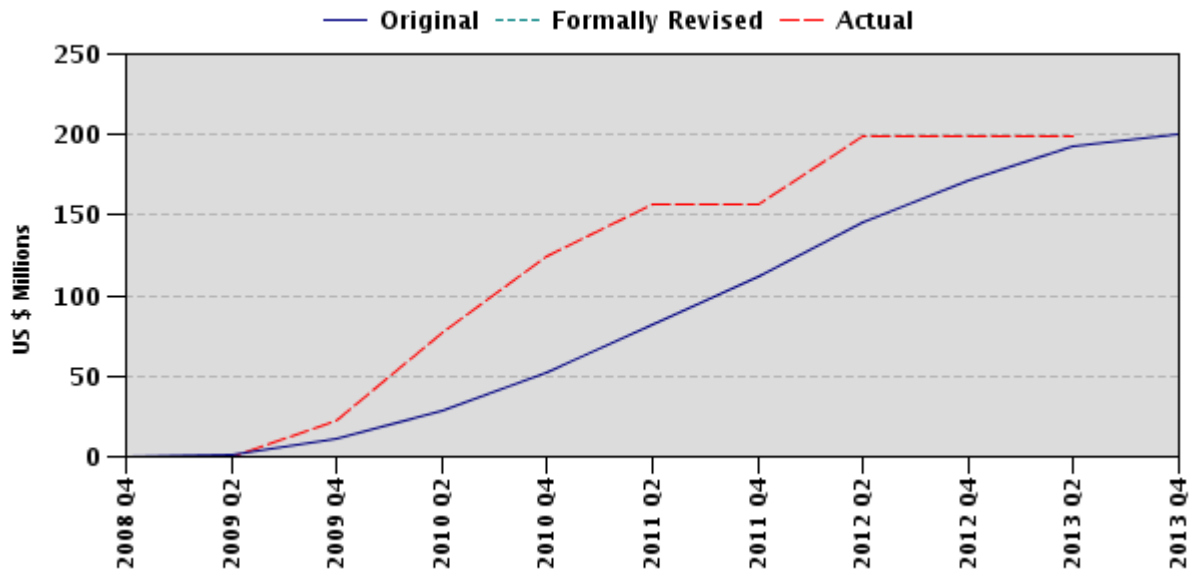
G. Ratings of Project Performance in ISRs

No.	Date ISR Archived	DO	IP	Actual Disbursements (USD millions)
1	08/13/2008	Satisfactory	Satisfactory	0.00
2	01/24/2009	Satisfactory	Satisfactory	0.00
3	12/02/2009	Satisfactory	Satisfactory	57.71
4	12/24/2010	Satisfactory	Highly Satisfactory	156.54
5	12/24/2011	Satisfactory	Highly Satisfactory	199.50

H. Restructuring (if any)

Not Applicable

I. Disbursement Profile



1. Project Context, Development Objectives and Design

1.1 Context at Appraisal

Anhui Province, with about 65 million people in 2006, was one of the most populous and densest provinces of China. Compared to its more successful neighbors to the east and north (Zhejiang, Jiangsu, and Shandong) Anhui had lagged markedly behind in socio-economic development, with a GDP per capita around one third the average level of those three provinces and two years lower life expectancy (73 vis-a-vis 75 years). Compared to those to the west and south (Hubei, Henan, and Jiangxi) Anhui had more similar though slightly lower-socio-economic indicators. Within Anhui, there was great regional disparity, with most of the wealth concentrated in industrial regions close to the Yangtze River.

In line with the Central Government's initiative of "Rise of Central China" in 2006 which was part of the 11th Five-Year Program (FYP), defined as crucial for a coordinated and harmonized development between eastern, central and western areas, the Anhui Government elaborated its own strategy of "Development to the East", with an aim at expediting the incorporation of the various regions of Anhui to the comparatively more affluent regions of the Yangtze Delta, including those poorer areas (in the north and south of Anhui). Transport was one of the priorities in that development strategy.

Although the highway network of Anhui Province (about 71,214 km by the end of 2006) represented a sizable network in terms of kilometers per inhabitant, the average service level was limited due to the relatively low technical standards. Compared to the six surrounding provinces, the density of the network (km per population) was above the average, while the percentage of paved roads (as a proxy for the quality of the infrastructure) was the lowest. This resulted in likely shortcomings of the existing highway network in meeting transport demand. Other major issues of the highway network included: (a) connections on the east-forward corridors consisting of a lower-class type of roads; (b) poor quality of pavement and weak resistance against disaster; and (c) unbalanced distribution of network across the regions in Anhui Province.

The Anhui Provincial Government had then advanced a program for upgrading and reconstructing the existing national and provincial trunk highway network - the so-called "5 1 5 Engineering Program" - to enhance the level of service and traffic capacity, while minimizing the needs for land acquisition. The Government of China requested the World Bank to support the implementation of the rehabilitation and improvement of provincial/national trunk highways within Anhui Province and attain the full benefits of an efficient transport network by fostering its integration of villages and towns within the Province and of those networks with its neighboring provinces. The Bank was technically in a good position to contribute to the incorporation of up-to-date approaches and tools for strengthening the capacity of Anhui Provincial Communication Department that was responsible for provincial highway development and management (renamed as Anhui Provincial Transport Department during the project implementation). The Bank pursued an innovative approach that introduced a performance-based contract in highway maintenance in Anhui Province.

1.2 Original Project Development Objectives (PDO) and Key Indicators

The project aimed to increase the effective use of the road infrastructure in Anhui Province to support its social and economic development, as evidenced by the increase in the flows of passenger and freight traffic along key corridors across the province at lower costs and with improved safety.

The achievement of the project development objective was assessed through the measurement of the following outcome indicators: reduction in average freight rates along a representative sample of key provincial and national road corridors, and reduction in travel time on the rehabilitated or improved roads.

1.3 Revised PDO (as approved by original approving authority) and Key Indicators, and reasons/justification

The PDO and the key indicators were not revised.

1.4 Main Beneficiaries,

The direct project beneficiaries were the users of the improved highways in 9 out of the 17 municipalities of Anhui Province and the inhabitants along these highways with safer and more environmentally-friendly features. The indirect project beneficiaries included the population in the entire province since this project not only enhanced the connection among municipalities and with the neighboring provinces, but also increased the ability of highway maintenance administrative entities in the Province to provide better services. Consequently, the project's interventions aim to lower transport costs, improve the productivity in the Province, enhance its competitiveness, and increase the inter- and intra-provincial trade.

1.5 Original Components

The project included the following components:

Component A. Road Rehabilitation

[Estimated cost US\$193.61 million - 47.3% of the total project cost - of which US\$97.70 million was to be financed by the Bank Loan]

This component supported the provincial rehabilitation and maintenance program from 2007-2010 under the 11th FYP. The Bank contribution helped finance eligible investments under the rehabilitation component of the program. A list of 18 segments to be rehabilitated, for about 890 km, was evaluated and found acceptable in the context of the province-wide program of the road network rehabilitation. Activities under this component consisted of improving pavement conditions of the roads by resurfacing, specific structural strengthening, and limited adjustments to the alignment when required to improve safety. This component included the pertinent supervision activities of the rehabilitation works to be undertaken by local supervision firms.

Component B. Road Improvement

[Estimated cost US\$209.85 million – 51.290 of the total project cost - of which US\$99.79 million was to be financed by the Bank Loan]

This component supported the improvement or upgrading of about 320 km of key provincial and national roads located on the central-eastern and southeastern areas of the Province. These improvements or upgrades included in some cases the duplication of existing roads following the same alignment with specific bypasses in built-up areas (in order to minimize resettlement actions) or with short segments of new alignments when necessary to avoid difficult topographical conditions. In two cases (roads S311 and S322), this component included the construction of a limited number of kilometers to increase the transport capacity of the existing corridor or complete missing segments. In addition, for road S322, this component included the relevant complementary elements to make the road an eco-friendly road. The supervision of the works under this component was undertaken by local supervision firms and financed with local funds.

Component C. Pilot on Road Maintenance by Contract

[Estimated cost US\$1.95 million - 0.5% of the total project cost - of which US\$0.96 million was to be financed by the Bank Loan]

Under this component, APCD implemented the maintenance by contract approach in two highway segments of the provincial highway network for a cumulative length of 120 kilometers by the end of the project. The maintenance activities were limited to routine or periodic interventions within the existing road pavement width. The final design of this component was supported by a technical assistance, as further described below, that helped APCD with additional knowledge and analytical elements for exploring the alternative maintenance mechanisms as well as for the preparation and implementation of the selected contractual schemes. The supervision was carried out by local firms supported by the previously mentioned technical assistance.

Component D. Institutional Strengthening Program

[Estimated cost US\$4.09 million - 1.0% of the total project cost - of which US\$1.05 million was to be financed by the Bank Loan]

This component included the provision of improved tools for road management (technical, environmental, and economic) and a training program, as follows:

- (a) a study on technological options for the recycling of pavement materials when a pavement is to be rehabilitated;
- (b) the technical assistance for the pilot on maintenance by contract to provide the knowledge and analytical elements for exploring alternative mechanisms for contracting of maintenance activities as well as for the preparation, implementation, supervision, and assessment of the preferred contractual scheme under the pilot;
- (c) the preparation of standardized environmental specifications;
- (d) support to APCD's Anhui Highway Administration Bureau (AHAB) in implementing the enhanced version of the Chinese Pavement Management System (CPMS) in Anhui Province, to be financed with local funds;

- (e) the analysis of socio-economic impacts of key roads to be improved under the project, towards establishing an enhanced knowledge base of the impacts of road investments on the livelihoods of the population living within the area of influence of the roads targeted for improvement, through the incorporation of specific surveys and data collection at the time of undertaking the resettlement completion reporting effort; and
- (f) a training program building upon those activities previously carried out under the Second Anhui Highway Project, for staff not only of APCD but also of city and county highway bureaus, and focusing on: (a) overseas training in road management (in conjunction with the activity in support to AHAB in implementing the new CPMS); (b) overseas training on improved technologies for the use of recycled pavement materials (in conjunction with the study on technological options for the recycling of these materials); (c) road safety; (d) project management; (e) environmental supervision of road construction; (f) environmental design of scenic/ecological routes; (g) highway planning and design; (h) highway information systems management; and (i) training to communities along the S322 road to be upgraded under the project on road safety and on starting up or developing productive activities to help them realize the benefits of improved accessibility across the corridor.

1.6 Revised Components

The original components were not revised.

1.7 Other significant changes

While there was no revision of project components, some changes were made to engineering design, project sub-projects, the implementation arrangement and funding allocations.

Technical design variations

The major technical design variations occurred during the construction of S322 (Taohuatan-Gantang). Three major design changes led to the implementation delay and cost increase of the contract. A tunnel construction replaced the bypass road design at the section of K11+200 and K12+400 since a risk of potential landslide was identified in October 2008. The design of Taiping Bridge was modified due to the significantly-raised water level of Lake Taiping. A U-shape reinforcement concrete structure was built to stabilize a landslide that occurred between K7+244.773~K7+678 in November 2010.

Scope change

To satisfy the emergency needs of the Beijing Olympic Torch relay in Anhui in 2008, APCD resurfaced the Jixi Section of S215 under rehabilitation sub-projects with domestic funds. Further works to the section were unnecessary. The Bank loan finally funded the civil works of the remaining 17 rehabilitation roads and 7 improvement roads.

Implementation arrangement

In addition to the original implementation arrangement, AHAB specially established a Chief Supervision Engineer Office (CSEO) to enhance the supervision of the project implementation in 12 cities/prefectures, provide technical assistance to the resident engineers, and ensure consistency and quality of the technical solutions applied across the 24 roads. This includes the treatment of environmental mitigation measures and management plans, the application of safety regulations, and the review of possible work variations. CSEO played an important role in the project management, particularly on the construction management, progress control and design variation management.

Funding allocation

At the final withdrawal application, about US\$470,152 was reallocated from Category 2 and 3 to fund the eligible expenditures under Category 1 upon the Bank's no-objection on May 30, 2012. This was to fully utilize the remaining fund under Category 2 (Consultant's Services) and Category 3 (Training) for Category 1 (Civil Works) to disburse the entire amount from the Loan.

2. Key Factors Affecting Implementation and Outcomes

2.1 Project Preparation, Design and Quality at Entry

The project responded to Anhui highway sector's priorities, for which it was critical to have a full commitment of APCD to ensure smooth implementation. Four components of the project targeted key aspects of improving the service level of the highways and the maintenance management capacity to jointly help realize the project objective — the effective use of the road infrastructure in Anhui province. Components A and B focused on directly improving the pavement conditions, Component C assisted to maintain the road infrastructures in an efficient way by introducing performance-based contracting, and Component D aimed to strengthen management capacity in key areas such as asphalt pavement recycling technologies, environment design and supervision, and highway management information systems.

Project implementation design was complex. The civil works of 24 roads of Component A and B were divided into 55 contracts that dispersed in 12 cities/prefectures. In addition, highway maintenance through performance-based contracting was a new approach in Anhui province. Hence, the quality implementation of all the contracts required strong management ability of the implementing agency and support from the higher level management of APCD. Still, the completion was within the capability of APCD as it had implemented earlier Bank-financed projects.

The project's design was built on lessons learned from similar projects in other provinces as well as the previous two transport projects in Anhui Province. It departed from previous Bank-financed highway projects in China with its exclusive focus on the rehabilitation and maintenance of the existing road network, stressed the management of roads assets and the serviceability of the network, considered the challenge of changes in the overall sector approaches in a short timeframe, took a gradual approach through pilot activities, and paid

attention to the full disbursement of the Bank loan at preparation stage to avoid the situation of about 15% of the loan funds un-disbursed in the first Anhui project.

2.2 Implementation

Implementation progress of the project was smooth. Forty three out of 55 civil works contracts and most of the Institutional Strengthening Program were completed with satisfactory quality one year before the closing date, and the remaining activities were fully completed by May 2012. The disbursement was way ahead of the scheduled pace. Several factors contributed to this achievement. First, the Project Executing Office (PEO) and APCD had implemented the two Bank-financed projects prior to this project. They were familiar with the Bank's policies and procedures. Second, AHAB utilized the existing sophisticated administration system, fully engaged the 12 local city/prefecture highway administration bureaus (decentralized units of the AHAB and where the actual road rehabilitation and improvement works took place) in project implementation, and assigned experienced staff to form the Sub-Project Construction Management Offices (Sub-PCMOs). Third, AHAB established a Chief Supervision Engineer Office to enhance the supervision of project implementation and to provide technical assistance to the resident engineers and Sub-PCMOs. This was critical to ensure consistent implementation quality among these rehabilitation and improvement roads responsible by 12 Sub-PCMOs whose capacities were varied. Fourth, the PEO and AHAB kept a good working relationship with the Bank team, which enabled a constructive discussion of issues that the project periodically faced. As a result, the procurement of the civil work contracts started before the end of 2007 and the construction of the first batch of civil works commenced soon after project approval. The implementation of most civil works contracts progressed well.

One issue encountered in the implementation of civil work was that low contract price increased the difficulty of project management. Since many contractors in China were not familiar with the Bank procurement policy, they often underestimated the contract risk and quoted a low price. AHAB made a good effort to handle this kind of situation during project implementation. After 7 months of stagnancy and communication, the contractor of Contract No. 9.2 (S211) terminated the contract due to heavy losses and AHAB had to find another contractor to complete the remaining works. The lowest bidder of Contract No.21.1 (S322) also expressed intention to drop the contract at contract negotiation stage because of extremely low bid price and construction challenges. Compared to the second lowest bidder, AHAB believed the lowest bidder had stronger capacity to build this technically-difficult and environmentally-sensitive road. So AHAB went through a hard contract negotiation to sign the contract.

Two performance-based maintenance contracts were successfully implemented, and the comparative advantage of performance-based contract in road asset management were noted in APCD's report. However, a two-year contract period was considered too short for contractors to lower maintenance cost and manage for long-term results. AHAB now suggests extending the performance-based road maintenance contract period to at least 4 years in the future. Similarly, the size of the pilot maintenance works, two roads of 60 km, was small to take the advantage of scale effect and allow contractors to reduce their fixed costs.

2.3 Monitoring and Evaluation (M&E) Design, Implementation and Utilization

When setting the monitoring indicator targets, the impact of external factors was not fully assessed. For example, freight/passenger tariffs reduction was used to measure the outcome of road infrastructure improvement. However, fuel and labor are two important inputs for the provision of trucking and bus services, which are beyond the control of the project. To counter the negative impact of the global financial crisis in 2008, the Government launched a huge stimulus package that led to the increase in fuel and labor prices about 59.5% and 82.9% respectively. In addition, the Government raised the minimum salary level to promote social cohesion and to share development benefits, which also contributed to a large increase in the labor costs.

Average speed as an indicator of the project outcome of road rehabilitation and improvement was also not designed to take into account potential exogenous factors, including policy responses. For example, in recent years, the Government paid more attention to traffic accident control, and as a result, more traffic police were deployed to enforce speed control along the roads, which resulted in slow driving. In addition, the traffic volume grew much faster than expected, which also slowed down travel speed, although the roads were not congested.

The accident rate was also monitored to measure intermediate outcomes of rehabilitated and improved roads. This indicator assumed that traffic accidents would be reduced as a result of improvement of pavement condition and safety facilities. However, other factors beyond the project interventions that could offset the impact of infrastructure improvements, such as drunk-driving, overloading, weak safety awareness, insufficient safety education and driver training were not taken into account when planning this PDO indicator. In addition, private car ownership in Anhui province grew rapidly in the past years and the new drivers became a major risk to road safety. Clearly, to define the target value appropriately, those factors should have been considered in addition to road infrastructure improvements.

Though the M&E system was fully implemented in terms of monitoring, it was inadequate for proper evaluation of the project. It also was not able to be utilized adequately for adjusting project activities given this inadequacy for evaluation. Nevertheless, these drawbacks of the M&E system has made APCD realize the wider issues associated with the road maintenance, rehabilitation and improvement. Accordingly, APCD has utilized these results as inputs to policy formulation and management decision-making processes more widely than before the project.

2.4 Safeguard and Fiduciary Compliance

Procurement was satisfactorily in compliance with the Bank policies and completed as scheduled. As noted in Section 1.7, contract management for this project was a challenging job because so many contracts and Sub-PCMOs were involved. AHAB issued on Dec.17, 2007 a document, “Implementation Procedures of Variation Management on World Bank Financed Anhui Highway III Project”, that stated in detail the situation and thresholds of variation approval, the responsibility of relevant parties in processing variations, the flow chart of procedures, standard forms and examples of common variation. This document was an effective tool for contract management.

Fiduciary compliance was satisfactory. Project financial management met acceptable standards during the implementation. Comments of independent auditors on annual financial statements, when they arose, were satisfactorily clarified and corrected.

Compliance with the Environmental Management Plan (EMP) was satisfactory. In addition to EMP, a Standardized Environmental Specification was developed by consultant as a part of Component D: Institutional Strengthening Program, and a training on “Low-Volume Roads Engineering: Best Management Practices” was arranged by the Bank and delivered to the staffs of APCD and its affiliated subsidiaries to enhance the environment management capacity. Negative environment impacts caused by construction activities were satisfactorily mitigated in compliance with the EMP.

Resettlement implementation was satisfactory. The compensation for land and households were fully paid according to the agreements, and the compensation rates for houses and attachments were complied with the rates in the Resettlement Plan (RP). In addition to the above resettlement measures, some affected villagers were provided job opportunities in project construction to increase incomes. Based on the result of resettlement follow-up study on 264 households, living standards and production conditions of the households affected by land acquisition and resettlement were improved as a result of the implementation of the Resettlement Plan and the project.

2.5 Post-completion Operation/Next Phase

All the rehabilitated and improved roads as well as the two pilot maintenance road sections have been handed over to local highway bureaus that are responsible for highways operation and maintenance. These bureaus have established organizations, staffs, experience, and the other resources to fulfill their operation and maintenance duties.

The successful experience of performance-based contracting in Component C and the application of the Chinese Pavement Management Systems (CPMS) in Component D have inspired APCD to continually explore an effective way of maintaining its existing highway network at a satisfactory service level with limited funds, and improve highway asset management in the province.

China’s development strategy will gradually shift from focusing on growth rate to growth quality. Following this strategy, local governments have started paying more attention to the provision of quality service by maintaining their highway infrastructure. The project’s knowledge achievements are expected to enhance the efficient use of the available maintenance budget to increase the efficiency of operation and maintenance.

3. Assessment of Outcomes

3.1 Relevance of Objectives, Design and Implementation

The Project's development objective remained highly relevant to the development priority of China. After decades of heavy investments in highway infrastructures, the total length of highways in China exceeded 4 million km by the end of 2010. In its 12th Five Year Development Outline for Highway Maintenance Management (2011-2015), the Ministry of

Transport identified five main issues in highway maintenance in China, including growing gap of maintenance funds, less optimum highway network, strong demand for service improvements, a serious situation of road safety and weak road maintenance management. All of these issues were addressed by the project in the design of its components and contributed to achieving the objectives of the provincial 12th Five Year Development plan. For example, the highway network of Anhui Province was improved by completing missing segments and upgrading low capacity roads. Asphalt pavement recycling technologies lowered maintenance costs and reduced environmental impacts. Performance-based maintenance approaches helped improve road maintenance quality and efficiency. In addition, the application of CPMS enhanced road maintenance programming and decision-making capacity in Anhui Province.

The interventions being considered under the project were in line with the Bank's FY06-10 Country Partnership Strategy (CPS) with China particularly under the second pillar where the upgrading of transport infrastructure, while improving network management and traffic safety, was singled out as an element for reduction of poverty, inequality, and social exclusion. The project was also in line with China's 12th Five Year Plan (2011-2015) that focuses on improving the quality of life, rather than just the pace of growth, and pays attention to balanced development. It is also consistent with the Strategic Theme Two: Promoting More Equitable Development of the Country Partnership Strategy for FY2013 - FY2016, particularly the outcome 2.3 Enhancing Opportunities in Rural Areas and the outcome 2.4 Improving Transport Connectivity For More Balanced Regional Development. Though the relevance of the objectives was substantial and implementation was completed as planned (on schedule and completing all investments), it is difficult to adequately assess design given the inadequacies of the M&E system. As a result, the assessment of the relevance of objectives, design, and implementation is rated Moderately Satisfactory.

3.2 Achievement of Project Development Objectives

The PDO was to increase the effective use of the road infrastructure in the Anhui Province to support its social and economic development, as evidenced by the increase in the flow of passenger and freight traffic along key corridors across the province at lower costs and with improved safety. The PDO indicators for average increases in travel speeds were met for rehabilitation roads and achieved at a 72% level for improvement roads. For freight and passenger tariff rates, the targets were not reached in nominal terms (with current prices reflecting inflation) owing to significant exogenous input price increases. However, when evaluated in constant 2006 prices, the end of project targets for tariff rates were largely met as shown in the Results Framework Analysis (in the Project Data Sheet).

Intermediate outcome targets for traffic volume (ADT), application of recycling mechanisms in road maintenance, installation of enhanced CPMS, maintenance outsourcing, and environmental manual development were all reached or met to a level of 86%. However reduction in road accident rates and the AHAB budget allocation increase for maintenance and rehabilitation were met only at levels of 13-33% of the target levels. As discussed in Section 2.3, these indicators that were not achieved had design issues and were impacted by unforeseeable policy changes. The impacts of the project interventions are discussed separately below. Overall, given the range of achievements of PDO and intermediate outcome indicators, achievement of the PDO is rated Moderately Satisfactory.

Support social and economic development in Anhui

One additional indicator of the project's support to social and economic development was developed by a follow-up study that found that the average income of ten thousand people along highway G205 increased from RMB1,500 in 2007 to RMB 6,500 in 2011. Road improvement and the application of the key institutional developments achieved by the project clearly contributed to this increase (as well as the resettlement actions made by the project to the project affected people (see Section 3.5 (c) for related discussions).

Improve the condition of the roads across the province

As Table 1 shows, transport of good and passengers in Anhui has grown quickly over 2008-2011, coinciding with the period of project implementation. Through this project, about 1,160 km of national and provincial highways were rehabilitated or improved to meet the requirements of the national technical standards in aspects of pavement condition and traffic safety facilities. These interventions increased transport efficiency and enhanced the connectivity between prefectures in Anhui as well as Anhui and its neighbor provinces. "Increase in the flow of passenger and freight traffic along the key corridors across the province" was confirmed by the traffic volume increase to be much higher than the target values in the intermediate outcome indicators. With these output achievements, the average travel speeds have increased about 16% and 25% on the rehabilitated and improved roads respectively compared with the baselines in 2006. Traffic volumes on the rehabilitated/improved roads increased about 7.5% and 7.31% on the rehabilitated and improved roads respectively, exceeding the targeted values of 5.1% and 4.5%.

Table 1 Good and Passenger Turnover in Anhui Province, 2008-2011

	Unit	2008	2009	2010	2011
Annual turnover of Goods transport by highways	Billion Ton-Kilometers	62.84	419.72	500.49	612.32
Annual turnover of Passenger transport by highways	Billion person-kilometers	68.213	88.05	101.02	115.16

Source: Statistics Bureau of Anhui Province.

Even with higher travel speed and more traffic volume, the highways became safer after rehabilitation and improvement. The traffic accidents per thousand of vehicle-km-year on roads to be rehabilitated and roads to be improved were reduced from 0.32 and 0.34 to 0.28 and 0.32, respectively, from 2006 to 2011.

Pilot more efficient initiatives for road maintenance

By the end of project, a market-oriented maintenance approach was introduced in Anhui. Two highways, about 120 km in length, have been maintained by perform-based contracts in Component C. At the end of two-year contracts, the road conditions were significantly improved, which led to traffic volume increase and accidents decrease on the roads. The

changes of the Maintenance Quality Indicator (MQI) and the Pavement Surface Condition Index (PCI) in the contract period are summarized in Table 2 below.

Table 2 Road Quality Indicators

Year		2010				2011			
Season		1	2	3	4	1	2	3	4
S318 Yaozhong	MQI	73.3	73.8	78.51	87.6	87.2	88.9	89.3	91.5
	PCI	68.6	68.5	83.6	86	85.4	86.5	87.8	89.5
S332 Anwang	MQI	70.5	74.6	77.3	85.4	86.3	87.8	88.2	90.1
	PCI	65.5	67.3	73.2	82.1	83.2	85.4	86.9	88.7

In addition, different asphalt pavement recycling technologies were explored on 5 rehabilitation roads in Component D, which included central plant hot recycling, central plant cold recycling, and cement stabilized in-place recycling. (The other two proposed roads were dropped after the site investigation result showed unsuitable for recycling.) The five roads were monitored and compared in the aspects of quality, costs and construction management, and it was concluded that cold recycling of asphalt concrete pavement had a competitive advantage over the hot recycling in the cost aspect in this environment. The PEO is promoting the cold recycling technology to other applicable projects after this pilot analysis. The results and experience of the project have contributed to the development of Technical Guideline for Anhui Highway Asphalt Pavement Recycling Design and Construction. The expected savings of recycling application in Anhui is expected to be over US\$ 72.7 million per year.

Enhance the capacities of highway maintenance and construction management

The highway infrastructures and management capacities of Anhui were significantly improved through the project. Various training and study tours were supported by the project to improve the management capacity in the aspects of construction management, environment protection, pavement management system application, and asphalt recycling technologies. The China Pavement Management System (CPMS) supported under Component D has been widely used by all the 17 municipalities in Anhui since October 2009. Based on the survey data, the system has been used to analyze the road maintenance demand and to propose its annual road maintenance plan since 2010. The Manual for Highway Construction & Environmental Protection in Anhui was finalized by July 2010, which integrated the international experience with local practices and improved environment management in transport sector in Anhui province.

3.3 Efficiency

A conventional ex-post economic analysis has been undertaken for the 24 rehabilitation and improvement roads. The results indicated that the investments were economically viable for all roads, with EIRR ranging from 19.9% for S311 to 51.4% for S322. The overall EIRR for all the roads was 30.2%, above the estimated 27% at appraisal. This is due to the fact that actual costs were about 18.3% lower than the estimated costs and the traffic volume was higher than the forecast in 2012. As a result, efficiency is rated Satisfactory.

3.4 Justification of Overall Outcome Rating

Rating: **Moderately Satisfactory**

In view of the Moderately Satisfactory ratings for Relevance of Objectives, Design, and Implementation and for Achievement of Development Objective, and the Satisfactory rating for Efficiency, the Overall Outcome rating is deemed Moderately Satisfactory.

3.5 Overarching Themes, Other Outcomes and Impacts

(a) Poverty Impacts, Gender Aspects, and Social Development

Based on a survey on 217 directly-affected households and 64 non-directly-affected households, the living standards and production conditions of affected households were restored or improved after resettlement, particularly on housing conditions, clear water, power and road infrastructures aspects. The household incomes and disbursements of both groups have a similar trend and without significant difference.

As an example, Hexi village of Longmen town is located in a tourism area along S322. The project resettlement office coordinated with local government to consider the opportunity of agritainment when planning and constructing the resettlement houses, which helped increase the incomes of affected households. Besides, with the support of resettlement office, a private company, Huiding Ruoye, affected by the highway G205 (Tunxi-provincial border), has expanded its production capacity and provided job opportunities to ten thousand households. The average income per household increased from RMB1, 500 at 2007 to RMB6, 500 today and it helps reduce poverty around the region.

(b) Institutional Change/Strengthening

In addition to the *Manual for Highway Construction & Environmental Protection in Anhui* and the *Technical Guideline for Anhui Highway Asphalt Pavement Recycling Design and Construction* (produced in Component D), AHAB and Chief Supervision Engineer Office also developed several project management guidelines for the project that included the *Guideline for Delicacy Management and Key Construction Technologies of Anhui Highway Rehabilitation and Improvement Project*, the *Performance Evaluation Method for Anhui Highway Rehabilitation and Improvement Project*, the *Method of Design Variation Management* and the *Detailed Regulation of Measurement and Disbursement*.

The Manuals and Guidelines developed by the project have been used in the other projects financed by Anhui Province. For example, the *Technical Guideline for Anhui Highway Asphalt Pavement Recycling Design and Construction* was officially issued and promoted to all the highway rehabilitation projects (where applicable) in Anhui Province, and the application of recycling technologies is given a priority at project approval and considered as a performance indicator of energy saving evaluation.

(c) Other Unintended Outcomes and Impacts (positive or negative)

The improvement of highway design and safety measures at town-crossing sections in the project, which the Bank team emphasized the importance of and APCD promoted in this project, was considered as a good practice and promoted in Anhui.

3.6 Summary of Findings of Beneficiary Survey and/or Stakeholder Workshops

N/A

4. Assessment of Risk to Development Outcome

Rating: **Moderate**

The main sustainability risks include the conditions of rehabilitated and improved highways that may deteriorate quickly due to the lack of maintenance funds and effective institutional arrangements.

Maintenance funds. The monitored results showed the lack of attainment of the target value of resources allocated to maintenance and rehabilitation in 2010. With the expansion of the highway network in Anhui, the maintenance cost will also increase in long run, which puts pressure on the government budget plan. This risk is moderate for several reasons. Firstly, in its 12th five year plan, China's development strategy will gradually shift from focusing on growth rate to growth quality. Following the strategy, local governments have started paying more attention on the provision of quality service by maintaining their highway infrastructure. Secondly, there exists a fierce competition among local governments to attract investments, and the provision of better transport infrastructures are commonly recognized by local governments as an advantage and priority. Thirdly, the wide application of the Chinese Pavement Management System (CPMS) will help effectively identify the maintenance demand and improve the maintenance plan and fund allocation. Fourthly, the promotion of asphalt recycling technologies and performance-based contract has started to increase maintenance efficiency and reduce maintenance costs.

Effective institutional arrangement. China is still in the transition from a planned economy to a market economy, and further institutional reform in highway sector is expected. A tendency is to decentralize highway maintenance responsibility from provincial government to local governments, which will increase the demands on local governments' administration capacity. Anhui Province has an established highway administration system at provincial and local levels with well experienced staffs and resources that can be well utilized and strengthened to assure greater responsibilities at the local level.

5. Assessment of Bank and Borrower Performance

5.1 Bank Performance

(a) Bank Performance in Ensuring Quality at Entry

Rating: **Moderately Satisfactory**

Overall development objectives were closely aligned with both Government and Bank strategies at the preparation stage and remain relevant to current priorities of China and Bank' CPS. These objectives were supported with interventions on key areas and clear implementation arrangements to facilitate timely completion without compromising environmental and social safeguard concerns. Lessons learned in the past Bank-financed projects were taken into account in the project design, but design of the M&E system did not take full account of a number of relevant factors which influenced project outcomes. As a result, the rating of Bank performance in ensuring quality at entry is Moderately Satisfactory.

(b) Quality of Supervision

Rating: **Satisfactory**

The Bank supervision is rated satisfactory. The Bank team worked with the Project Executing Office in a constructive way:

- to ensure the achievement of project objectives and the compliance with safeguard and fiduciary policies;
- to improve the traffic safety and implementation quality of rehabilitation and improvement roads;
- to promote good practices during the project implementation, such as provision of training to villagers and partnering with local governments on environment protection; and
- to solve implementation issues effectively and efficiently.

(c) Justification of Rating for Overall Bank Performance

Rating: **Moderately Satisfactory**

Throughout the project preparation and implementation, the Bank team took preventive measures to mitigate risks, provided necessary training, timely responded to clients' requests, and took appropriate actions when major issues emerged. However, given the Moderately Satisfactory rating on Quality at Entry, overall Bank performance is rated Moderately Satisfactory.

5.2 Borrower Performance

(a) Government Performance

Rating: **Satisfactory**

As in the previous projects financed by the Bank loan, the Anhui Provincial Government fully supported the project, from preparation through implementation. It provided adequate counterpart funds to ensure that the project would be completed in time for both the physical works as well as the institutional components. The Provincial Government also fully committed to the training program, and allowed it to proceed as originally intended, especially the overseas training activities which were under tight control.

(b) Implementing Agency or Agencies Performance

Rating: **Satisfactory**

AHAB worked highly-effectively and managed the project well, with completing all the project components before the loan closing date. During the implementation, AHAB actively coordinated with the Sub-PCMOs to ensure the quality and progress of civil works and the compliance with safeguards. AHAB effectively dealt with the cancelation of a construction contract and prevented it from delaying the completion of the entire project. AHAB also prepared project reports in a timely manner throughout the project implementation period, which provided detailed information, and allowed a close monitoring of the project.

(c) Justification of Rating for Overall Borrower Performance

Rating: **Satisfactory**

Strong government support prevailed throughout the project, and a very effective implementing agency carried out both the physical and the institutional components on time and with high quality outputs with satisfactory ratings for both Government performance and the performance of the implementing agencies. Overall Borrower Performance is rated Satisfactory.

6. Lessons Learned

6.1 Project Design and Preparation

The monitoring indicator must be tailored with cause and effect relations between the project interventions and the indicators.

As discussed in Section 2.3, monitoring indicator selection and target-value setting are critical to measure the effectiveness of project interventions. Inadequate indicators distort the performance results and lower the confidence on evaluation system. When project interventions merely focus on civil works, freight / passenger tariffs and commodities prices should be cautiously used as project indicators unless their correlation with the project interventions is clearly identified and the risk of policy and market fluctuations is considered since they may be affected by external factors other than the project interventions.

As experienced in this project, fuel and labor price rose rapidly and a global economic crisis was encountered, which had dominant influence on transport price rather than that of road condition improvements. Similarly, many factors may contribute to traffic safety. A fast growth of new drivers on roads is considered as one of key factors of road accidents in China in recent years, and speeding on improved roads is another key factor, which offsets the

effect of physical improvement of pavement conditions and traffic facilities. Road condition improvement should be integrated with other safety enhancement measures to reduce safety risks and prevent traffic accidents, and the target value has to be designed reasonably taking these factors into account.

It is necessary to conduct quantitative impact evaluation and/or economic analysis to isolate the impacts of proposed project investments from the effects of other exogenous factors that are expected to increase or decrease substantially during project implementation.

To avoid major technical changes and environmental impacts, it is critical to control the quality of feasibility study and optimize engineering designs at project preparation stage. Both time and fund for project preparation and implementation should be adequately considered.

6.2 Project Implementation

The project management can be improved by introducing advanced IT technologies and information management system to manage project progress and costs.

For the performance-based maintenance component, both the size and duration of pilot contracts of the project were considered less optimal to lower maintenance costs and to motivate contractors to make a long-term decision. It is recommended that the duration of a contract be extended to over 4 years to encourage a long-term comparative decision and to include more roads to increase efficiency.

In addition to road conditions, traffic growth should be monitored and considered as an evaluation parameter in performance-based maintenance contracts.

The smooth implementation of the performance-based maintenance contracts in this project was largely due to two factors — strong support from AHAB and extra efforts of all parties because of its pilot nature. Though the performance-based maintenance approach has achieved quite positive results, its promotion still faces institutional barriers, particularly in China, including staffs' reluctance to recognize the shift from public to private service, slower response of contractors to natural disasters and emergency events, and the weak position of contractors' coordination with government agencies on law enforcement.

The Chinese Pavement Management System (CPMS) has been promoted to the entire province, which assists the development of maintenance plans and fund allocation in the province. However, the effectiveness of CPMS depended on the completeness and reliability of collected data as well as timely update of the data. Currently, local governments rely on manual collection of data and lack advanced equipment. More investments and training are needed in this regard.

7. Comments on Issues Raised by Borrower/Implementing Agencies/Partners

(a) Borrower/implementing agencies

Borrower/Implementing Agencies have summarized the project implementation experience that is attached in Annex 7. The Bank concurs with the conclusion that Anhui will benefit from the capacity enhancement through the project in the long run. The Borrower/Implementing Agencies have reviewed the Bank's ICR and have no comment.

(b) Cofinanciers

N/A

(c) Other partners and stakeholders
(*e.g. NGOs/private sector/civil society*)

N/A

Annex 1. Project Costs and Financing

(a) Project Cost by Component (in USD Million equivalent)

Components	Appraisal Estimate (USD millions)	Actual/Latest Estimate (USD millions)	Percentage of Appraisal
Works			
Civil Works(Rehabilitation)(Part A)	162.837	191.219	117.43%
Civil Works(Improvement)(Part B)	166.313	214.771	129.14%
Pilot on Maintenance by Contract(Part C)	1.600	4.868	304.26%
Supervision			
Supervision of road rehabilitation program	4.530	4.924	108.70%
Supervision of road improvement program	3.994	4.210	105.41%
Supervision of road maintenance pilot	0.094	0.230	245.10%
Studies and training			
Technological issues on pavement recycling(int.)	0.150	-	0
Technological issues on pavement recycling(dom.)	0.150	0.213	142.04%
Foreign assistance to establish and supervise the maintenance pilot	0.090	0.074	82.58%
Preparation of standardized environmental specification	0.060	0.083	137.63%
Strengthening of CPMS(Analytical tools)	1.900	2.089	109.96%
Impacts analysis (as part of resettlement completion reports)	0.140	-	0
Training and study tours	1.600	1.384	86.50%
Land Acquisition and Resettlement	12.749	26.865	210.72%
Total Baseline Cost	356.207	450.931	126.59%
Contingencies			
Contingencies	53.293	-	0
Front-end fee IBRD	0.500	0.500	100.00%
Total Financing Required	410.000	451.431 ^{*1}	110.11%

Notes: *1. The actual costs are calculated by the exchange rate at the appraisal (1US\$ = RMB7.65911).

2. The estimated costs of civil works in Annex 4 of PAD are different from those in Annex 5 of PAD but consistent with the costs used for economic analysis.

(b) Financing

Source of Funds	Type of Cofinancing	Appraisal Estimate (USD millions)	Actual/Latest Estimate (USD millions)	Percentage of Appraisal
Borrower		210.00	251.43	119.73%
International Bank for Reconstruction and Development		200.00	200.00	100%

Annex 2. Outputs by Component

Component	Final Output	Original Plan (PAD)
Component A: Road Rehabilitation		
National and Provincial Road Rehabilitation	Final Output Length: 840.845 km Final Cost: RMB1, 464.6 mil. Final Cost/km: RMB1.74 mil/km	Original Plan Length: 885.6 km Estimated Cost: RMB1, 606.6 mil. Estimated Cost/km: RMB1.81 mil/km
Component B: Road Improvement		
National and Provincial Road Improvement	Final Output Length: 320.6 km Final Cost: RMB1, 645.0 mil. Final Cost/km: RMB5.13 mil/km	Original Plan Length: 318.1 km Estimated Cost: RMB1,724.3 mil. Estimated Cost/km: RMB5.42 mil/km
Component C: Pilot on Road Maintenance by Contract		
	Pilot Maintenance by Contract for two highway sections of 120 km in total	Pilot Maintenance by Contract for at least two highway sections of 120 km in total
Component D: Institutional Strengthening Program		
Asphalt Recycling for Pavement	Testing was conducted in five sections (two sections for hot recycling and three sections for cold recycling), and the completion report issued on Dec 12, 2011.	Pilot study on technological options for recycling of pavement materials for rehabilitation to reduce the consumption of resources.
Chinese Pavement Management System (CPMS)	The data collected and analyzed for 9,512 km of the 17 municipalities in the Province. With extensive training programs, the system has been used by all the 17 municipalities since October 2009.	Support in implementing the enhanced CPMS in Anhui Province to establish a stronger analytical base to make optimal network based maintenance and rehabilitation decisions.
Environmental Specifications (Manual) for Highway Construction	The Specifications (Manual) were completed by Nov 2009. The manual was finalized by July 2010 with a reference to the Bank's seminar in the Province on "Low-Volume roads Engineering: Best Management Practices".	Preparation of standardized environmental specifications to streamline the elaboration of environmental impact assessments and environmental management plans in road works.
Training	The domestic training completed with 1,230 person-months with a total cost of RMB6.06 mil. The overseas training completed with 32.2 person-months with a total cost of US\$0.50 mil. The overseas study tour completed with 9.67 person-months with a total cost of US\$0.22 mil.	Training program focusing on (a) overseas training in road management, (b) overseas training on recycling of pavement materials, (c) road safety, (d) project management, (e) environmental supervision of road construction, (f) environmental design of scenic/ecological routes, (g) right-of-way management, (h) highway planning and design, (i) highway information systems management, (j) community training along S322 for benefits of improved accessibility and road safety education with 1,326 person-months for domestic, 46 person-months for overseas, and 47.5 person-months for study tour.

Annex 3. Economic and Financial Analysis

The economic evaluation of the project covers all the roads rehabilitated or improved by the project, including:

- (a) Rehabilitation of 13 roads (totaling 17 segments, 840.845km); and
- (b) Improvement of 4 roads (totaling 7 segments, 320.6km)

The analysis is based on the actual costs and updated forecast data on traffic volume, vehicle operating cost, users' time savings and reduction in accident cost etc. The actual costs are showed in the Table 1 below:

Table 1 Actual Road Costs

No.	Roads	Investments (RMB: million)
Rehabilitations		
1	G104 Chuzhou - Chahe	59.28
2	G206 Suzhou South _ Huiyuan North	180.27
3	G3 11 Suzhou Section	59.96
4	G3 18 Muzhen- Nanling	38.49
5	G3 18 Dadukou - Yinhui	65.70
6	G3 18 Yuexi Section	102.92
7	S 10 1 Hefei/ Chuzhou Border _ Bengbu	194.84
8	S 103 Hamoling - Qingyang	70.51
9	S2 1 1 Zhuping - Dashan	105.80
10	S2 12 Huaining - Section	107.61
11	S303 Suzhou _ Provincial Borde	166.30
12	S303 Huaibei Section	51.52
13	S3 10 Shouxian - Huoqiu	119.15
14	S3 10 Huoqiu - Zhongxing	49.62
15	S320 Changhe - Hengbu	101.36
16	S321 Zhufan - Jiangkou	45.01
17	S32 1 Fanchang - Boyangpo	52.45
Improvements		
18	S3 1 1 Chuzhou - Dingyuan	233.08
19	S3 1 1 Chuzhou - Wuyi	187.89
20	S322 Taohuatan - Gantang	206.91
21	G205 Caijiaqiao - Tanjiaqiao	184.13
22	G205 Tangkou - Qiankou	97.06
23	G205 Tunxi - Provincial Border	101.24
24	SI05 Chaohu- Wujiang	825.61
25	Cost of Chief Supervision Engineer Office	6.90
Total*		3,413.62

Note: The total costs include the actual costs of civil works, supervision, design, project management and resettlement.

The economic analysis result shows the actual economic internal return rate (EIRR) of the rehabilitations and improvements of the project is about 30.2%, more than the EIRR expected at appraisal. The net present value (NPV), at the discount rate of 12%, is RMB4, 224 million. The details are summarized in the Table 2 below:

Table 2 Economic Evaluation Summary

No.	Roads	EIRR (in %) at Appraisal	EIRR (in %) at Completion
Rehabilitations			
1	G104 Chuzhou - Chahe	42.6	41.7
2	G206 Suzhou South - Huiyuan North	22.5	24.5
3	G3 11 Suzhou Section	27.6	32.4
4	G3 18 Muzhen- Nanling	23.1	24.3
5	G3 18 Dadukou - Yinhu	31.6	38.6
6	G3 18 Yuexi Section	22.4	21.3
7	S 10 1 Hefei/ Chuzhou Border - Bengbu	27.2	27.8
8	S 103 Hamoling - Qingyang	22.6	25.7
9	S2 1 1 Zhuping - Dashan	23.8	25.2
10	S2 12 Huaining - Section	40.9	40.7
11	S303 Suzhou - Provincial Borde	25.3	32.2
12	S303 Huaibei Section	25.7	24.9
13	S3 10 Shouxian - Huoqiu	30.3	29.6
14	S3 10 Huoqiu - Zhongxing	28.1	47.2
15	S320 Changhe - Hengbu	30.9	28.1
16	S321 Zhufan - Jiangkou	29.6	24.8
17	S32 1 Fanchang - Boyangpo	43.0	44.6
Improvements			
18	S3 1 1 Chuzhou - Dingyuan	18.1	19.9
19	S3 1 1 Chuzhou - Wuyi	16.8	24.6
20	S322 Taohuatan - Gantang	55.2	51.4
21	G205 Caijiaqiao - Tanjiaqiao	29.2	30.6
22	G205 Tangkou - Qiankou	31.1	28.0
23	G205 Tunxi - Provincial Border	33.4	32.7
24	SI05 Chaohu- Wujiang	22.4	26.9
Total Project*		27.0	30.2

Source: APTD

The post-evaluation of the project, by sections and as a whole, shows that the road investments of the project were economically viable.

Annex 4. Bank Lending and Implementation Support/Supervision Processes

(a) Task Team members

Names	Title	Unit	Responsibility/ Specialty
Lending			
Rodrigo Archondo-Callao	Senior Highway Engineer	ECSS5	
Junxue Chu	Senior Finance Officer	CTRLN	
Fei Deng	Senior Transport. Spec.	EASIN	
Carlos Ricardo Escudero	Consultant	LEGLA	
Yi Geng	Sr. Financial Management Specialist	EAPFM	
Jingrong He	Procurement Specialist	EAPPR	
Imogene B. Jensen	Consultant	EASTS	
Xiaofeng Li	Operations Analyst	FEUUR	
Xiaoping Li	Senior Procurement Specialist	AFTPC	
Aurelio Menendez	Sector Manager	LCSTR	TTL
Teresita Ortega	Program Assistant	EASIN	
Juan D. Quintero	Consultant	SASDE	
Jacques M. Tollie	Consultant	EAPCO	
Peishen Wang	Consultant	EASIN	
Hongkun Yang	Consultant	EASCS	
Han-Kang Yen	Research Analyst	EASTE - HIS	
Wenlai Zhang	Senior Transport Specialist	EASCS	
Chaohua Zhang	Lead Social Development Specialist	SASDS	
Supervision/ICR			
Fei Deng	Senior Transport Specialist	EASIN	
Yi Geng	Sr. Financial Management Specialist	EAPFM	
Jingrong He	Procurement Specialist	EAPPR	
Yan Lu	Transport Specialist	EASCS	
Juan D. Quintero	Consultant	SASDE	
Lynn Wang	Consultant	EAPFM	
Mitsuyoshi Asada	Senior Transport Specialist	EASIN	TTL
Ning Yang	Environmental Specialist	EASCS	
Songling Yao	Senior Social Development Specialist	EASCS	
Xiaoke Zhai	Senior Transport Specialist	EASCS	
Wenlai Zhang	Senior Transport Specialist	EASCS	
Qi Zhu	Consultant	EAPFM	

(b) Staff Time and Cost

Stage of Project Cycle	Staff Time and Cost (Bank Budget Only)	
	No. of staff weeks	USD Thousands (including travel and consultant costs)
Lending		
FY06	0.5	11.74

FY07	41	218.81
FY08	17	74.57
Total:		305.12
Supervision/ICR		
FY06	0	0.00
FY07	0	0.00
FY08	0	0.98
FY09	19	78.14
FY10	17	82.47
FY11	9	39.03
FY12	8	31.63
Total:		232.25

Annex 5. Beneficiary Survey Results

N/A

Annex 6. Stakeholder Workshop Report and Results

N/A

THE PEOPLE'S REPUBLIC OF CHINA

PROJECT COMPLETION DOCUMENT
(ABSTRACT VERSION)

FOR A

**CHINA: ANHUI HIGHWAY REHABILITATION AND
IMPROVEMENT PROJECT**

**ANHUI PROVINCIAL DEPARTMENT OF TRANSPORT
FOREIGN FUND PROJECT MANAGEMENT OFFICE**

OCTOBER 2012

CONTENTS

1. Project Overview.....	28
2. Organizational Institution.....	28
3. Project Objective Evaluation	29
4. Project Design Evaluation.....	29
5. Project Implementation Evaluation.....	31
5.1 Rehabilitation Subprojects	31
5.2. Improvement Subprojects	31
5.3. Maintenance Pilot by Contract	32
5.4. Institutional Strengthening.....	33
5.4.1 Pavement Asphalt Recycling	33
5.4.2 China Pavement Management System (CPMS)	34
5.4.3 Highway Construction Environment Manual (Specifications).....	34
5.4.4 Maintenance Pilot by Contract.....	34
5.4.5 Training.....	35
5.4.6 Analysis for Impact on Project Social Economy	35
6. Evaluation on Project Operation	36
7. Successful Experiences	36

ABSTRACT

1. Project Overview

Anhui's geographic location—right to the west of Shanghai and Hangzhou metropolitan areas—makes the province a natural crossing area for the interchange of industrial products and technology between the more developed coastal provinces and those less prosperous to the center and west. In line with the Central Government's initiative of "Rise of Central China" which is part of the Eleventh Five-Year Program (EFYP), defined as crucial for a coordinated and harmonized development between eastern, central and western areas, the Anhui Government has elaborated its own strategy of "Development to the East", with an aim at expediting the incorporation of the various regions of Anhui to the comparatively more affluent regions of the Yangtze Delta, including those poorer areas (in the north and south of Anhui). Transport is one of the priorities in that development strategy.

Although the existing highway network of Anhui Province (of about 71,000 km) represents a sizable network in terms of kilometers per inhabitant, the average service level is limited due to the relatively low technical standards. Compared to the six surrounding provinces, the density of the network (km per population) is above the average, while the percentage of paved roads (as a proxy for the quality of the infrastructure) is the lowest. These results are likely shortcomings of the existing highway network in meeting future transport demand. Other major issues of current highway network include: (a) connections on the east-forward corridors consisting of lower-class type of roads; (b) poor quality of pavement and weak resistance against disaster, and (c) unbalanced distribution of network across the regions in Anhui Province. The Government of Anhui has then advanced a program for upgrading and reconstructing existing national and provincial trunk highway network—the so-called "515 Engineering Program"—to enhance the level of service and traffic capacity, while minimizes the needs for land acquisition. Anhui Provincial Government has decided to apply for US\$200 million from the World Bank and use it in Anhui Highway Rehabilitation and Improvement Project (the "Project"). This Project including four components—Road Rehabilitation, Road Improvement, Pilot on Road Maintenance by Contract and Institutional Strengthening Program—is the third World Bank financed highway project.

The total investment of this Project is about 4.18 billion Yuan RMB, of which, World Bank loan is US\$200 million. The Chinese Government provides part of the funds, and the rest is raised by Anhui Provincial Government.

2. Organizational Institution

Anhui Provincial Department of Transport (APDOT) is the owner of this Project. World Bank Loans Project Executing Office (PMO) under APDOT is responsible for the project's preparation & implementation works and the coordination affairs among different components, including procurement, supervision, environment and resettlement,

etc. Anhui Provincial Highway Administration Bureau (AHAB) is in charge of local road rehabilitation & improvement and Pilot on Road Maintenance by Contract plan.

Local Highway Bureaus are deputed by APHAB to establish Project-Site Management Offices (PSMO) to manage the construction, because the project distributed in different cities. These PSMOs draw main leaders and technical assets from the local highway bureaus, and then allocate them according to the project's scope and hardness. Four departments—Engineering Technology Department, Plan Contract Department, Financial Audit Department and Comprehensive Department—are included in PSMOs. Each office has a clear division of labor, responsibilities clear and dispatches timely, which effectively offers an organizational guarantee to the engineering construction.

This project uses domestic consultants to perform the supervision activity. It establishes one Chief Supervision Engineer Office (CSEO) and several supervision engineer field offices. Supervision works are undertaken by qualified and reputable supervision units, which are confirmed by the domestic competitive bidding method. According to the contract documents of FIDIC items, specifications and drawings, the supervision engineers take all-round control of the engineering quality, progress, measurement & payment, security and environmental protection.

3. Project Objective Evaluation

The project aims at increasing the effective use of the road infrastructures in Anhui Province to support its social and economic development, meanwhile reduce costs and improve the safety by increasing the flow of passenger and freight traffic. After four years' execution, this project's objectives have been achieved through the joint efforts of participating units.

The main achievements are listed as follows:

- ✧ Increased traffic speed & volumes and lowered accident rates on the upgraded and rehabilitated roads
- ✧ Beneficial attempt at exploring a new maintenance mechanism offered by contractual maintenance pilot in Anhui Province.
- ✧ Application of asphalt recycling technology over the province
- ✧ Direction for standardized management of highway construction environmental protection efforts through the compilation of environmental manual in Anhui.
- ✧ Scientific decision basis for provincial highway maintenance management by popularizing the application of China Pavement Management System (CPMS).
- ✧ Technical quality and management level of numerous highway project management staffs have been increased through home and abroad training.

4. Project Design Evaluation

In order to create a harmonious society, promote the image of transport industry, accelerate the optimization and upgrading of road network structure, increase the integrated service level of trunk highway, build a transport environment of “*smooth, security, comfortable, beautiful*” and insist on designed guiding ideology of “*security,*

endurance, economy, harmony”, it is required to clearly understand the project’s functional position and construction necessity then choose rational technology standards; select reasonable route corridor depending on technical analysis, study, demonstration and comparison in engineering and economic aspects between multiple schemes. More, to carry out proper layout and design for bridges, tunnels, and subgrades & pavements with overall consideration of landforms, geology and construction conditions within the regions, it is adopted the mode of using existing roads as much as possible and upgrading or newly building partial road segments. Finally, it puts forward a recommendation with engineering feasibility and economic rationality, and to determine the reasonable engineering scale through the comparison and demonstration on multiple construction schemes.

During the design process, it raises some innovative, practical measures and plans in aspects like road safety, road drainage, environmental protection and grade crossing regarding to the project’s characteristics.

Drainage Design: It is adopted various forms of side ditch, such as rectangle side ditch, trapezoid side ditch, L-shaped side ditch, slab side ditch and pebble-paving blind ditch for the consideration of characteristics in different projects & road segments and the link with former water system. It is a way to guarantee the pavement’s smooth drainage. For side slope drainage, chutes and cut ditches are installed to prevent slope surfaces from collapsing led by water erosion.

Safeguard Design: The road safety measures of the World Bank financed Project III, mainly focused on road section sharp turns, longitudinal slopes, roadside dangerous sections, bad sight distance, junctions and market towns. Here are some examples. First, outside trees in minor radius curves mislead drivers, so that these trees should be moved to provide a broader roadside clear zone. Second, the goal of optimum interaction between drivers and roads can be reached through guidance measures like setting up delimiting visual marking & line-shaped induced mark and increasing roadside cultures. Third, curves in mountainous areas would lead to bad sight distance, thus reflectors are needed. Fourth, it is used different grade crossing designs to standardize the insecure junctions. The design of canalized diversion for large junctions and the signal lamps supported by traffic police department contribute to the traffic vehicles, which ensures the security of vehicles and pedestrians in the junction. Fifth, topography differs from plain rolling terrains to mountainous hilling terrains, therefore, designers need different protection methods—warning piles, stump type fender piers, arched guardrails, imitation wood & bamboo guardrails, wall buttress style guardrails and wave pattern guardrails—on the basis of road and roadside danger classes, to coordinate with regional environment, and reach the effect of “*security, economy, beauty, nature*”.

Environmental Renovation: Natural landscape along the road of the project is beautiful and attractive. To avoid much destruction, principle is adhered that the best practice for protection is to minimize destructive construction. Moreover, both sides of the road are well-planted, making the road match well with the site’s natural surroundings.

Dynamic Design Implementation: Design drawings are carefully investigated by construction units and design units before the implementation of project. If they found any problem in the drawings, they would give feedback to design units for optimization and revision. Design units adopt multiple-step design mode in accordance with various geological situations afterwards.

To conclude, the scientific and reasonable design of this project in line with highway engineering technology standard, highway design standard and any other standard. Moreover, designers' thoughtful consideration, high-quality design drawing, timely modification to problems that occurred and follow-up service works has given a strong guarantee to the construction units. Materials about environmental coordination & protection along the road and construction guidance in the design document have facilitated the site operation for construction units. Some suggestions have been put into practice during the construction period.

5. Project Implementation Evaluation

5.1 Rehabilitation Subprojects

The rehabilitation subprojects under the third World Bank financed highway project in Anhui involve 17 segments in 12 national and provincial roads (*G104, G206, G311, G318, S101, S103, S211, S212, S303, S310, S320 and S321*) with a total length of 840.845 km, respectively locating in 21 districts & counties in Anhui under the jurisdiction of 9 cities (*Suzhou, Huaibei, Bengbu, Chuzhou, Liu'an, Anqing, Chizhou, Tongling and Wuhu*). Rehabilitation mainly aim at upgrading pavements & bridges, recovering its traffic capacity, and conducting improvement to pavement & vertical sections along the existing subgrade basically without involving new segments.

5.2. Improvement Subprojects

It involves 4 subprojects, namely, 7 segments in 4 national and provincial roads (*G205, S322, S105 and S311*) with a total length of 320.6 km, respectively locating in 10 districts and counties in Anhui under the jurisdiction of 4 cities (*Xuancheng, Huangshan, Chaohu and Chuzhou*). These subprojects mainly take approaches of widening existing roads or optimizing their geometrical characteristics, improving existing roads in densely built-up areas in order to minimize resettlement and land acquisition, newly constructing some small segments or completing end roads to avoid hard topographic conditions as necessary.

The Project consists of 24 subprojects with implementation in 5 batches. The first batch including 8 rehabilitation subprojects commenced in December 2007; the second batch consisting of 4 improvement subprojects began in March 2008; the third batch involving 6 rehabilitation and 2 improvement components started in September 2008; the fourth batch comprising 1 improvement component (*S105 Chaohu - Wujiang*) initiated in February 2009; the fifth batch is composed of 4 rehabilitation subprojects, which commenced in April 2009. Currently, all the five batches have been finished. Under the leadership of APDOT and PMO, abiding by the principle of “*innovating construction & management mode, promoting management level*”, it fully pursues refine and

standardization management in the construction. Construction units made good achievements of controllable project progress, acceptable quality, no safety production accident, no corruption case with their united efforts, in overcoming difficulties.

To minimize the construction impact on the local environment and to materialize the sustainable development of transport construction projects, PSMOs always pay attention to the environmental protection during the road construction period. They take actions to reduce the adverse effect on environment, for instance, enact a good environmental management system, employ full-time environmental management staff, and adopt measures to slow down the environmental influence according to the requirements of environmental management plan. After the joint efforts of APDOT, AHAB and PSMOs, the World Bank provides a loan of US\$90 million for environmental protection of this project. Through the establishment of effective environmental protection system and the adoption of protection measures, this project eliminates the environmental destruction and minimizes the ecological damage.

The land acquisition and resettlement works of the Project focus on 7 improvement components. It began in September 2008 and completed 2510.09 mu of land acquisition and 31,194 m² of house demolition. Based on monitoring and evaluation, the external monitoring agency summarized that land acquisition and resettlement was completed in line with *Resettlement Action Plan* by resettlement offices at all levels, and also permanent land acquisition & house demolition were totally finished as schedule. Therefore, the resettlement works are entirely completed. To guarantee smooth going of resettlement works and realization of expected effect, related resettlement office as internal monitoring and implementing agencies were set up by AHAB and local governments in project implementation. By the principles of conforming to local conditions, convenience to the living and production, resettlement works should fully take advantages of natural resources, speed up agricultural structure adjustment, improve irrigation conditions for cultivated lands, increase the land use capability, and provide momentum for future development of agriculture to maintain the previous living standard for immigrants.

5.3. Maintenance Pilot by Contract

Maintenance pilot by contract is a diversion of maintenance modes from traditional unit price maintenance contract (UPMC) or direct labor service maintenance contract (DLS) to performance-oriented road maintenance contract. S332 Anwang Road and S318 Yaozhong Road with respective mileages of 60 km are chosen as maintenance pilots by contract in this project. Carrying out the design concept of “*security, endurance, economy, harmony*”, adhering to the principle of taking actions according to local circumstances and drawing materials from local resources, and considering regional economic & natural conditions, it is adopted new technology, materials, equipments and workmanship in the project to maximize the economic and social benefits and stick to the Life Cycle Cost standard as well.

The roads are in operation during the design and construction periods; therefore, it is in dynamic change. To guarantee the engineering quality, clients require designers to make

the design drawing dynamically which smooth the implementation of this project. Social economy in Anhui has been developed after making full use of Anhui Road Infrastructures. Passenger flow and logistics in interprovincial crucial corridor has increased and its security has enhanced simultaneously, while the cost has decreased. Maintenance pilots have completed different types of maintenances including 120km small, 34.47km intermediate and 21.44km heavy maintenances. Road conditions & appearance has been improved compared with the previous one. No accident or related complain has happened in this road up to now, which means service level of highway has upgraded effectively.

5.4. Institutional Strengthening

5.4.1 Pavement Asphalt Recycling

Combined with the actual situations of technologies of asphalt pavement recycling applied in 5 components (*including G104 Chuzhou to Chahe Section, G318Yinhui to Dadukou Section, S321 Zhufan to Jiangkou Section, S212 Huangdun to MaiYuan Section, S303 Jiangsu Border to Suzhou Section*) under the World Bank Loaned Anhui Highway Project III, technologies of plant-mix hot recycling and plant-mix & in-situ cold recycling are respectively applied in G104, G318, S321 with total length of about 24.87km and S212, S303 with about 62.44km (*of which 49.96km for plant-mix cold recycling, and 12.48km for in-situ cold recycling*) as pavement asphalt recycling pilots according to the characteristics of pavement distress in each component. It aims at drawing up reasonable strategy to recycling technology, analyzing and researching on design methods of mix proportion for recycling mixture, indicator and assessment systems for mixture's quality, economy, and construction technology to form a set of recycling technology suitable for arterial highways in Anhui Province. Through the application in construction sites, analysis on investigation data and assessment on technical applicability of both plant-mix hot recycling and in-situ cold recycling, it summarizes the economics of recycling technologies. The quality requirements for new asphalt mixture can be totally reached by plant-mix hot recycling mixture with proper design proportion. Compared with new asphalt mixture, the performances of fatigue and low temperature for recycling mixture are equivalent to it, while anti-rutting performance is even better. To fulfill the purposes of recovering required pavement alignment and sections, eliminating the phenomena of rutting on original pavement and irregular and uneven areas, as well as horizontal, longitudinal and reflection cracks, the technology of in-situ cold recycling is adopted. In addition, recycling and reusing old asphalt materials in pavement by milling, it is to save in materials, protecting environment, reduce engineering cost and save cost during the construction. The mentioned technology is promoted and applied. Meanwhile, the compilation of *Technical Guideline for Anhui Highway Asphalt Pavement Recycling Design and Construction* was completed by APDOT in Dec. 2011 in order to promote this technology in whole province. The preliminary statistics showed that the recycling rate of old asphalt pavement was over 90% in whole province in 2010. The research achievements on recycling of asphalt pavement is awarded *the third Prize of Science and Technology* granted by China Highway and Transportation Society and *the first Prize for Progress in Science and Technology* granted by Anhui Highway and Transportation Society.

5.4.2 China Pavement Management System (CPMS)

CPMS has been fully utilized in 17 prefectures since October 2009. Based on the survey data, the data collection have covered mileages of national and provincial arterial highways, which have been used for analyzing road maintenance needs and assisting in drawing up a plan for annual road maintenance.

The utilization of CPMS aims at coordinating highway management activities to make the course of highway management systematization and scientification by the method of system analysis and advanced computer technology. The targets could be reached as following:

- 1) Carrying out objective evaluation and real-time monitoring on traffic situation, so that take appropriate measures to improve road conditions, and keep the network service in a good condition.
- 2) Comparing the impacts on road network, condition and service level due to different investment (budget) modes, and set as the objective basis for investment application to the government.
- 3) To consider and analyze various possible countermeasures, quantitatively predict these countermeasure effect; on the basis of predetermined standards and constraint conditions, choosing the most ideal maintenance planning and plan, reduce pavement life cycle cost, and greatly improve management level and efficiency of highway maintenance.
- 4) As a communication tool with the government and the public, it could supply better service to the society.

5.4.3 Highway Construction Environment Manual (Specifications)

The compilation of *Manual for Highway Construction & Environmental Protection in Anhui Province* (the Manual) was completed jointly by international consultant Mr. Marco Z and domestic consulting company—Shanghai Ship and Shipping Research Institute.

We believed that, the completion of the Manual with extensive application range, absorbed advanced environmental protection idea of highway construction in foreign countries and combined with China's national conditions and actual situation in Anhui Province, can not only be utilized as environmental protection technical manual for ordinary highway construction staff in China and Anhui Province, but also give reference to expressway construction staff. Also, final version of this Manual won the affirmation from the World Bank.

5.4.4 Maintenance Pilot by Contract

The study on maintenance pilot by contract includes the items of selections of maintenance contract mode (PBMC mode) and pilot road segments, contract limit, contractor's qualification, design optimization and approval, check and approval of

tendering documents, supervision to the bidding course, contract negotiation, design variation and evaluation on pilot achievements, etc.

Based on the topography in Anhui, two road segments are chosen as maintenance pilots by contract with each mileage of 60km for this study. S322 Anqing Road and S318 Liu'an Road are respectively located in plain and mountainous areas. Both of roads share common ground of individual municipal jurisdiction, similar traffic volume indexes, and currently in poor road conditions which could be improved by overhaul and daily maintenances. The research achievements mainly include a piece of technical specification training materials, purchasing files, suggested maintenance contract and standards for contractors selection in maintenance pilot by contract.

5.4.5 Training

Domestic training programs were fully completed at the end of 2011 with 1230.1 man-months in total. And the overseas training and study tour programs were completely finished in March 2012, of which training were 32.2 man-months and study tour were 9.67 man-months, with 82.55% satisfaction rate.

This project, through domestic and overseas training and study tour programs, has improved the technical quality and management level of a large number of talents on the aspects of professional technology and project management in highway project management. And they have become technical backbone and leading cadres in the fields of their department and profession, distributed in each field of highway transport sector in Anhui Province. The achievements not only guarantee the successful completion of World Bank Financed Project, but also play a pivotal role for the construction of highway projects in other provinces and make outstanding contributions for all-around development of highway construction in Anhui Province.

5.4.6 Analysis for Impact on Project Social Economy

Immigration Institute under Anhui Communications Vocational and Technical College, as external independent monitoring agency, has investigated on social economy impact in terms of project investment in 11 counties/districts involved in the upgrade subprojects during April to June 2012. The results indicate that:

1) The social economy has maintained a sustainable momentum of development in affected areas and it accelerated development speed and optimized economic structure by fully using investment opportunities from engineering construction. The public have benefited from engineering construction on the whole.

2) Through investigation and analysis, living and production conditions for affected people have all recovered and improved after land acquisition and demolition. On the one hand, although it suffered some land resources loss, it increased any other new production and business ways by using compensation fund of land use and enhanced efficiency of existing production resources. On the other hand, the housing conditions were greatly improved, and also the infrastructures such as water, electricity, roads and others were obviously advanced. The objectives of *Resettlement Action Plan* were

realized.

3) The positive evaluation on resettlement works were given by direct affected people and this project was accepted by most of affected people.

4) The contrast between before and after resettlement, regarding to their production and living objective conditions and subjective evaluation, showed that affected people held positive attitude to changes in their own production and living conditions. More, the evaluation on resettlement was also positive.

6. Evaluation on Project Operation

After delivery and acceptance of completed rehabilitation and upgrade subprojects, relevant individual prefectural highway bureaus are responsible for management and maintenance regarding the operation of this Project. All the bureaus pay attention to innovate in maintenance concept, take efficient measures, and improve daily, preventive and comprehensive maintenances.

So far, the pavement is in a good condition after successive acceptance of each subproject. The achievements of improving pavement quality, implementing auxiliary projects in place and enhancing road anti-disaster ability have been gained. On the one side, it lightened working capacity of maintenance units and reduced road maintenance cost; On the other side, it promoted road operational capacity, boosted economic development and improved economic benefits. Higher road standard and less traffic accident rate made reduction of damage degree to people's property and life safety. The improvement to road environment reduced pollution to surrounding environment, strengthened road service function and improved living conditions for residents.

7. Successful Experiences

1) Through the implementation of this project, the targets including of enhancing traffic capacity of arterial road network in Anhui Province, perfecting the connection between network roads and rural roads, improving infrastructures in poor areas, driving economic development in counties and townships along the alignment, are reached. Therefore, social and economic effectiveness are obviously improved.

2) To meet the goals of fully saving resources and protecting environment, reducing engineering cost, promoting new technology and crafts, enhancing the implementation of this project, it utilized technologies of plant-mix hot recycling, plant-mix cold recycling and in-situ cold recycling in this project. In parallel, successful experiences are summarized and formed a book called *Technical Guideline for Anhui Highway Asphalt Pavement Recycling Design and Construction*. Currently, asphalt recycling technology was on the course of extensive application within the range of road network projects in Anhui Province.

3) In this project, it was compiled *Manual for Highway Construction & Environmental Protection in Anhui*. This Manual concluded environmental protection experiences during domestic highway construction and specific practices in Anhui, learned some good

practices and management experiences in foreign countries, which provided comprehensively technical guidance to actual environmental protection work for all highway construction staff in Anhui and even in whole China.

4) The maintenance quality was outstandingly improved through the brand new highway maintenance quality evaluation system, namely maintenance quality was evaluated by MQI value of project implementation results.

5) This project, through domestic and overseas training and study tour programs, has trained professional staff who have become technical backbone and leading cadres in the fields of their department and profession, distributing in each field of highway transport sector in Anhui. Thus, the achievements not only guarantee the successful completion of World Bank Financed Project III, but also play a pivotal role for construction of highway projects in other provinces and make outstanding contributions to all-around development of highway construction career in Anhui Province.

Annex 8. Comments of Cofinanciers and Other Partners/Stakeholders

N/A

Annex 9. List of Supporting Documents

The World Bank, *Anhui Highway Rehabilitation and Improvement Project: Project Appraisal Document (Report No. 42642-CN)*, March 14, 2008

The World Bank, *Anhui Highway Rehabilitation and Improvement Project: Loan Agreement (Loan No. 7511-CN)* between People's Republic of China and the International Bank for Reconstruction and Development, August 8, 2008

The World Bank, *Anhui Highway Rehabilitation and Improvement Project: Project Agreement (Loan No. 7511-CN)* between the International Bank for Reconstruction and Development and Anhui Province, August 8, 2008

The World Bank, *internal documents*, from 2006 to 2009

People's Republic of China, *Progress Reports of World Bank Loan Project, Anhui Highway Rehabilitation and Improvement Project*, from 2008 to 2012

MAP

