The World Bank

Report No.: ICR00003435

IMPLEMENTATION COMPLETION AND RESULTS REPORT
(IBRD-75570)

ON A

LOAN

IN THE AMOUNT OF US$ 300 MILLION

TO

THE

PEOPLE'S REPUBLIC OF CHINA

FOR A

SHIZHENG RAILWAY PROJECT

October 14, 2016

Transport and ICT Global Practice
East Asia and Pacific Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective November 2015)

Currency Unit = Renminbi (RMB)
RMB 1.00 = US$0.15
US$1.00 = RMB 6.68

FISCAL YEAR
January 1 – December 31

ABBREVIATIONS AND ACRONYMS

CR	China Railways
CMV	Catenary Maintenance Vehicles
CR	China Railways
CRC	China Railway Corporation
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EMP	Environmental Management Plan
EMU	Electric Multiple Unit
FCTIC	Foreign Capital and Technical Import Center of MOR
FM	Financial Management
GHG	Greenhouse Gas
HSR	High-speed Railway
ICR	Implementation Completion and Results Report
JGHC	JingGuang Dedicated Passenger Railway Henan Company Limited
M&E	Monitoring and Evaluation
MLTRDP	Mid- and Long-term Railway Development Plan
MOR	Ministry of Railways
MTR	Mid Term Review
NPV	Net Present Value
PAD	Project Appraisal Document
PDO	Project Development Objective
RA	Regional Administration
RAP	Resettlement Action Plan

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PEOPLE'S REPUBLIC OF CHINA
SHIZHENG RAILWAY PROJECT

CONTENTS

A. Basic Information			
Country:	China	Project Name:	ShiZheng Railway Project
Project ID:	P099062	L/C/TF Number(s):	IBRD-75570
ICR Date:	10/17/2016	ICR Type:	Core ICR
Lending Instrument:	SIL	Borrower:	MINISTRY OF FINANCE
Original Total Commitment:	USD 300.00M	Disbursed Amount:	USD 297.06M
Revised Amount:	USD 297.06M		
Environmental Category: A			
Implementing Agencies: China Railway Corporation			
Cofinanciers and Other External Partners:			

B. Key Dates				
Process	**Date**	**Process**	**Original Date**	**Revised / Actual Date(s)**
Concept Review:	06/28/2006	Effectiveness:	11/18/2008	11/18/2008
Appraisal:	02/08/2007	Restructuring(s):		08/21/2012
Approval:	06/24/2008	Mid-term Review:		
		Closing:	12/31/2013	11/30/2015

C. Ratings Summary	
C.1 Performance Rating by ICR	
Outcomes:	Satisfactory
Risk to Development Outcome:	Low or Negligible
Bank Performance:	Satisfactory
Borrower Performance:	Satisfactory

C.2 Detailed Ratings of Bank and Borrower Performance (by ICR)			
Bank	**Ratings**	**Borrower**	**Ratings**
Quality at Entry:	Satisfactory	Government:	Satisfactory
Quality of Supervision:	Satisfactory	Implementing Agency/Agencies:	Satisfactory
Overall Bank Performance:	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)		
Railways	100	100
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:	Axel van Trotsenburg	James W. Adams
Country Director:	Bert Hofman	David R. Dollar
Practice Manager/Manager:	Michel Kerf	Ede Jorge Ijjasz-Vasquez
Project Team Leader:	Gerald Paul Ollivier	John Carter Scales
ICR Team Leader:	Romain Pison	
ICR Primary Author:	Romain Pison, Laure Albinet, Fatima Arroyo Arroyo[1]	

F. Results Framework Analysis

Project Development Objectives (from Project Appraisal Document)

The project development objectives are to meet growing freight and passenger market demand in the railway corridor between Shijiazhuang and Zhengzhou, while substantially improving the level of service offered to customers.

[1] Based on substantial analysis from Richard G. Bullock, Jitendra Sondhi, and Nanyan Zhou.

Revised Project Development Objectives (as approved by original approving authority)
The Project Development Objective are to meet growing freight and passenger market demand in the railway corridor between Shijiazhuang and Zhengzhou, while substantially improving the level of service offered to customers and to improve the maintenance of the catenary system on high speed rail lines.

(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 :	Average number of pairs of trains of maximum speed of 300 km/h operated per day on the Shijiazhuang and Zhengzhou section of the new line			
Value quantitative or Qualitative)	0	77		56
Date achieved	12/31/2006	12/31/2015		11/25/2015
Comments (incl. % achievement)	Number of pair of trains is representing 73% of the target, when considering the average number of pair of trains by sections, reflecting a decision to keep many more trains in operation on the parallel conventional line.			
Indicator 2 :	Average number of pairs of trains of maximum speed of 200 km/h operated per day on the Shijiazhuang and Zhengzhou section of the new line			
Value quantitative or Qualitative)	0	23		4
Date achieved	12/31/2006	12/31/2013		11/25/2015
Comments (incl. % achievement)	Number of pair of trains is representing 17% of the target, when considering the average number of pair of trains by sections, reflecting a decision to keep many more trains in operation on the parallel conventional line.			
Indicator 3 :	Average travel time of 300km/h train between Shijiazhuang and Zhengzhou (minutes) on the same section of the new line.			
Value quantitative or Qualitative)	0	85		81
Date achieved	12/31/2006	12/31/2015		11/25/2015
Comments (incl. % achievement)	Average travel time for direct trains between Shijiazhuang and Zhengzhou is better than the target by 5%			

Indicator 4 :	Average number of pairs of freight trains operated per day on the Xinxiang to Zhengzhou section of the existing railway			
Value quantitative or Qualitative)	56	67		55
Date achieved	06/30/2006	12/31/2015		11/25/2015
Comments (incl. % achievement)	Number of pair of trains is representing 82% of the target.			
Indicator 5 :	Power failure incident per operated train on HSR lines (Index 100 in 2013)			
Value quantitative or Qualitative)	100	95		15
Date achieved	12/31/2013	12/31/2015		11/25/2015
Comments (incl. % achievement)	The power failure incident indicator has been reduced by 85%, but before the introduction of the Catenary Maintenance Vehicles			

(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 :	Progress rate of world and procurement of goods (%)			
Value (quantitative or Qualitative)	0	100%		100%
Date achieved	12/31/2006	12/31/2012		11/25/2015
Comments (incl. % achievement)	100% achievement			
Indicator 2 :	% equipment contracted (by value)			
Value (quantitative or Qualitative)	0	100%		100%
Date achieved	12/31/2006	12/31/2012		11/25/2015
Comments (incl. % achievement)	100% achievement			
Indicator 3 :	New equipment contracted (%)			
Value	0	100%		100%

(quantitative or Qualitative)				
Date achieved	11/14/2012	12/31/2013		11/25/2015
Comments (incl. % achievement)	100% achievement			

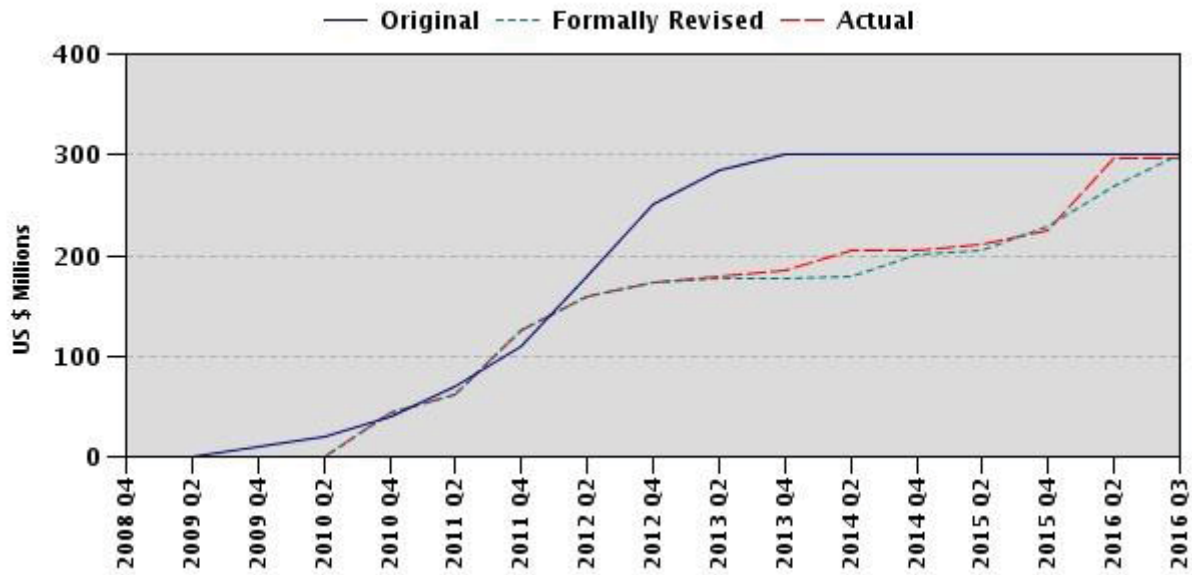
G. Ratings of Project Performance in ISRs

No.	Date ISR Archived	DO	IP	Actual Disbursements (USD millions)
1	06/26/2009	Satisfactory	Satisfactory	0.00
2	05/20/2010	Highly Satisfactory	Satisfactory	32.05
3	06/27/2011	Highly Satisfactory	Satisfactory	125.15
4	03/29/2012	Highly Satisfactory	Satisfactory	167.80
5	12/05/2012	Highly Satisfactory	Satisfactory	179.05
6	06/23/2013	Highly Satisfactory	Satisfactory	184.58
7	12/17/2013	Highly Satisfactory	Satisfactory	204.99
8	06/16/2014	Highly Satisfactory	Satisfactory	204.99
9	12/09/2014	Satisfactory	Satisfactory	208.47
10	06/23/2015	Satisfactory	Satisfactory	224.39
11	11/30/2015	Satisfactory	Satisfactory	275.73

H. Restructuring (if any)

Restructuring Date(s)	Board Approved PDO Change	ISR Ratings at Restructuring		Amount Disbursed at Restructuring in USD millions	Reason for Restructuring & Key Changes Made
		DO	IP		
08/21/2012		HS	S	173.74	The project restructuring enabled the project to support the purchase of advanced catenary maintenance equipment using some of the original loan savings. Such equipment allows more efficient maintenance of the catenary system, by allowing faster access to the sites where maintenance needs to be carried out, and by allowing work to be carried on the catenary above both tracks simultaneously.

I. Disbursement Profile



1. Project Context, Development Objectives and Design

1.1 Context at Appraisal

1. The railway sector was considered vital to China's economic and social development and its international trade, continued economic growth, and ability to extend the benefits of development to people living in the central and western regions of the country. China is a vast country where people and goods move over long distances, for which railways was considered to provide the most economic means of transport over the distance range supported by the project. Railways are also more energy-efficient, are environment-friendly, and require less land than highways of comparable capacity.

2. Between 2000 and 2008, traffic on the China Railways (CR) network grew rapidly. Passenger traffic (measured in passenger-km) grew by 70 percent and freight (in ton-km) grew by 82 percent. Even the economic downturn had comparatively little impact, with passenger traffic in the first two months of 2009 up by 10 percent compared to the previous year and freight traffic down by only 6 percent. The network had been expanded by 11 percent since 2000 but had been unable to keep pace with traffic demand. As a result, much of the system, already intensively used a decade earlier, operated close to, or at, capacity. Some traffic on these routes was diverted to transport modes with higher economic and social costs. To avoid railway congestion slowing sustainable economic growth in China, its railway network and services needed to be both expanded and improved.

3. To tackle the increase in demand, in 2004 the State Council approved the Mid- and Long-term Railway Development Plan (MLTRDP) of the Ministry of Railways (MOR) which set out the investment required at the rate of about US$12–15 billion per year through 2020 to keep pace with demand. An element of the World Bank's strategy for China was to support this government initiative to bring the various parts of the country closer with regard to personal mobility and the movement of goods through railway development, especially between the central and western regions of the country.

4. Following State Council approval of the 11th Five-Year Plan (2006-2010), the annual rate of investment in railways had increased significantly above the level originally envisaged in the MLTRDP, and in 2008 had reached a level of approximately US$45 billion. Although the Bank financing for this project aimed at contributing to achieving the overall investment target, an equally important reason for China to seeking Bank participation during the early years of developing higher standard rail lines for freight and passengers that are able to accommodate electric multiple units, EMU, was to continue to access technical advice, especially on the application of appropriate safeguard policies, as well as international practice in project preparation, procurement and implementation, since those were still the early years of developing higher standard rail lines for freight and passengers able to accommodate electric multiple units (EMU).

5. At the time of appraisal, the Bank initiated its engagement through a wide program of railway projects, with 2,660 km over six projects during the period. The choice of a multi-project engagement from the Bank was supported by the objective to leverage additional benefits from a holistic support compared to a single-project financing approach. In addition and in parallel to the

program support, the Bank also fostered a railway sector-based policy dialogue and institutional support nurtured by multiple railway policy notes, which eventually facilitated and enriched the railway sector in China.

1.2 Original Project Development Objectives (PDOs) and Key Indicators

6. The PDOs as indicated in the Project Appraisal Document (PAD) and the Loan Agreement were to meet growing freight and passenger market demand in the railway corridor between Shijiazhuang and Zhengzhou, while substantially improving the level of service offered to customers.

7. The key PDO indicators as indicated in the PAD were:

a. average number of pairs of trains of maximum speed of 300 km/h operated per day on the Shijiazhuang and Zhengzhou section of the new line;

b. average number of pairs of trains of maximum speed of 200 km/h operated per day on the Shijiazhuang and Zhengzhou section of the new line;

c. average travel time of 300km/h train between Shijiazhuang and Zhengzhou (minutes) on the same section of the new line; and,

d. average number of pairs of freight trains operated per day on the Xinxiang to Zhengzhou section of the existing railway

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

8. The development objective and key indicators were modified by a Level I restructuring in August, 2012, as follows:

a. The Project Development Objective was revised as follows "to meet growing freight and passenger market demand in the railway corridor between Shijiazhuang and Zhengzhou, while substantially improving the level of service offered to customers and to improve the maintenance of the catenary system on high speed rail lines".

b. One component has been added to include the procurement, purchase and operation of Catenary Maintenance Vehicles (US$115 million) financed from (1) savings derived from international tenders (US$28 million); (2) use of domestic financing instead of the loan for the signal system (US$44 million) to unify the signal system along the entire Beijing-Guangzhou line; (3) lower than anticipated price of raw materials used for bridge bearings (US$43 million).

c. One outcome indicator and one intermediate result indicator were added to the result framework to reflect the impact of the new component on the Catenary System Maintenance. The new outcome indicator measures the evolution in the number of power failure incidents per operated high speed rail train.

1.4 Main Beneficiaries

9. The project was expected to benefit both current and potential passengers who traveled between Shijiazhuang and Zhengzhou as well as the volume of freight and commodities, as the capacity and the level of service for both were anticipated to improve significantly. The rail transport capacity will expand to meet growing freight and passengers demand along this rail corridor, as the freight trains are on the parallel conventional tracks along the corridor. The project was expected not only to benefit the railways as a business but also the country overall, by encouraging the use of the more economically and environmentally efficient railways.

1.5 Original Components

10. At appraisal, the project consisted of the following activities:

a. Construction of a new 355 km dedicated high-speed passenger rail line between Shijiazhuang in Hebei province and Zhengzhou in Henan province (ShiZheng line), including the construction of subgrades, bridges, culverts, and buildings; acquisition and installation of goods (including, without limitation, communications, signaling and electrification equipment, and maintenance vehicles); and provision of related technical assistance. By international standards, this was a megaproject. It was, and still is, the only high-speed rail line designed for 350 km/h speed ever supported by the World Bank.

b. Construction of new and reconstruction of existing railway stations along the rail line.

c. Resettlement and rehabilitation of displaced persons.

11. The initial project cost was US$6.2 billion, including a Bank loan of US$300 million. The Bank loan financed the procurement of goods, including communications, signaling and electrification equipment, and maintenance vehicles. In addition to the goods financed by the Bank loan, there was an allocation for potential technical assistance as warranted during project implementation but not specified at the time of appraisal. This project was part of a much wider program of railway projects that supported the construction of 2,660 km of rail lines over six projects during the period.

1.6 Revised Components

12. A project component has been added to include the purchase of Catenary Maintenance Vehicles (US$115 million) financed from (1) savings derived from international tenders (US$28 million); (2) use of domestic financing instead of the loan for the signal system (US$44 million) to unify the signal system along the entire Beijing-Guangzhou line; (3) lower than anticipated price of raw materials used for bridge bearings (US$43 million).

1.7 Other Significant Changes

13. **Restructuring.** The project underwent a Level I restructuring in August, 2012. The main changes made during restructuring were:

a. The Project Development Objective was revised as follows "to meet growing freight and passenger market demand in the railway corridor between Shijiazhuang and Zhengzhou, while substantially improving the level of service offered to customers and to improve the maintenance of the catenary system on high speed rail lines."

b. The following additional adjustments to the project were also made simultaneously: (i) introduction of a new component called "Catenary Maintenance Vehicles" (US$115 million) financed from (1) savings derived from international tenders (US$28 million); (2) use of domestic financing instead of the loan for the signal system (US$44 million) to unify the signal system along the entire Beijing-Guangzhou line; (3) lower than anticipated price of raw materials used for bridge bearings (US$43 million); (ii) amendment of the results framework by adding a new outcome indicator and a new intermediate indicator to reflect the new component and which consists in measuring the number of power failure incidents per operated high speed rail train; (iii) reallocation of loan proceeds between expenditure categories; and (iv) extension of the project closing date by 23 months to 30th November 2015.

14. Project design did not include a Midterm Review (MTR). When the Bank indicated that a MTR should be conducted of all projects, all contracts had been awarded and project implementation was well under way, and there was no need for a MTR. Besides, the core Bank team was located in the country office and thus was able to meet China railway every six weeks or so to follow up on implementation of the railway program, providing an even more regular tracking on the implementation of the railway program and a more intense supervision than what a MTR enables.

2. Key Factors Affecting Implementation and Outcomes

2.1 Project Preparation, Design and Quality at Entry

15. The project quality at entry is Satisfactory based on the analysis detailed hereafter.

Soundness of Background Analysis (Satisfactory)

16. In the period from 1995 to 2010, the Chinese railway industry had been pursuing two key objectives. One was to reform the industry to become more responsive to the market economy. The other was to achieve an order-of-magnitude change in the capacity and quality of infrastructure and services in a network that was already the busiest at the time of appraisal, by a wide margin, of any railway system in the world and which was still facing rapidly growing demand. The ShiZheng Railway Project and its documentation clearly described the background and sector challenges and objectives, including the step-by-step approach chosen by the government toward industry reforms, concentrating on reforms within the existing framework rather than breaking up the CR itself.

Assessment of Project Design (Satisfactory)

17. **The selection of the final route was based on a diligent multi-criteria selection, including economic, environmental, social, and technical factors.** Several alternatives were considered, with the final choice based on multiple criteria that included connections with existing rail network, minimizing cost and land acquisition/resettlement, highly populated areas, and environmental degradation, as well as connecting potential areas of economic development. Further efforts were made to avoid abandoned coal mines, places with cultural relics, scenic and historic spots, and areas with poor geological conditions. The design institutes consulted urban planning development officials of the various cities in selecting sites for proposed railway stations and railway facilities.

18. **Environmental and social aspects were diligently considered during feasibility engineering and environmental assessment preparation.** Feasibility engineering included, as required by Chinese practice, an alternative analysis. A single Environmental Impact Assessment (EIA) consultant was responsible for overall EIA/Environmental Management Plan (EMP) preparation.

19. **Two project companies were planned to be created for project implementation, based on the lessons learned from other Bank railway projects in China.** This project and the two other Bank-financed projects around the same time (the NanGuang Railway Project and the GuiGuang Railway Project), differed from previous Bank-financed railway projects in China in that a project company was to be created and the Ministry of Railways (MOR) was to transfer assets created by the project to the project company. This arrangement was considered to strengthen ownership of the project for both implementation and future operations.

Assessment of Risks (Satisfactory)

20. Risks were assessed diligently, taking into account the Bank's previous engagement in the railway sector in China. The following risks were identified and risk management measures were taken:

a. **Traffic estimates.** Success of the project would be dependent on traffic volume. The current total level of traffic at corridor level, including freight and conventional and high speed passenger, is in line with expectation, even if the high speed rail line is substantially lower than expected for reasons explained later in this document.

b. **Sustainability.** The risk that this high cost project would not be economically and financially sustainable was considered substantial. Results of the economic analysis indicate a project that is economically sustainable based on initial years of operations. The sustainability at the technical level is considered ensured by the experience of MOR in carrying over 1 billion passenger per annum via high speed rail in 2015 as well as the use of mature high-speed railway technology and products from well-established suppliers.

c. **Resettlement and Land Acquisition.** The project required the acquisition of a large extent of land. There was a risk that land acquisition and resettlement would not be carried out as per the Resettlement Action Plan (RAP). Assessment of land acquisition and compensation payments confirmed that these were as per the standards indicated in the RAP.

d. **Environmental risk.** The project was along a well-developed corridor, parallel to a major river, with urban areas as well as agricultural areas throughout the entire corridor. There was a moderate risk that the environmental management plan (EMP) would not be implemented satisfactorily. However, the arrangements for implementing the EMP turned out to be appropriate and the EMP was implemented satisfactorily.

2.2 Implementation

21. **The implementation of the railway infrastructure project was satisfactory thanks to the performance of the Dedicated Passenger Railway Company Limited (JSC) and the JingGuang Dedicated Passenger Railway Henan Company Limited (JGHC).** Project implementation proceeded in line with expectations and with high administrative efficiency despite the scale of this megaproject. Outside China, a high speed rail line designed to operate at 350 km/h is quite unique. The line has been delivered below cost and on time. Traffic after 3 years and half in terms of pairs of trains is better than even Tokyo-Osaka at the same stage, the benchmark line for high speed rail (also supported by the World Bank) outside China. The quality of work was good and suitable measures were taken to ensure safety, environmental preservation, and specified quality standards. The 355 km railway line between Shijiazhuang in Hebei province and Zhengzhou in Henan province started commercial operations on December 2012, and has been now operating for three years. In order to understand the project context and its implementation, it is important to note that the ShiZheng railway corridor is a segment in one of the longest rail corridor in the world (JingGuang line of 2,324 km). The JingGuang corridor includes two parallel rail lines: the conventional JingGuang line between Beijing and Guangzhou and the high speed passenger dedicated line between Beijing and Guangzhou.

22. **The purchase and implementation of specialized Catenary Maintenance Vehicles (CMV) for high speed railway lines in operation was satisfactory**. The experience from HSR lines opened by 2012 underlined the significance of catenary maintenance equipment to provide high levels of services to customers and achieve the original project development objective in the long term. Any failure in the catenary system can rapidly lead to negative perception on the overall quality of services and undermine the project impact. Accordingly, China developed a high priority program to strengthen the maintenance and operation of its high speed rail network. The CMV component (US$115 million) has been financed from (1) savings derived from international tenders (US$28 million); (2) use of domestic financing instead of the loan for the signal system (US$44 million) to unify the signal system along the entire Beijing-Guangzhou line; (3) lower than anticipated price of raw materials used for bridge bearings (US$43 million).

23. **These CMVs were the first of this kind in China. They are improving the system reliability by improving periodic maintenance and fault detection, and therefore the long term sustainability of the operations.** All CMVs have been delivered to the respective maintenance units where they are to be located by the end of the project. There were two contracts, representing 28 units received between the end of 2014 and the end of 2015. Out of the 8 imported CMVs, 5 are already operating and the 3 remaining will be operating after high-speed experiment in the end of July 2016. All the 20 domestic CMV are now operating after being tested in May 2016. It is noted that the CMV in service have performed satisfactorily and have met all operational requirements. The key aspect of this CMV related component was that it was the very first time

such equipment, operating at 160 km/h and equipped with an extending arm enabling them to work on an adjacent line, was introduced in China. As a result of this component, CRC has been ordering a large number of units of the same type as part of its strengthened catenary maintenance program, thereby enhancing the sustainable operation of its high speed rail system from this point forward.

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

24. **Overall M&E quality rating - Modest.** There were some shortcomings in the M&E system's design and implementation. The M&E system, as designed and implemented, was only partly sufficient to assess the achievement of the objectives and to test the links in the results chain, as it did not capture the results for the overall corridor nor the benefits from the CMV.

25. **M&E design.** The M&E framework had clear and simple-to-use definition of indicators in order to measure the achievement of the PDO: four PDO indicators and two intermediate indicators. These indicators are based on easy to gather data and are specific, measureable, adequate, realistic and targeted.

26. **However, train related indicators only partly measured the corridor level objectives, and the CMV related indicator did not enable to capture CMV related benefits through a direct results chain.** Indicators related to the number of passenger on high speed trains (indicators 1 and 2), did not fully capture how passenger market demand was met at corridor level, since it omitted the role of conventional trains that remained predominant in terms of passenger volumes. In addition, the indicator related to the CMV component (added at the restructuring) does not enable the attribution of benefits deriving from the CMV purchase to the overall project.

27. The indicators for the number of passenger trains have been separated from the indicator relating to the number of trains for the freight (indicator 4). At the design stage, a decision was made to measure the increase in capacity through separate indicators for passenger and freight traffic. A single indicator for capacity (freight combined with conventional and high speed rail passengers) could instead have been considered as an alternative, as the PDO relates to the rail corridor capacity as a whole, and does not distinguish passenger and freight traffic.

28. The capacity related indicators do not specify which sections of the railway line they are related to. The ICR uses an average when analyzing the difference between the targets and the actual results. Annex 3 in the PAD does not define clearly how the intermediate indicator "Progress rate of works and procurement of goods" would be measured, e.g., as a % of total investment or as % km of infrastructure works completed and equipment installed. In practice, it was measured taking a combination of both, as captured in annual audit reports. The project could have developed better intermediate indicators to measure progress of project outputs.

29. **M&E implementation and utilization.** MOR monitored and evaluated the progress of the project on a six-monthly basis. MOR, through the Foreign Capital and Technical Import Center (FCTIC), and the China Railway Corporation (CRC) reported on project progress, including achievement of performance monitoring indicators. Data on baseline, target values and intermediate values were provided by MOR, through FCTIC. Overall progress was reviewed as part of annual audit reports, with progress compared to targets.

2.4 Safeguard and Fiduciary Compliance

30. **Procurement under the project complied with Bank policies.** Procurement has been mostly carried out by FCTIC, with the assistance of a tendering company and several design institutes. The Bank's assessment of FCTIC's capacity to implement procurement actions for the project during project preparation had confirmed that FCTIC would be able to manage project procurement in compliance with Bank Procurement Guidelines. This assessment proved valid and the project did not face any procurement issues or delays, despite its very large size.

31. **Financial Management (FM) of the project complied with Bank policies, although there were some minor delays.** The project FM system provided, with reasonable assurance, accurate and timely information that Bank loan proceeds were used for the intended purposes. Counterpart funds were provided as planned. The auditors issued unmodified/clean opinions on project audit reports and interim unaudited financial reports (IUFRs), and any minor issues identified were addressed by the implementing agency. In 2011, some procurement and contract management issues financed by counterpart funds were identified in project companies. Upon Bank's request, FCTIC provided written response to the Bank regarding their improvement actions. The Project Companies confirmed right after that all issues have been addressed. In June 2015, the FM was temporarily rated Moderately Satisfactory because of a delay in providing the most recent interim financial. The delay has been cleared in a short time and the FM rating therefore went back to Satisfactory as of November 2015.

32. **The Environmental Safeguards Policies triggered (OP/BP 4.01, OP/BP 4.04, OP/BP 4.11) were complied with.** The overall implementation of Environmental Management Plan (EMP) is satisfactory. Throughout project implementation, CRC and the two Railway Administrations (RA - Beijing and Zhengzhou) have attached close attention to the environmental protection, and set up comprehensive environmental management structures. Following the good practice of previous three Bank-funded railway projects, an independent external environmental monitoring consultant was engaged throughout the project implementation stage. All environmental mitigation measures are implemented according to design, i.e. all temporarily occupied land (e.g. borrow/disposal sites, beam-casting plant and mixing plants, camp sites) have been restored through grass/tree replantation, farmland reclamation, reused as railway station/freight yards, returned to local communities for development or returned to local governments according to agreements. Noise barriers and insulation windows have been installed for noise sensitive communities as per design and subject to actual monitoring during trial operation. Extensive soil erosion control measures have been completed for slope bank protection and at restoration/reclamation sites.

33. **The Social Safeguards Policy triggered (OP/BP 4.12 on Involuntary Resettlement) was complied with.** A RAP was prepared, reviewed, and disclosed in compliance with OP/BP 4.12. Active public consultations took place with affected villages and households on the selection of railway alignment and the locations of railway stations, as well as compensation rates, relocation arrangements and livelihood restoration approaches and measures and helped optimize project design and reduce project impacts. At project closure, the implementing agency had completed land acquisition (10km^2 of which 5.5km^2 in Hebei and 4.5km^2 in Henan, compared with the appraisal estimate of 11.5km^2) and paid the required compensation. A total of 4,752 households were relocated, of which 3,195 were in Hebei and 1,557 in Henan, compared to the 3,029

households estimated at appraisal. The house compensation (average of RMB450/m^2 in Henan and RMB600-800/m^2 in Hebei) is higher than that of the RAP. The external social monitoring carried out for the project concluded that the RAP was implemented in a satisfactory manner.

2.5 Post-completion Operation/Next Phase

34. **Operations and Maintenance**. China Railway (CR) has been operating high speed railways successfully now for over six years, with over 19,000 route km of high speed rail operational at the end of 2015. China Railway has developed and operationalized robust and effective maintenance systems for infrastructure and rolling stock for the very intensively used high speed rail systems. The CMV components enable CRC to introduce a comprehensive program for inspection and maintenance of its overhead catenary system for the entire planned network of high-speed lines. This system will help ensure the sustainability of the project. This project has contributed in providing CMVs for existing depots that serve high-speed lines in operation. The institutional setting as well as maintenance infrastructure is considered adequate for the foreseeable future. The content of various maintenance schedules are aligned to maintenance requirements arising out of train usage and expected wear and tear. Each train undergoes an overhaul at the works of the manufacturer after it has covered 600,000 km in service (after about one year in service).

35. **Financial sustainability.** Based on its location on a major national corridor, the project line generates positive cash flow from operation. The project companies are likely to pay interest on the debt and then negotiate any payment for infrastructure maintenance with the local Regional Administrations, who are also shareholders in the companies. The Companies will however need to restructure its debt, when repayment of the principal begins in 2017. The need to restructure project-related debt is linked to the difference in maturity between the commercial loans and the life of the asset and the need for traffic to ramp up. CRC would address the restructuring at a network level, since fewer high speed trains are operating compared to appraisal estimates.

3. Assessment of Outcomes

3.1 Relevance of Objectives, Design, and Implementation

36. **Relevance of objectives - High.** Project objectives were and remain highly relevant to the development priorities of China. The project directly contributed to the World Bank Group Country Partnership Strategy (2006–2010), especially on the dimensions of integrating China into the world economy; reducing poverty, inequality, and social exclusion with affordable transport; and improving public and market institutions. The railway sector is vital to China, especially to its continued economic growth and development and to international trade. Railways also enhance China’s ability to extend the benefits development more widely in society and to people living in remote regions. This project remains a key response to China’s current transport challenges as greener development through railway transport have the potential to address China's environmental degradation and resource depletion and also to become a new driver for growth. The project is still aligned with the World Bank Group Country Partnership Strategy (2013–2016), especially on the dimensions of greener growth through low-carbon transport and the improvement of transport connectivity for more balanced regional development.

37. **Relevance of design and implementation – Substantial**. Project design and implementation were and remain highly relevant in achieving the PDO. Bank financing covered only 5% of costs, which is a relatively low level compared to most Bank projects in China. Such an approach had two main merits: (a) it enabled the Bank to support a much wider program of railway projects (2,660 km of rail lines over six projects during the period) within the overall lending volume; and (b) it leveraged Bank resources effectively by extending the application of Bank requirements, especially safeguards, over a much larger project. Project components and expected outputs are consistent with the stated objectives, as outputs and outcomes are a direct result of the causal chain of the project. The results framework included a few minor shortcomings as detailed in paragraphs 25 to 29. Despite its massive size and technical challenges, project implementation was consistent with on-going Government programs.

3.2 Achievement of Project Development Objectives

38. **Achievement of the PDO – Substantial against the original project objectives and modest against the revised project objectives.** This was based on the assessment of the achievement of each of the elements of the PDO as follows.

39. **Meeting growing freight and passenger market demand in the railway corridor between Shijiazhuang and Zhengzhou (Substantial).** Overall, additional rail capacity has been provided as planned and capacity utilization in number of pairs of trains along the corridor reached its targets, despite the fact that the results framework captures that only 71 percent of the overall objective has been achieved.

40. The corridor is defined as a combination of the new high speed rail line, supported by the project, and the existing conventional rail line. The distribution between trains on the conventional line and trains on the high speed rail line differed from what was originally anticipated, reflecting decisions by CRC based on social considerations. At Appraisal, the corridor was forecast to carry 181 pairs of trains including 100 high speed pairs, 67 freight trains by 2015 according to the result framework, as well as an additional 14 conventional trains according to the economic evaluation. Actually, by 2015, the corridor carried 180 pairs daily including 60 high speed pairs, 65 conventional trains and 55 freight trains. The most recent figures from August 2016 indicate that the corridor carries on average 201 pairs daily including 81 high speed pairs, 65 conventional trains and 55 freight trains.

Number of pairs of trains…	… Anticipated at Appraisal	… At project closing	… In August 2016
… captured by the results framework	167	117 (71% of target)	136 (81% of target)
… for the entire corridor	181	180	201

41. It is worth nothing that, in August 2012, when the project was restructured, the line had not started to operate. The results for the first year of operation in 2013 were in line with the result framework with 36 pairs of high speed trains on the new high speed rail line. Public concerns over

affordability led CRC to reconsider the reduction in conventional trains originally foreseen. The result framework does not take into account conventional passenger traffic along the corridor. The number of pairs of trains on the corridor as measured in the results framework is 117 compared to an anticipated 167, representing 71 percent of the overall target. The distorted performance between the corridor analysis and the results framework level analysis is the reason for the rating of Substantial impact towards the achievement of the PDO (and not higher).

42. In general, traffic along the corridor has increased markedly since the high speed rail line opened, with most of the traffic growth coming from the high speed rail line. As new capacity became available as a result of the project, total passenger density on ShiZheng corridor grew from 61 million pass-km/route-km in 2012 to 75 million in 2014, with high speed rail accounting for 23 million. In year 2, between 2013 and 2014, passenger traffic on the ShiZheng corridor enjoyed a similar growth rate as national passenger volume (9.5% for national passengers-km and 8.6% on ShiZheng). Traffic growth on the national network was similarly boosted by a large increase in the number of high speed rail lines in operation. Between 2007 and 2013 train pairs on the conventional line continued to grow by a cumulative 5 percent, essentially using the full capacity of the conventional line with capacity use ranging between 93% to 99%, depending on the segment. Freight density grew significantly as well in 2013, even though national freight traffic was contracting, as a result of the reduced number of passenger services on the conventional line. However, in 2014, freight traffic on the corridor contracted like on the rest of the network; this system-wide contraction has continued in 2015 and 2016, and the number of freight trains in the corridor is now about 55 pairs compared to the 2015 forecasts of 67 pairs.

43. **Improving the level of service offered to customers (Substantial).** The project led to a substantial improvement in passenger services. Average travel time of non-stop high speed trains between Zhengzhou and Shijiazhuang at 81 minutes (better than the original target of 85 minutes) is a major improvement compared to the 198 minutes prevailing prior to the project, and with much higher quality of service. The frequency of high speed passenger trains with about 53 to 60 pairs[2] of trains operated daily, as of November 2015, is substantial even if lower than anticipated, since the result framework anticipated 77 pairs of 300 km/h trains and 23 pairs of 200 km/h trains by end 2015. This reflects a decision from CRC to maintain about 65 conventional pair of trains on the conventional line instead of 14 as expected at the time of project approval in response to public feedback regarding fare affordability and accessibility to intermediate stations. The beneficiary survey results conducted shows that more than 58 percent of the interviewed travelers chose the train because of the short travel time and the convenience of the HSR. Comfort, punctuality, and safety were other main reasons for choosing the train. The number of high speed trains grew nonetheless rapidly from 36 when the line opened (exceeding expectations) to about 60 at this stage indicating sustained growth along the corridor[3]. It is worth noting however that, after only two years of operation, the high speed rail line carried already a high density of 23.4 million passenger km/km of line (2014), making it a high density high speed corridor by international standards.

[2] Shijiazhuang-Handan: 60; Handan-Xinxiang:54; Xinxiang-Zhengzhou 53;

[3] Such number is based on the November 2015 timetable. The train schedule evolves throughout the year. More trains will be running during holidays.

44. **Improving the maintenance of the catenary system on high speed rail lines (Substantial).** The last PDO dimension relates to the improvements in the maintenance of the catenary system on high speed rail lines, introduced as part of a project restructuring. China developed a high priority program to strengthen the maintenance and operation of its high speed rail network and reduce the rate of power failures, which include the purchase of the CMV under the project. To monitor the impacts of the CMV, an indicator of power failure incident was introduced using an Index 100 in 2013 as baseline. The power failure rate is calculated as the number of times overhead catenary systems experience power failure incidents on the HSR network over passenger-km on HSR passenger dedicated lines, as detailed in the Table below. The Index improved markedly to 49 in 2014 and 15 in 2015 indicating a respective improvement by 51% and 85% in performance. Actual achievement of 0.116 in 2015 (45 power failure incidents for 386 billion passenger-km) is further supported by the CMV by providing relevant equipment for both effective maintenance (reduce failure rate) and rapid interventions in case of failure (reduced consequence of such failures).

45. Such achievements haven been reached before the introduction of the CMV, which does not allow to provide a direct attribution factor to the CMV component towards the achievement of this PDO aspect, but rather a correlation between China high priority program related to maintenance and the achievement of this PDO aspect. The lack of attribution related to this PDO indicator and its full achievement even before a single CMV was delivered is per se not a problem of not achieving the PDO, but of a non-adequate choice of indicator, as noted under the section related to the quality of the results framework. Therefore, the overall efforts made by CRC towards better maintenance along the railway lines outside the scope of the CMV component also contributed to the improvement of the maintenance of the catenary system on HSR lines, as shown by the data captured along the rail corridor.

Year	#Power Failure Incidents	Passenger-km on HSR (billion)	Ratio	Index
2013	166	214	0.775	100
2014	107	282	0.379	49
2015	45	386	0.116	15

46. Since the first CMV was put in operation in February 2015, and most CMVs entered service in early 2016, this indicator will need to be monitored and updated next subsequent year to fully understand the impact of the CMV on system performance. Nonetheless indications of major efficiency gains generated by the first CMV in operation were confirmed during site visits and CRC detailed its intention to scale up the CMV program as a result contributing to service quality and improved maintenance.

3.3 Efficiency

Rating: Substantial

47. **Ex-post economic analysis.** The ex-post economic analysis indicates that the infrastructure investment was economically viable, with an overall Economic Internal Rate of

Return (EIRR) of 15%, compared with an estimated EIRR of 20% at appraisal, due primarily to the major slowdown in freight demand and the change in operating strategy adopted by CRC during the construction period, compared to what was forecasted at appraisal. More details are provided in Annex 3. While the EIRR is slightly lower than the one calculated at appraisal, a 15% rate after only a few years of operations for a HSR is exceptional as per international standards. In France, a country with more history and data on HSR than China, studies have shown that the ex-post economic analyses give most of the time rate of returns which are inferior to the forecasted ones. Ex-post analysis on the main HSR line in France show various EIRR ranging from 4 to 15 percent, which is lower than the EIRR observed for Shizheng. The impacts included in the analysis of the infrastructure component can be classified as (a) cost-benefit analysis of passenger and freight traffic (for example, through travel time savings); and (b) externalities (carbon emissions, and reduced accidents). Agglomeration benefits are also likely to have a marked long term effect as an increasing number of companies become more closely connected and enjoy efficiency gains. However, to maintain comparability with the original evaluation, agglomeration benefits were not incorporated in the current quantified evaluation.

48. **CMV.** This project component is still in the process of rollout and the impacts cannot be fully quantitatively evaluated until later in 2016 or 2017. The economic evaluation done at the time of restructuring is therefore the same that the ex-post evaluation for the CMV component. The monitoring of the early successes of this component indicates that the introduction of these vehicles to date has matched the assumptions used for evaluation and these have been assumed to have been achieved for the purposes of the ICR. The impacts included in the analysis of the CMV are: (a) reduced routine inspection and maintenance costs and (b) if an incident does occur, faster response times and reduced costs to both the railway and passengers. The full economic analysis is provided in Annex 3 and a calculated EIRR is 30 percent. The CMV component is robust against a range of sensitivity tests concerning these factors, such as reducing the number of conventional vehicles saved by the new vehicles or excluding any reduction in accident costs, with the EIRR typically reducing to 15-20% and the NPV to RMB 40-100 million.

49. **Cost effectiveness.** The latest project cost estimate including rolling stock and CMV is 40,901 million RMB, representing 91% of appraisal in RMB terms (6,058.09 million USD, representing 97% of appraisal in USD terms), which is highly satisfactory for a rail project of this scale. The actual financing required was lower than the estimate at appraisal as rolling stock was leased and not purchased (US$863.50 million). In addition, the exchange rate at appraisal was US$1.00 = RMB 7.18, and was US$1.00 = RMB 6.68 at completion, and therefore the comparison between appraisal and completion in USD terms is impacted. Substantial reduction in cost of goods (56% of appraisal in RMB terms) is due to the fact that some of the items included in goods were transferred to the civil works and many were cancelled. As for civil works, there was significant change in the design and in many places embankments were replaced by elevated track. This design change contributed to the slight increase the cost of civil works (115% of appraisal in RMB terms). A full cost comparison is provided in Annex 1.

50. **Administrative efficiency.** The administrative efficiency of the project is high, as project activities were completed ahead of time and at lower dollar costs. The line was opened in December 2012, ahead of the original loan closing date. Meanwhile adding a new component, the restructuring extended the closing date by 23 months to 30th November 2015 so as to take into account the additional component. Project was completed on November 30, 2015 with the

restructuring and with loan funds almost fully disbursed. There is a decrease of 6% between project costs estimated at appraisal in RMB terms and preliminary final costs, and a decrease of 9% in terms of project financing required, which is remarkable given the scope and size of this mega railway project. The loan account was closed on March 31, 2016 with a decrease of 6% between total costs estimated at appraisal in RMB terms and final costs.

3.4 Justification of Overall Outcome Rating

Rating: Satisfactory

51. As the project objectives have been formally revised, the overall project outcome needs to be assessed against both the original and revised project objectives. To assist in arriving at the overall outcome rating following this principle, separate outcome ratings (against original and revised project objectives) will be weighted in proportion to the share of actual disbursements made in the periods before and after approval of the revision.

		Against original PDOs	**Against revised PDOs**	**Overall**
1.	Rating	Satisfactory	Satisfactory	-
2.	Rating value	5	5	-
3.	Weight (% disbursed before/after PDO change)	65%	35%	
4.	Weighted value	3.25	1.75	5
5	Final rating	-	-	Satisfactory

52. At all levels, the project's success are clear (completion ahead of time, under budget, introduction international best practices, without any significant fiduciary and safeguards issues under a project of such large scale, etc.). In summary, the relevance of objectives is rated High and the relevance of design and implementation are rated Substantial. The PDO has been substantially achieved against the original project objectives as well as against the revised project objectives. The overall efficiency is rated substantial. The split evaluation and the combination of the ratings for project relevance, achievement of PDO, and efficiency justify an overall outcome rating of Satisfactory.

3.5 Overarching Themes, Other Outcomes, and Impacts

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

53. **Impacts are best assessed about five years after operation starts; nevertheless, it already appears that the ShiZheng Rail Project has been a major contributor to the economic transformation of the region.** Shizheng line has already had a deep impact on the accessibility of cities along the corridor, in particular Shijiazhuang and Zhengzhou, as well as on cities that connect to Beijing through the JingGuang Corridor, like Xi'an, which is now connected by HSR through

Zhengzhou and ShiZheng to Beijing. Most of the traffic growth on the JingGuang corridor has come from the HSR line, with stable traffic on the conventional line.

54. **The project has had a significant impact in all cities on transport patterns and in general the take-up has been faster than many local authorities expected.** In addition to allowing much easier travel to and from Beijing (especially so where no alternative air service existed and the option was thus travelling by road), it has made medium-distance travel (e.g. Handan – Shijiazhuang) much easier. However, for short-distance travel like Xingtai – Shijiazhuang and, to a certain extent, Anyang – Zhengzhou, road is still a competitive option especially when the HSR stations are located some distance from the commercial centre. This has led to a general increase in trip frequency. Examples were cited ranging from the Beijing-based senior management of a Shijiazhuang brewery to a Zhengzhou-based glass manufacturer in Anyang who all made more frequent trips. Xingtai Steel representatives also travelled more frequently. Medium and long-distance bus services along the corridor have been substantially reduced as a result of the HSR service.

55. **High speed train service remains expensive for part of the population and explains the decision by CRC to retain a higher number of conventional passenger trains on the corridor at this point, while men to women passenger ratio could be enhanced by better connectivity between HSR stations and the city centers.** Based on the passenger onboard survey along the Shizheng railway line made in 2015, when asking passenger on ordinary train their reasons for not taking the HSR instead, the high ticket price (42%) was the main concern. This is consistent with the average self-reported monthly personal income of around RMB 5,700 on the HSR line, compared with RMB 3,700 for ordinary line.

(b) Institutional Change/Strengthening

56. The Bank reinforced its engagement in the railway sector beyond the current project through a program of six projects during the period. The choice of a multi-project Bank engagement enabled the Bank to engage in policy dialogue and to provide institutional, including multiple railway notes. These contributed to sector reforms, including financing options, optimization of testing and commissioning, and the understanding of wider economic impact of high speed rail.

(c) Other Unintended Outcome and Impact (positive or negative)

Not applicable.

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

57. During August 9 to 17, 2015, and September 18 to 20, 2015, the Bank organized a survey with a sample of 925 interviews surveyed on-board and in stations, including 536 for HSR and 389 for conventional line. Results detailed in annex 5 show that more than 58 percent of the interviewed travelers chose the train because of the short travel time. Comfort, punctuality, and safety were other main reasons for choosing the train. Over 56 percent of the passengers reported an increase in travel frequency. The traffic on the ShiZheng railway line shows a 54 percent breakdown for tourism or visiting friends and relatives.

58. **Men to women ratio is about 3:2, showing that men are still more likely to use the train, especially because of the prevalence of business trips**. This men to women ratio is similar to the one observed along the Changji and Jinghu lines. The current connectivity level between the city centers and the stations is low, and that may have an adverse impact vis a vis gender. The Government's programs to increase connectivity and densify the areas around the HSR stations may likely improve the men to women ratio in the use of HSR.

4. Assessment of Risk to Development Outcome

Rating: Low or Negligible

59. **The financial risk to the PDO is Moderate**. Results of the initial period of operation show strong growth in HSR demand. The appraisal estimate of the total volume of passengers and number of passenger trains is similar to that which has been achieved, although the distribution between HSR and conventional services is different, with only around one-third of passengers in the corridor using the HSR. However, the forecast yield (revenue per passenger-km) from HSR assumed in the appraisal was the equivalent of RMB 0.29 in 2015 prices. The current yield on these services is about RMB 0.50, generating a much greater operating surplus over above-rail operating costs than assumed at appraisal. The project has thus been cash-positive (excluding depreciation and debt service) from the start of operations, with revenues typically being over twice the cost of operating the trains and maintaining the infrastructure, with every incentive to continue operations form the foreseeable future.

60. **The technical risk is Low.** Similar train systems have been operated and maintained at very high levels of reliability and safety in China since 2007; they are also in operation in Japan, Germany, Italy, UK and France for many years.

61. **The social risk is Low or Negligible.** Detailed passenger attitude surveys have established a strong willingness to pay a surcharge of 50% on high-speed services compared to conventional rail. Even with higher fares on the new services, the cost to most passengers will be lower because of the substantial distance savings. The price of a train ticket on the project line is comparable to the cost of a bus ticket for the same distance in many locations along the line. The overall impact of the project will be to encourage more passengers to rail.

62. **The risk of reduced government ownership and commitment and institutional support risk is Low or Negligible.** The railway sector benefits from strong government commitment and institutional support. China has the world's longest High Speed Railway network. The State Council approved 2004 MOR Mid- and Long- Term Railway Development Plan' (MLTRDP) sets out the investment required to keep pace with demand at about US$12-15 billion per year through 2020. This has increased substantially to over US$90 billion per annum post 2009 and remains a priority in the 13th Five Year Plan.

5. Assessment of Bank and Borrower Performance

5.1 Bank Performance

(a) Bank Performance in Ensuring Quality at Entry
Rating: Satisfactory

63. The Bank ensured quality at entry through an adequate alignment of the project objectives with the CPS and national and World Bank transport strategies, combined with components designed to achieve the PDO, as well as appropriate implementation arrangements. Bank inputs and processes prior to Board approval were appropriate.

64. The Bank provided guidance and support to ensure that technical and environmental specifications and feasibility studies were prepared to meet high quality standards, and within a short time. Project preparation included a screening to identify the poorest cities and the impact of the line on poverty issues. The need for connectivity improvement between HSR stations and city centers has also been recognized and highlighted in the project design and by the Bank.

65. The results framework was straightforward despite the shortcomings pointed in earlier sections and related to the quality of the indicators. These indicator-related challenges were difficult to anticipate at appraisal, as they fully relate to the train operation policy put in place by CRC. The overall risk assessment was comprehensive and proved robust during the implementation of a very large project.

(b) Quality of Supervision
Rating: Satisfactory

66. The Bank worked closely with the government and the implementing agencies that this mega railway project was completed on time and to high quality standards, in compliance with Bank policies (especially safeguards and fiduciary policies), despite financing only 5% of an almost USD 6 billion project. The Bank supervised the project diligently with the required expertise. The field based team interacted with CRC every six weeks or so to monitor the implementation of the program. Implementation Status Reports (ISRs) were prepared on a six-monthly basis and the ratings were candid and appropriate. The Task Team has been commended by Management for using the risk framework in all the ISRs to update risk ratings and the management of identified project risks. The Bank team was located in the country office and thus was able to meet China railway every six weeks or so to follow up on implementation of the railway program, providing an extremely close tracking on the implementation of the railway program and a very intense supervision schedule.

67. The Bank also drew extensively on lessons learned from this project to document the experience of China in developing its high speed rail network, including notes[4] on traffic, costs, success factors in project implementation, good practice in environmental management, and wider economic impact evaluation[5]. In parallel with project activities, the Bank engaged in policy dialogue with MOR and CRC on sector reforms and analytical work in railway financing.

[4] See China Transport Topic Notes on those topics at:
http://www.worldbank.org/en/country/china/research/all?docty_exact=Brief&qterm=&lang_exact=English&teratopic_exact=Transport
[5] Regional Economic Impact Analysis of High Speed Rail in China (P143907)
(http://operationsportal2.worldbank.org/wb/opsportal/ttw/about?projId=P143907)

68. At the time of the restructuring in August 2012, the project's progress was performing ahead of schedule and overall within budget, and was rated Highly Satisfactory. It was then decided that the original indicators would remain, and that one outcome indicator and one intermediate result indicator would be added to the result framework to reflect the impact of the new CMV component. Accordingly the new outcome indicator would measure the evolution in the number of power failure incidents per operated high speed rail train. The decision by CRC to keep more conventional trains on the parallel rail line to meet customer feedback was only shown in the values of indicators for 2014, which became available in 2015, too close to the project's closing date to enable adjustments to the results framework. In conclusion, there were only minor shortcomings in the proactive identification of opportunities and resolution of threats related to the use of the M&E during implementation and supervision, namely: (i) the absence of modification of the results framework to capture the corridor level benefits related to traffic instead of the HSR related benefits only (ii) the lack of attribution between the CMV related indicator introduced at the restructuring and the capturing of maintenance and safety related benefits towards the achievement of the PDO.

(c) Justification of Rating for Overall Bank Performance
Rating: Satisfactory

69. The rating of overall Bank performance is based on the ratings for each of the two dimensions: (a) Bank performance in ensuring quality at entry and (b) the quality of supervision. Bank performance was rated Satisfactory for the quality at entry and quality of supervision dimensions. Therefore, the overall Bank performance is Satisfactory.

5.2 Borrower Performance

(a) Government Performance
Rating: Satisfactory

70. The Government ensured that the project was prepared and implemented in record time with good quality, and also complied with loan covenants, including fiduciary and safeguards aspects. MOR delegated responsibility and provided the needed resources to enable implementing units to implement the project. MOR demonstrated strong ownership in the project and actively participated in Bank supervision missions and wrap up meetings and ensured that the implementing agency executed the project in accordance with the agreements reached with the World Bank. MOR engaged in a dialogue with the Bank on railway sector reform and took Bank inputs into account while finalizing reforms.

(b) Implementing Agency or Agencies Performance
Rating: Satisfactory

71. Project implementing agencies deserve major credit for successfully implementing this massive infrastructure project. FCTIC, CRC as well as the two Railway Companies responded

efficiently on all project issues, adhered to project implementation requirements, engaged with Bank missions, and contributed to the timely completion of the project. These agencies successfully led overall project management and oversight, and delivered results on time. They furnished progress and other reports on time, monitored environmental and social issues, and suggested good practices for environmental methodologies. FCTIC managed procurement activities without issues or delays. CRC ensured that testing and commissioning went well. The Railway Companies monitored resettlement and timely payment of compensation to project affected persons, coordinated with local governments to review options to improve connectivity between urban areas and the new stations, and provided data on performance indicators as soon as the service was operational.

(c) Justification of Rating for Overall Borrower Performance

Rating: Satisfactory

72. The rating of borrower performance is based on the ratings for each of the two dimensions: (a) government performance and (b) implementing agency or agencies performance. The borrower performance was rated Satisfactory for the government performance and Satisfactory for the implementing agencies dimensions. Therefore, the overall borrower performance is Satisfactory.

6. Lessons Learned

73. Based on the issues discussed in the earlier sections of the present Implementation Completion and Results Report (ICR), some of the lessons learned that could be applied in similar operations are the following:

a. **Unified control over railway program development, project design, financing and implementation is a recipe for overall project success even when the Bank's financial contribution is relatively marginal:** China Railway Corporation has single point responsibility for planning, financing and implementation of individual projects, for the creation of delivery mechanisms (such as the joint venture companies with provincial governments), and for administration of China's national railway services. This, combined with legal and institutional power, strong technical capability, access to operating cash flows of railways and ability to borrow, gave CRC the agility to plan and deliver projects very quickly. Eventually, the fruitful cooperation between national and local authorities with a timely availability of counterpart funds, made the project a success. This unified control over the project, as well as the overall commitment of the Government and the implementing agencies, enabled the project to be a technical and environmental success despite the relatively marginal financial contribution of the Bank. The low level of Bank financing for the project allowed the Bank to support a much wider and unified program of railway projects (2,660 km over six projects during the period).

b. **A large and linear infrastructure investment projects calls for a good preliminary design and strict control over compliance with standards and specifications and quality control but also a focus on the post-project maintenance to ensure sustainability, including through CMV.** An early and good preliminary project design was the basis of the Feasibility Report and initial cost estimates. The detailed design taken up later did not deviate significantly from the preliminary design, thus enabling smooth

progress in construction. In addition, applicable standards and technical specifications for railway construction and material inputs were formulated and followed strictly. That supported a smooth implementation of the project. But while the original infrastructure component has been successfully implemented, the experience from recently opened lines underlined the significance of catenary maintenance equipment to provide high levels of services to customers and achieve the original project development objective in the long term. Any failure in the catenary system can rapidly lead to negative perception on the overall quality of services and undermine the project impact. Accordingly, China developed a high priority program to strengthen the maintenance and operation of its high speed rail network. The new CMV are now able to travel to sites at a maximum speed of 160 km/hr, providing a fast response time to any incident or system failure on the high-speed network, as required by the current standards. They improve the system reliability by improving periodic maintenance and fault detection. The new maintenance vehicles is now more efficient than the existing equipment, much of which is now over 10 years old. The restructuring, through the emphasis on safety and long-term maintenance with CMV, will help both the level of service on the line, and the sustainability of the project.

c. **Understanding and addressing passenger needs in the context of affordability and tailored level of services will be critical to achieve the full impact of the high speed rail network.** While initial results are encouraging, high speed rail remains a major investment that requires high traffic density to be justified economically and financially. This can be achieved by working on tariffs and services that answer specific needs for different users in a way that leverages the benefits in travel time provided by the rail. It also requires careful attention to the overall trip experience of travelers, who answer to different needs and do not have the same sensitivity vis a vis price and travel time. An aligned policy includes optimizing train frequencies and city pairing, based on emerging trip patterns and user surveys, introducing flexible ticket prices reflecting peak/off-peak periods, and introducing convenient e-ticketing services. These aspects have been reflected in the train mix issued from the CRC policy, which take into account a multi-market segment/dimension of train services, and led to the continued service of conventional train on the existing line. By focusing on these aspects, and on the efficient and effective operation of the HSR network, HSR in China can be expected to continue to experience substantial growth for many years to come.

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

(a) Borrower/implementing agencies

74. Both the borrower and the implementing agency consider that the project can be evaluated as successful. This project is, according to their completion report, meeting the development objectives and priority of the government for the economic growth of China, for passengers, and

in the future, for freight as well. They emphasize that results are showing the effectiveness and relevance of the project and that the Bank, the borrower, and partners have showed a satisfactory performance in managing the ShiZheng Railway Project with regard to efficiency, effectiveness, quality of inputs, quality of supervision, and M&E. The project also conformed to social and environmental requirements. A summary of the ICR of the borrower is provided in Annex 7.

(b) Cofinanciers

Not applicable.

Annex 1. Project Costs and Financing

(a) Project Cost by Component (in US$, millions equivalent)

Components	Appraisal Estimate[6]	Actual/Latest Estimate	Percentage of Appraisal
Civil works	3,090.90	4,086.54	132
Goods	1,138.80	433.37	38
Land acquisition and resettlement	217.70	283.83	130
Other	229.90	134.14	58
Consulting services	1.00	0.00	0
CMV[7]	115.00	113.93	99
Total Baseline Cost	**4,793.30**	**5,051.81**	**105**
Physical contingencies	223.95	0.00	0
Total Project Costs	**5,017.25**	**5,051.81**	**101**
Interest during construction	342.60	142.07	41
Rolling stock	863.50	2.70	0
Front-end fee IBRD	0.75	0.71	95
Total Financing Required	**6,224.10**	**5,197.29[8]**	**83**

(b) Project Cost by Component (in RMB, millions equivalent)

Components	Appraisal Estimate	Actual/Latest Estimate	Percentage of Appraisal
Civil works	22,193	25,450	115
Goods	8,177	4,596	56
Land acquisition and resettlement	1,563	1,842	118
Other	1,651	1,043	63
Consulting services	7	0	0
CMV	826	761	92
Total Baseline Cost	**34,416**	**33,692**	**98**
Physical contingencies	1,608	0	0
Total Project Costs	**36,024**	**33,692**	**94**
Interest during construction	2,460	952	39
Rolling stock	6,200	18	0
Front-end fee IBRD	5	5	100
Total Financing Required	**44,689**	**34,667**	**78**

[6] Exchange rate at appraisal is US$1.00 = RMB 7.18, and US$1.00 = RMB 6.68 at completion.
[7] CMV component was added and estimated at restructuring, and is included under "appraisal estimate" for comparison purposes.
[8] The "total financing required" as presented in the table does not include the component "Rolling stock" as no Rolling stock was purchased, but leased instead. For comparison purposes, the actual/latest estimate including rolling stock purchase as estimated would be 40,849 million RMB, representing 91% of appraisal, while the total project costs is 33,692 million RMB, representing 94% of appraisal.

(c) Financing

Source of Funds	Type of Cofinancing	Appraisal Estimate (US$, millions)	Actual/Latest Estimate (US$, millions)	Percentage of Appraisal
Borrower	Counterpart	5,924.10[9]	4,897.49[10]	83
IBRD	n.a.	300.00	297.10	99
Total Financing	n.a	6,224.10	5,194.59	83

[9] CMV component was added and estimated at restructuring, and is included under "appraisal estimate" for comparison purposes.

[10] The "total financing required" as presented in the table does not include the component "Rolling stock" as no Rolling stock was purchased.

Annex 2. Outputs by Component

1. The project delivered the following elements as planned:

a. ShiZheng Railway (Shijiazhuang to Zhengzhou) is a double track electrified railway having a maximum speed of 350 km/h. It is a Passenger Dedicated Line (PDL) designed for 17t axle load that is appropriate for lightweight Electrical Multiple Unit (EMU) trains specially designed for high-speed operation It is part of the Beijing-Guangzhou PDL (JingGuang line-2,298 km) that has been constructed in three parts, Wuhan-Guangzhou (1,069 km, opened December 26, 2009), Zhengzhou-Wuhan (536 km, opened September 28, 2012) and Beijing-Zhenzhou (693 km, opened December 26, 2012). Although trains on the entire JingGuang line initially operated at 350 km/h, the speed was reduced to 310 km/h when ShiZheng opened, mainly to reduce energy consumption.

b. The purchase of specialized Catenary Maintenance Vehicles (CMV) (US$115 million) was financed from (1) savings derived from international tenders (US$28 million); (2) use of domestic financing instead of the loan for the signal system (US$44 million) to unify the signal system along the entire Beijing-Guangzhou line; (3) lower than anticipated price of raw materials used for bridge bearings (US$43 million). They are able to travel to work sites at a maximum speed of 160 km/h for carrying out normal maintenance (during scheduled maintenance blocks) and provide a fast response time to any incident or system failure on the high-speed network. They are improving the system reliability by improving periodic maintenance and fault detection, and therefore the long term sustainability of the operations. These CMVs are equipped with twin working platforms instead of single ones and an extending arm that enables them to work on the adjacent line, thus increasing maintenance efficiency and productivity. It is noted that the CMV in service has performed satisfactorily and has met all operational requirements. No safety issues have been noted.

2. The length of railway between Shijiazhuang and Zhengzhou is 412 km out which the length of new construction is 355 km. ShiZheng railway has 298.7 km of this railway laid on viaducts and has no tunnel. The use of viaducts reduces land take as compared with that required for railway design using embankments, permits easy access to people and animals below the railway tracks and improves safety as well as security of railway infrastructure. However, this approach increased the capital cost of the project.

3. Substantial reduction in cost of goods (56% of appraisal in RMB terms) is due to the fact that some of the items included in goods were transferred to the civil works and many were cancelled. As for civil works, there was significant change in the design and in many places embankments were replaced by elevated track. This design change contributed to the slight increase the cost of civil works (115% of appraisal in RMB terms).

4. To enable a high operating speed this railway has relatively straight alignment with very large radius curves of 9,000m or more. The terrain is flat and has low seismicity. The option of locating the new tracks very close to the existing right of way was not considered feasible since the existing line traverses several highly populated areas and the construction of the proposed line would require displacement of a very large population. Further, it would not be feasible to obtain relatively straight alignment with large radius curves to permit high-speed of trains. The second

option of choosing an entirely new alignment that runs broadly parallel with the existing railway line was chosen. New stations were constructed about 5-10 km way from city centers.[11].

5. The technical parameters of this railway meet international standards in respect of track, power supply, overhead electric system, signaling, communications, train control and dispatching system and energy conservation. Ballast-less slab track has been used. Safety systems such as fencing of railway right of way, automatic train protection system (ATP), cab signaling, radio communication on train and a safety system that monitors weather conditions including wind, rain and snow as well as seismic activity and fire has been provided. Suitable protection against electromagnetic interference to communications has also been provided. Axle box temperature is monitored by equipment installed on EMUs and therefore, wayside hot box detectors have not been installed.

[11] New railway stations have been set up at Shijiazhuang, Gaoyi, Xingtai, Handan, Anyang, Hebi, Xinxiang and Zhengzhou. The new stations at Shijiazhuang and Zhengzhou are not part of this project and Shijiazhuang station is set in the city.

Annex 3. Economic and Financial Analysis

1. This note documents the economic re-evaluation of the Shizheng HSR, constructed between Shijiazhuang and Zhengzhou and fully opened to traffic in December 2012. It is based on data collected during a mission in March 2015, supplemented by data obtained from a survey of passengers conducted in November 2015 and by other data supplied in March 2016. The estimated economic return of the infrastructure component is about 15%, compared to 20% in the original evaluation, due to the major slowdown in freight demand and the change in operating strategy adopted by CRC during the construction period, compared to what was forecast at appraisal. The estimated return of 30% on the CMV component is the same as estimated at restructuring.

INFRASTRUCTURE COMPONENT

Project Summary

2. At the time of appraisal, freight traffic was growing rapidly, both for the system as a whole, and within the Shizheng corridor (which was close to capacity)[12] and it was expected that this growth would continue for the foreseeable future. However, much of this traffic, as on the network as a whole, was coal, either for power stations or for industrial consumption. In 2014, there was a major policy change in China in which electricity generation in eastern China was discouraged with future capacity to be primarily constructed in western China and transmitted from there to central and eastern China. At the same time there was a much greater emphasis on the development of renewable energy sources as well as moves to relocate major coal-burning industries from urban areas and at the same time improve their energy efficiency.

3. The net result has been that the historic nexus between economic growth in China, coal consumption and coal transport by rail has been broken; rail freight traffic as a whole has fallen by 17% between 2013 and 2016. One of the original arguments for the high-speed network (and Shizheng in particular) was that the new high-speed line would significantly relieve the existing conventional line and thus provide additional capacity for the forecast continuing increase in freight traffic. Whilst this will still be the case in the long-term, the anticipated short-term benefits for freight (i.e. by 2020) are now unlikely to arise and this has affected the forecast rate of return.

4. When the line was being planned, it was also expected that all through passenger services would transfer to the new line, leaving only a handful of local services on the existing line. In practice, many conventional services have continued to operate whilst the high-speed services are operating with a much higher tariff than originally planned. As a result, only around 25% of the passengers on the existing services transferred to the high-speed lines.

5. At appraisal, the project evaluation separately considered the two impacts of the increase in capacity and the higher-speed services by considering an alternative (known as Option A) in which additional capacity was provided on the existing corridor by constructing a four-track

[12] So much so that potential users in southern China rarely attempted to ship general freight from northern China by rail.

corridor, allowing segregation of the passenger and freight services. Because of the forecast continuing growth in freight services, this additional capacity delayed the suppression and diversion of freight which would otherwise occur as well as allowing faster services for both passengers and freight because of the service segregation[13].

6. The evaluation could then be done in two steps: the benefit due to the additional capacity can be estimated by comparing Option A to the 'without-project' case and the direct benefits of high-speed services can be estimated by comparing the 'with-project' case to Option A. The re-evaluation has retained this structure.

Traffic

Passenger traffic

7. Two sets of forecasts were prepared at appraisal – one by the Design Institute based on 2003 data and the other by the Bank team, based on 2005 data. The Design Institute forecast about 75 million passengers in the corridor in 2015 and 91 million and 117 million in 2020 and 2030 respectively, 90% of them on the high-speed line. The corresponding Bank forecasts were 79 million passengers in 2015, increasing to 132 million in 2030 (Figure 1). The reason for the increased demand in the IBRD forecasts compared to the Institute forecasts at appraisal was due to differences in the assumed tariff. The original plan was to operate two levels of service on the new line:

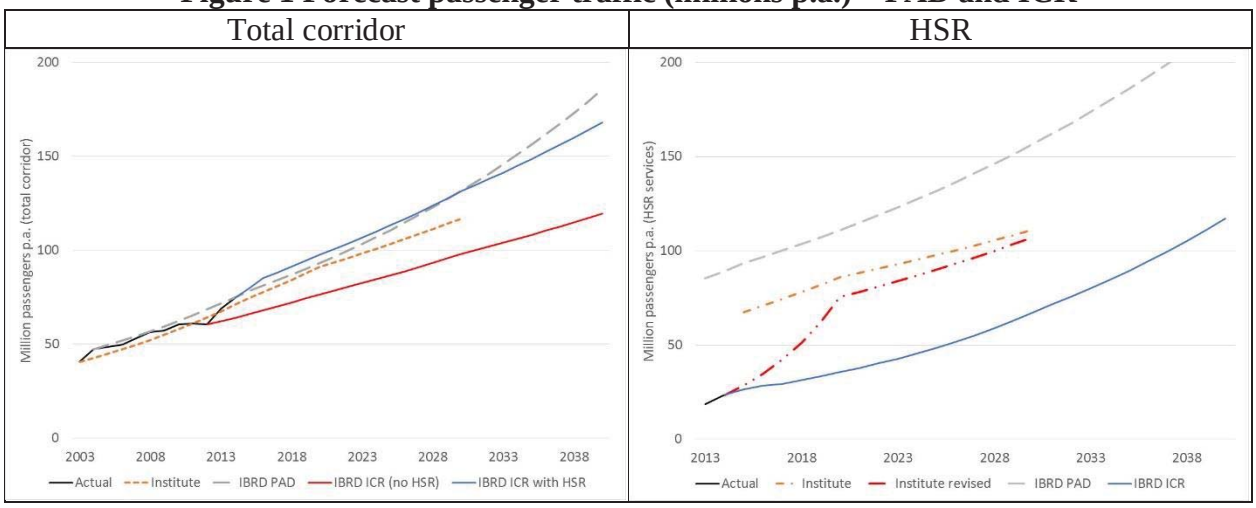
- Limited-stop 350 km/hr services designed for through passengers, with fares set at the equivalent of 54 fen/passenger-km (pkm) (2015 prices)
- 250 km/hr stopping services, with fares set at the equivalent of 32 fen/pkm.

8. The Institute expected services on the high-speed line to handle 90 percent of the demand, with the remaining 10 percent using local services on the existing line. The IBRD forecasts assumed that, in practice, CRC would find it difficult to transfer almost all passengers to new services, however fast, with much higher-fares – the average fare at that time was the equivalent of 18 fen/pkm (2015 prices). They therefore assumed that there would be a transition from the existing fares to the new fares over a ten-year period and the lower fares would generate greater demand then the Institute assumptions. In addition, the comparatively small increase in fares on the HSR services would mean that almost all demand would transfer, with only a negligible volume remaining on the conventional services.

9. In practice, CRC found it was politically impossible to withdraw the existing services and these have continued to operate. They currently carry about 70% of the passenger traffic in the corridor.

[13]In spite of this segregation, the variation in speed within the passenger services would still impose some penalties compared to a line in which all services travelled at the same speed, which is the case with the current HSR.

Figure 1 Forecast passenger traffic (millions p.a.) – PAD and ICR



10. The actual traffic was close to the passenger forecasts until 2010, following which it was constant until the high-speed line opened. Between 2010 and 2012 the line was close to capacity and the lack of growth may reflect diversion to other lines. However, since the high-speed services began in 2013, there has been strong growth (which will probably be reinforced by the 2015 figures when they become available). The re-evaluation has adopted relatively conservative forecasts for both the with-project and without- project cases, with growth rates of 2-3% p.a. for the without-project case and 2.5-4% p.a. for the with-project case (see Table 1). Nevertheless, the ICR forecasts for the corridor as a whole are similar to those adopted at appraisal.

Table 1 Passenger growth rates 2004-2040

PAD (corridor and HSR)		ICR				
		Without –project (corridor)		With project		
					HSR	Corridor
2004-2015	4.7%	2004-2007	4.0%			
		2008-2012	2.5%	2015-16	15%	7.0%
2015-2020	3.5%	2013-2020	3.0%	2017-2020	5%	3.5%
2021-2030	3.5%	2021-2030	2.5%	2021-2030	4%	3.0%
2031-2041	3.5%	2031-2040	2.0%	2031-2040	3%	2.5%

11. The forecast HSR traffic is, however, much less than at appraisal. About 25 percent of the passengers on the existing services did transfer to the high-speed line when it opened and these currently represent about 40 percent of the high-speed passengers. The remainder have either transferred from other modes or have been generated. Table 2 compares the sources of the 2015 traffic, based on on-board surveys undertaken in March 2015, with the forecasts at appraisal.

Table 2 Sources of HSR traffic 2015 (million p.a.)

Source	Appraisal		Actual	
	Million	%	million	%
Conventional rail	78.5	84	11.2	42
Air	7.5	8	5.9	22
Bus			2.6	10
Car			4.8	18
Generated	7.5	8	2.0	7
Total	93.5	100	26.5	100

12. The high-speed traffic is about 30 per cent of that forecast at appraisal but the current fare of about 50 fen/pkm is over 60 percent higher than the 29 fen (2015 equivalent) assumed at that time[14]. Rail has captured a large share of the medium-distance air market (seat capacity between Beijing and Zhengzhou fell by over 50 percent within three months of the high-speed line opening and there are now just two flights each way each day), and much of the longer-distance (say 250 km) bus market. It has also captured a surprising share of the 'car' market, although this is probably from minibuses[15] rather than from saloon cars.

13. Generated passengers are 7 percent of the total, less than many other new lines. However, these are passengers who would not previously have made the trip by any mode. HSR also seems to be increasing the frequency with which existing travelers make trips, with passengers typically quoting a 50 percent increase in trip-making compared to the situation before the line opened. This increase, which results from the combined effects of the reduced travel time for all except air passengers, the comparable cost for bus and car travelers, and the much improved frequency, capacity and reliability of the rail service, was not allowed for at all in the appraisal forecasts and will have been a significant factor in the under-estimation of passengers diverting from other modes (especially air).

14. The re-evaluation has forecast growth in HSR traffic as changes in the share of total corridor traffic. As incomes continue to grow, more passengers could be expected to migrate from the conventional services to the HSR and this has been estimated using a pivot-point logit model, based on changes in the value of the time saved if travelling by HSR. Incomes are forecast to increase at an average of just under 5% p.a. over the forecast period. As a result the share of the total corridor traffic moving by HSR increases from the 2015 estimate of 33% to a 2040 forecast of 75%.

15. In November 2015, the Henan company included a revised HSR forecast (Figure 1) as part of their internal project review. This shows very strong growth over the next five years, at over 20% p.a., with demand almost reaching their original forecast by 2020. Although demand for HSR services has often out-performed predictions in recent years, in this particular case this expected growth appears optimistic.

Freight traffic

16. The Design Institute forecast an average freight traffic in the section of 76 million tons in 2015, increasing to an average of 114 million tons by 2030. The corresponding Bank forecast,

[14] Assuming a fare elasticity of -1.5 (a typical intra-rail elasticity for different types of service in UK), a fare of 29 fen/pkm would increase demand to about 60 million, still well short of the appraisal estimate but getting closer
[15] In China minibuses up to 10 seats are conventionally classified as cars rather than buses.

which was influenced by the very high rates of growth between 2003 and 2005, was forecast as 94 million tons in 2015, increasing to 146 million tons by 2030.

17. Although freight continued to grow strongly for 2-3 years (by 2008 it was three years ahead of the Institute forecast), from 2009 onwards traffic did not increase and in 2014, as China's economic growth began to slow and as reductions in coal consumption in eastern China began in earnest, traffic dropped sharply, especially in 2015. One reason for the stagnation in the corridor since 2009 may be that, as the line was close to capacity, through traffic has been increasingly diverted to other routes. If this is the case, then such traffic may return if capacity again becomes available. However, for the purposes of the re-evaluation of the project, a conservative case has been adopted in which traffic demand on the line remains stable.

Figure 2 Forecast and actual freight (million tons)

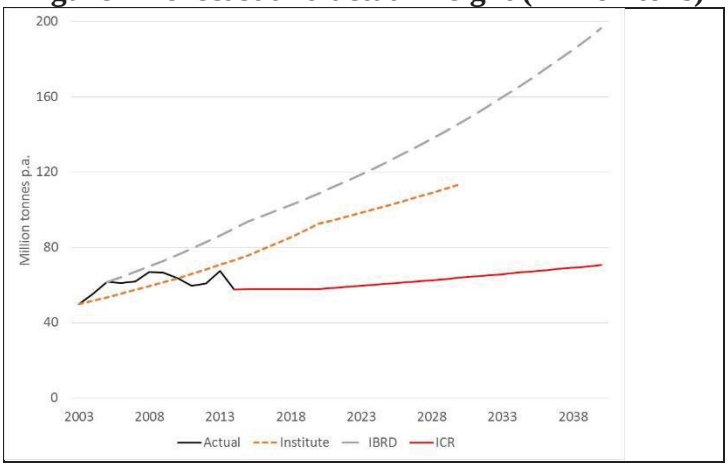


Table 2B Freight growth rates 2004-2040

	PAD	ICR
2004-2015	4.3%	
2015-2020	3.0%	0%
2021-2030	3.0%	1%
2031-2041	3.0%	1%

Project Investment

18. The estimated cost of the project infrastructure at appraisal was RMB 35.2 billion (US$ 4.9 billion) at 2008 Q2 prices (including contingencies but excluding interest during construction). The final cost of the project is estimated at RMB 2.0 billion less than at appraisal (in current prices). Taking into account the estimated time profile of disbursement, this is equivalent to a cost at 2008 Q2 prices of RMB 32.1 billion.

19. The initial cost of the train-sets and other rolling stock was an additional RMB 6.2 billion (US$ 864 million). This is not explicitly included in the evaluation but is incorporated in the above-rail train operating cost as an equivalent annual cost.

20. The evaluation at appraisal assumed that Option A (expanding the existing line from two to four tracks) could be done for RMB 45 million/route-km (2008 Q2 prices) or 56 percent of the cost of constructing the high-speed line and this proportion has been retained in the re-evaluation.

Project Benefits

21. There were two main groups of potential benefits from the construction of the Shizheng line at appraisal:

- a major reduction in travel time for the traffic diverted to the new line, thereby generating significant operating cost savings to the railway and time savings for passengers. Service frequency would also be greatly improved.
- freeing up capacity on the existing lines would allow them to handle the projected increase in freight traffic, which would otherwise travel by road or not at all.

Time Savings

22. At appraisal, the new line was expected to save the average rail passenger 3.5 hours compared to the existing timetable, while Option A would save the average passenger 1.1 hours. This time saving was valued at appraisal using a weighted average income per head of forecast passengers, based on 2002 on-board surveys of rail services in the region, adjusted for subsequent income growth. Business and non-business travelers were valued at 100% and 35% of this average income and the business/non-business mix was taken at 35:65, again based on the on-board surveys.[16] This gave an average value of time savings in 2005 of RMB 5.49 per hour (US$ 0.77), which was forecast to increase in line with the expected growth in average income per head.

23. The improved level of service was expected to attract passengers from other modes, as well as generating additional trips by providing greater opportunities for potential passengers to travel (e.g. it would be easily possible to make a day return trip between Beijing and Zhengzhou, something which was very difficult to achieve at appraisal). This trip transfer would create user benefits as well as, in most cases, reducing both operating costs and externalities.

24. Diverted and generated traffic, calculated as part of the demand forecasting, was allowed benefits calculated at 50% of the increase in user benefit for base traffic, as provided by the 'rule-of-a-half'[17]. The associated operating cost savings for traffic diverted from other modes was calculated using average operating costs derived from user surveys and highway cost studies (for road) and from the assumed operating cost component of air fares of 85%.

25. The forecast time saving has been largely borne out in practice, with the fastest EMU services saving about 3.5 hours for the trip between Shijiazhuang and Zhengzhou. However, most services stop at three or four intermediate stations and the average saving is about 3 hours. The average income of high-speed passengers, based on the March 2015 on-board survey is RMB 5700/month or RMB 35.63/hour. The business/non-business mix from the survey was 46:54 (compared with 35:65 at appraisal), with travel to and from work being treated as business[18], giving

[16] On-board surveys in 2002 gave a mix of 44:56; this was assumed to reduce by 2015 to 35:65.

[17] This adjustment should be applied to the benefit net of any changes in fare levels. At appraisal, this only included the time-related benefits as the assumed fare in the evaluation was similar to that on the existing line. However, because the difference in fare is now much greater, the re-evaluation has been modified to allow for benefits associated with the increased service frequency, reliability and capacity.

[18] Based on interviews with passengers, who stated that the train enabled them to return to work faster and thus earn more

an average value of time savings of RMB 23.12/hour (US$ 3.56). The corresponding value of time for the conventional services, where passengers had an average income of RMB 3700/month and the business:leisure split was 27:73, was RMB 12.15/hour (US$ 1.87). The average value of time in the corridor from the survey is thus RMB 15.80/hour (US$ 2.43). The value of time assumed at appraisal for 2015 was RMB (2015)13.71/hour (US$ 2.11).

Distance savings

26. The value of the distance savings at appraisal was based on the estimated resources (loco-km, carriage-km etc) saved, combined with 2005 unit costs. Savings for passengers transferring from air and road (estimated as 2% and 6% respectively of the opening volume) were based on the estimated operating costs of buses and air. At appraisal, the project was part of a general improvement of the link between Beijing and Guangzhou and therefore contributed to benefits for trips made over much longer distances. For such trips, the project was credited with a share of such benefits in proportion to its distance relative to that of the total trip.

27. The re-evaluation has adopted the same approach, using estimated 2015 unit costs. Table 2 compares these with the 2005 unit costs adjusted for inflation. The two rail costs cover above-rail costs only i.e. rolling stock maintenance and capital, train and on-train crew and fuel and energy. Rail infrastructure-related costs are considered separately.

Table 2C Estimated unit costs – appraisal and current (2015 Rmb/pax-km)

Mode	Appraisal	Current
Conventional rail (above-rail)	0.06	0.17
EMU (above-rail)	0.11	0.20
Air	0.53	0.65
Bus	0.27	0.35
Car		0.50
Road freight	0.27	0.45
Rail freight	0.04	0.10

28. The large increase in estimated rail operating costs reflects the general increase of costs in the sector; between 2008 and 2014 the cost per traffic unit[19] increased from RMB 0.095 to RMB 0.178, an increase of 90 per cent over a period in which inflation was 17 percent. Aviation costs have reduced with the growth of budget airlines while bus and car costs have been reasonably stable (the appraisal road cost was heavily weighted towards bus).

Freeing-up capacity

29. At appraisal, transferring passenger and freight operations to the new line from the existing network was expected to provide additional capacity for freight which would otherwise have slower transit times or, if a route is saturated, be forced to travel by road or not travel at all. The most heavily-used alternative route is the parallel north-south route between Beijing and Hong Kong SAR, China. Both the appraisal and ICR evaluations assume a penalty of an extra 200 kilometers for traffic diverted to this corridor.

[19] The sum of passenger-kilometers and net ton-kilometers

External and environmental benefits

30. The external benefits included at appraisal include the reduction in road construction cost for traffic attracted from road, accidents and congestion, vehicle emissions (net of the change in rail emissions) and changes in greenhouse gases (GHG). These were all valued using standard unit costs adjusted to Chinese conditions. GHG emissions were valued at US $29 per ton at appraisal.

31. The re-evaluation adopted the same values for these benefits, updated to 2015 prices, except for GHG benefits. The economic value put on CO2 avoided is taken as $30/ton, increasing over time to $80/ton, consistent with values used in World Bank project evaluations. Further detail on the assumptions is given in the section below.

32. Based on the diversion of passengers from road transport to HSR, an estimated 400 road deaths will be avoided over the life of the project.

Economic rate of return

33. Table 3 compares the distribution of costs and benefits in the appraisal evaluation and ICR re-evaluation.

Table 3 Comparison of costs and benefits at appraisal and at ICR (RMB billion 2015) (discounted to 2012 at 12% p.a.)

		PAD	ICR	Difference
Capacity-related				
Passenger	Rail operating costs	1.2	0.5	-0.7
	Time savings	9.4	8.9	-0.5
	Diverted traffic opcosts	1.0	0.0	-1.0
	Diverted time savings	1.3	0.0	-1.3
	External benefits	0.0	0.0	0.0
		12.9	9.4	-3.5
Freight	Rail operating costs	1.2	1.0	-0.1
	Diverted traffic opcosts	76.6	5.0	-71.6
	External benefits	2.1	0.2	-1.9
		79.8	6.2	-73.6
Total benefits		92.7	15.6	-77.1
Construction		-32.0	-24.1	7.9
NPV		60.6	-8.5	-69.1
HSR-related				
Passenger	Rail operating costs	-19.0	-4.6	14.4
	Time savings	37.9	13.0	-24.9
	Diverted traffic opcosts	7.3	22.1	14.8
	Diverted time savings	3.9	13.9	10.0
	External benefits	-0.8	1.7	2.5
		29.3	46.0	16.7
Construction		-25.9	-17.2	8.7
NPV		3.5	28.8	25.3
Combined		64.1	21.3	-42.8
EIRR (%)		20%	15%	

34. At appraisal, the project was expected to yield a net present value (NPV) during 30 years of operation of RMB 64 billion (updated to 2015 prices discounted at 12% to the first full year of

operation in 2012) and to achieve an economic rate of return (EIRR) of 20%. The capacity component (Option A) had an EIRR of 25% and the HSR component an EIRR of 13%.

35. The re-evaluation estimates an NPV of RMB 21 billion (2015 prices discounted at 12% to 2012) and an EIRR of 15%. The capacity component (Option A) has an EIRR of 9%, due to the much lower growth rate of freight than was expected at appraisal but the HSR component has an EIRR of 20%, in spite of lower than forecast diversion from the conventional services, due to the much greater diversion from other modes for whom the unit savings per passenger are considerably greater.

Greenhouse gases

36. The GHG analysis combined the forecasts of passengers and freight travelling by each mode with the estimated future unit modal emissions (kg CO2 per ntkm or pkm). The unit emissions were based on the current emissions, adjusted for forecast changes in fuel efficiency and, in the case of electricity, future changes in emissions per kwh as coal-fired power stations become more efficient and as the supply mix changes.

37. The key assumptions made were:

- aviation and road fuel efficiency will improve by 1% and 2% p.a. respectively over the period
- coal-fired power stations will supply 30% of China's electricity by 2050, compared to an estimated 70% in 2015
- the efficiency of coal-fired power stations (as measured by kg coal/kwh) will improve from the current estimate of 1.2 kg/kwh thermal supply mix for electricity

38. The project is forecast to initially save about 150,000 tons of CO_2 annually but this steadily increases through time as demand increases and by the end of the project period annual savings[20] have reached 2 million tons p.a. About 90 % of these savings are associated with the HSR, as it diverts significant volumes of traffic from the more GHG-intensive aviation and road modes. The remaining 10% is associated with the increased capacity, which allows more economical operation of freight trains and, in the long-run, avoids the diversion of freight to longer routes or to road. Total GHG savings to 2041 from the start of operations in 2013 are nearly 23 million tons.

Financial Analysis

39. The line is owned by two project companies (one in Hebei and one in Hubei), although the former MOR (now CRC) was formally responsible for implementing the project, mobilizing the financing and repaying all borrowed funds. The project was financed using 50% of equity obtained from the project company partners, loans obtained from domestic banks and from the World Bank, and bonds raised in China, amounting to RMB 44 billion (US$ 6.1 billion) in total (2008 prices). Of this, US$ 300 million was funded by the Bank loan.

40. At appraisal, it was expected that the project company would be ultimately responsible for the maintenance and operation of the line, although in practice the actual functions would be subcontracted, with the regional administrations (RA) operating the trains under contract with

[20] These savings exclude the emissions associated with construction and maintenance of the infrastructure

infrastructure maintenance also contracted to them or to third parties. It was expected the RAs would own the train-sets and receive all revenue earned on the services. This model has been implemented in the case of Shizheng.

41. Access fees for the use of Shizheng by third parties are set on a national basis and cover both usage of the infrastructure (currently RMB 157 per train-km for a 16-car set on a 350 km/hr line such as Shizheng) and the use of railway stations (currently RMB 5 per departing passenger at a major station). Third parties also have to pay for traction electricity at a rate (on Shizheng) of RMB 53/000 gross ton-km (gtkm).

42. The company is responsible for the maintenance and operation of the infrastructure and stations, which in the case of Shizheng is contracted to the local RAs. There is little experience in China of what life-time average costs might be but estimates for this type of line of RMB 2 million per route-km are generally considered to be reasonable.

43. At appraisal, the general expectation was that existing services would be withdrawn once the high-speed services commenced, with the conventional services only serving intermediate towns by-passed by the high-speed lines. Unit revenues were initially assumed to be RMB (2009) 0.30 per passenger-km (pkm) in 2020, compared to the 2009 average level of RMB 0.14[21] (1.7 US cents) per passenger-km. However, the appraisal considered that it was unlikely the planned yields would be reached for the market as a whole for several years and that yield management policies would be required to provide a range of availability and service levels. The appraisal thus assumed a yield growing from RMB 0.20 (RMB 2009) per pkm in 2015 to RMB 0.25 (RMB 2009) per pkm in 2020, remaining constant thereafter.

44. In practice, CRC found it difficult to withdraw as many conventional services as it wished and these have in general been retained, although generally at lower frequencies than would have been the case in the absence of the project. However, they are now able to charge around RMB 0.50 (RMB 2015) per pkm on the HSR services. The current tariff is about 50% more than bus tariffs but is typically under half the cost of competing air services.

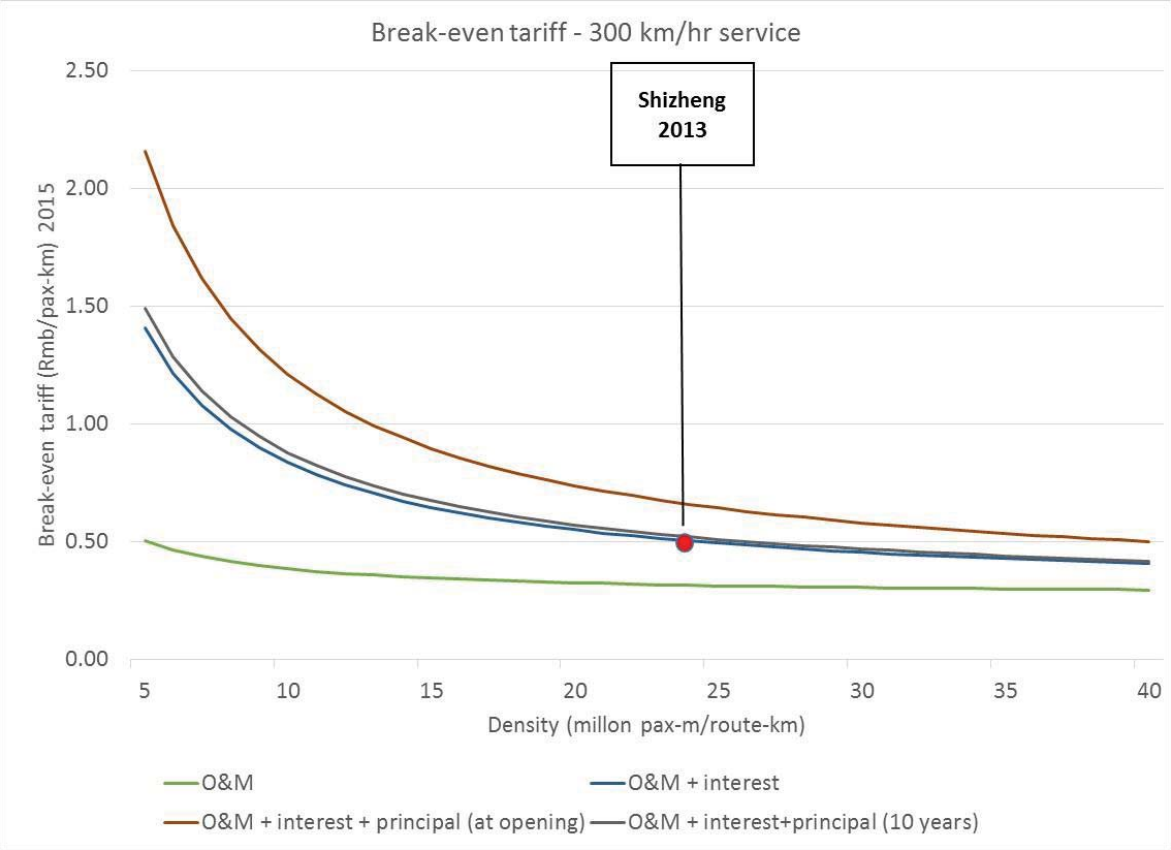
Financial analysis of the line as a whole

45. Shizheng (or the RA operating its services) can, like most lines operated at 310 km/hr, cover its operating costs of around RMB 0.22 per seat-km from its average yield of RMB 0.50 per pkm. However, even though it has a load factor (passenger-km:seat-km) of around 80 percent, in order to cover its expected maintenance cost of around RMB 2 million per route-km, it requires a passenger density of about 10 million per route-km. It has already easily achieved that. The next target is to be able to repay interest charges. Shizheng has about RMB 20 billion of debt, on which it is paying interest at 6%; the annual interest bill is thus about RMB 1.2 billion. The standard practice appears to be that this is paid before considering any payment for infrastructure maintenance. The Shizheng companies, in common with other HSR lines, would typically pay the interest on the debt and then negotiate any payment for infrastructure maintenance between itself and the local RAs, who are of course also shareholders in the Shizheng companies (and, in a recent development, the owner in the case of the Hebei section). As current volumes continue to increase, the Shizheng companies should be able to pay most, if not all, of the maintenance cost. However,

[21] Although tariffs can be double this rate for the higher-standard accommodation.

when repayment of the principal begins, Shizheng may well have to restructure all or part of its debt until the mid-2020s or even later.

Figure 3 Breakeven tariff for the Shizheng line as a whole

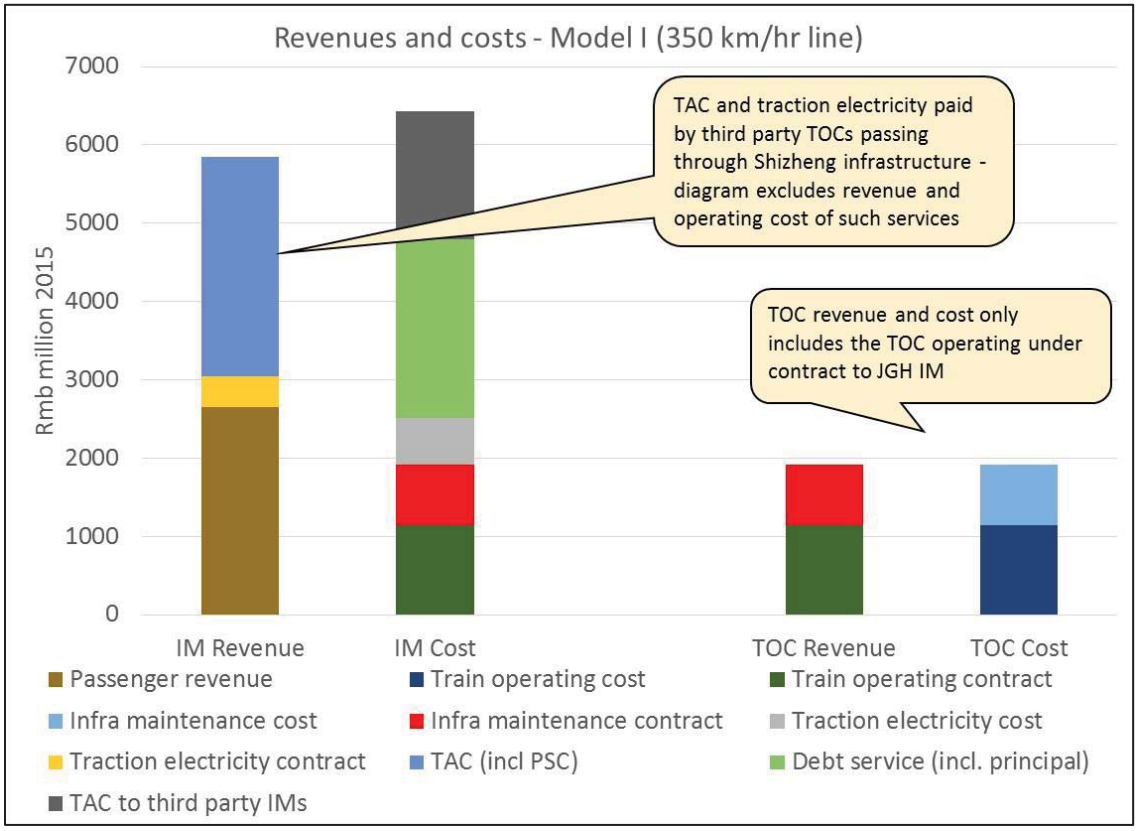


46. At its current volume, Shizheng can pay for the operation of the services and maintenance of the infrastructure. However, it is only likely to be able to also finance its debt service in full by 2020-2025, by which time volume will have increased and thus its gross margin over operating costs also increased.

Financial analysis of the Shizheng companies

47. The financial positions of the Shizheng companies is summarized in Figure 4.

Figure 4 Financial position of Shizheng companies 2015



48. The company has three sources of income: passenger revenue, track access fees and payment for traction electricity, which it uses to pay the electricity company. The access charges are more than enough to pay the cost of maintaining the infrastructure, especially in the early years, but are insufficient at current levels to pay the debt charges when they begin in full.

49. The RAs, as the train operating companies, earn revenue from operating the services under contract passengers which presumably covers train operating and traction electricity costs and track access charges where they use other parts of the network. The RAs, as maintenance and train control contractors, earn revenue from this activity but it is balanced by the corresponding expenditure that they incur.

50. Whilst the long-term outlook for the Shizheng companies is very promising, given the strong current demand which will increase as other routes are expanded, its short-term outlook will probably require renegotiation of the principal repayments of its loans as well as cross-subsidy by the local RAs of the maintenance and train control that they perform.

CATENARY MAINTENANCE VEHICLE COMPONENT

Project Summary

51. This component is the first stage of a comprehensive program for maintaining and inspecting overhead catenary lines (OCL) for the entire planned network of high-speed lines. MOR

intend to eventually develop six central repair depots, with 60 secondary depots (i.e. on about every 200-250 km of the network) responsible for dealing with incidents and 130 inspection and routine maintenance depots (i.e. about every 100 km). Each depot will have various sets of maintenance equipment, much of which will be procured during the current Twelfth Five-year Plan (12FYP). The current component represents the initial steps in implementing this plan, concentrating on the lines that are already in operation.

52. At the end of the 11FYP, MOR had one 350 km/hr OCL inspection train and one 250 km/hr OCL inspection trains. These were expanded to 17 sets at the end of the 12FYP, one per high-speed line expected to be in operation at that time. These trains were to be supplemented by lower-speed (160 km/hr) inspection trains, consisting of 2-3 cars equipped with combined optical and physical equipment, which inspect both high-speed and conventional electrified lines on a regular basis, every 3 months for conventional lines and every 10 days for high-speed lines, and will eventually replace the existing inspection trains which currently operate at around 50 km/hr.

53. The principal means of undertaking the actual physical inspection and maintenance will be new catenary maintenance vehicles, which will travel to site at a maximum speed of 160 km/hr, providing a response time of no more than 30 minutes to any incident on the high-speed network, as required by the current standards[22]. Compared to the existing equipment, much of which is now over 15 years old, the new vehicles are more efficient by having twin working platforms instead of just one. They are also equipped with an extending arm which will enable them to work on an adjacent line; this enables them to quickly reach any incident on the double-track PDL's by travelling on the parallel line. Twenty eight such vehicles are being procured under the loan, at a total cost of US$115 million.

Economic Evaluation

54. The economic evaluation considers two groups of incremental costs and benefits:

- reduced routine inspection and maintenance costs
- if an incident does occur, faster response and repair times and reduced costs to both the railway and passengers.

Reduced routine maintenance costs

55. The daily maintenance and centralized check of Chinese high-speed power supply equipment is conducted at a fixed time each day, generally lasting for around 4 hours. Based on the experience with high-speed rail operation in the last three years, including the rectification of faults incurred during construction, this currently requires a full inspection of the catenary equipment.

56. Currently, a full inspection of the catenary of 100 km of single-track high-speed line each year requires around 300 working days. The maximum travelling speed of the current catenary inspection vehicles is only 120km/h, with an average operating speed around 60km/h. The available maintenance time is thus limited to around 2 hours, with the other 2 hours used in

[22] Guidance on Issues concerning the maintenance and management of fixed facilities on Passenger Dedicated Lines MOR (2009) No 36.

travelling to and from the worksite. In addition, the current vehicles only have one inspection platform, so a full inspection of all the devices on a single catenary mast requires the platform to be moved, taking 20 minutes to complete the inspection. As the masts are about 50 meters apart, the current vehicles can only inspect about 300 meters of single track in a typical day. By contrast, the new vehicles have twin platforms, which should reduce the inspection time per mast to 10 minutes and allow about 600 meters of track to be inspected in a typical day, after allowing for travelling time between masts, and also after allowing for the reduced travelling time to and from the site (and hence greater time available for actual inspection and maintenance).

57. The inspection time for 100 km of single-track high-speed line can thus be conservatively reduced to 150 working days (Table 4). The time freed-up by this could be used to expand services but this would also need track maintenance to be similarly speeded-up, which is unlikely. For evaluation purposes, it has been assumed that the inspection areas would instead be expanded to about double the current length, with corresponding savings in vehicles and men.

Table 4 Comparison of Efficiency of current and proposed Catenary Maintenance Vehicles

Item	Current vehicle	Proposed vehicle
Maximum travelling speed	120 km/hr	160 km/hr
Daily travelling speed	60km/h	120km/h
Inspection time per mast	20 minutes	10 minutes
Full inspection time for 100 km of single track	4h/day×300 days	4 h/day×150 days
Accident repairs	Can only work on single line	Able to work on both lines

Improved response times to incidents

58. When incidents occur, the new equipment will allow service to be restored much faster than is currently possible. For minor incidents, the new catenary vehicles capable of travelling at 160 km/hr should be able to reach the incident site within 30 minutes, as required by the regulations. As the new vehicles are able to work on adjacent lines, the repairs can be done without requiring the failed train to be removed, a process often requiring a diesel locomotive to arrive after any intervening trains have been cleared (which can often take over two hours). For minor incidents, which are forecast to occur 5 times p.a. on a 1000 km double-track line, the new equipment should save at least 1 hour per incident compared to current procedures.

Valuation of benefits

59. Benefits associated with more efficient routine maintenance have been valued on the following basis:

- the new dual-platform vehicles will require 10 men compared to 8 men on the current vehicles, at an average cost of RMB 35,000 per man p.a.
- the current operating cost (excluding labor) of RMB 1.5 million per vehicle is 75% variable with usage and 25% fixed; the new vehicles will thus incur the same variable cost (as they are travelling further) but save the fixed cost component of the current vehicles they render surplus

60. Benefits associated with accident response and repair times have been valued on the following basis:

- minor incidents occur 5 times p.a. per 1000 km of double-track
- major incidents occur 1 time per 5 years per 1000 km of double track
- the new equipment will save 1 hour of delay per minor incident and 12 hours of delay per major incident
- the delay will affect passengers travelling on the blocked line within 4 hours of a minor incident and within 12 hours of a major incident.
- In practice, there will also be costs to the operating railway due to delays; these have been ignored in the benefits calculation
- The cost of delay is RMB 30 per person-hour of delay

Evaluation results

61. Table 5 summarizes the results of the evaluation under the above assumptions.

Table 5 Economic evaluation (RMB million)

	Capex		Savings				Net	NPV	Discount	Growth factors	
	Without project	With project	Labor	Material	Accident response	Total	benefits	@ 12%	factor	Demand	Labor /VOT
2012	582	730					-148	-148	1.0	1.00	1.00
2013			6	21	11	38	38	34	0.9	1.04	1.05
2014			6	21	12	39	39	31	0.8	1.08	1.10
2015			7	21	13	41	41	29	0.7	1.12	1.16
2016			7	21	14	42	42	27	0.6	1.17	1.22
2017			8	21	16	44	44	25	0.6	1.22	1.28
2018			8	21	17	46	46	23	0.5	1.27	1.34
2019			8	21	19	48	48	22	0.5	1.32	1.41
2020			9	21	20	50	50	20	0.4	1.37	1.48
2021			9	21	22	52	52	19	0.4	1.42	1.55
2022			10	21	24	55	55	18	0.3	1.48	1.63
2023			10	21	26	57	57	17	0.3	1.54	1.71
2024			11	21	29	60	60	16	0.3	1.60	1.80
2025			11	21	31	64	64	15	0.2	1.67	1.89
2026			12	21	34	67	67	14	0.2	1.73	1.98
2027			12	21	38	71	71	13	0.2	1.80	2.08
2028			13	21	41	75	75	12	0.2	1.87	2.18
2029			13	21	45	79	79	12	0.1	1.95	2.29
2030			14	21	49	84	84	11	0.1	2.03	2.41
2031			15	21	53	89	89	10	0.1	2.11	2.53
2032			16	21	58	95	95	10	0.1	2.19	2.65
2033			16	21	64	101	101	9	0.1	2.28	2.79
2034			17	21	70	108	108	9	0.1	2.37	2.93
2035			18	21	76	115	115	8	0.1	2.46	3.07
2036			19	21	83	123	123	8	0.1	2.56	3.23
2037			20	21	91	131	131	8	0.1	2.67	3.39
						IRR	30%	271	NPV		

62. The ‘without-project’ case assumes that the railway purchases replacement vehicles similar to the existing fleet. The ‘with-project’ case assumes the high-speed twin-platform vehicles are purchased. The estimated NPV, calculated over a 25-year period from 2012 with a 12 per cent discount rate, is about RMB 271 million in 2011 prices and an EIRR of 30 percent. The project is robust against a range of sensitivity tests concerning these factors, such as reducing the number of conventional vehicles saved by the new vehicles or excluding any reduction in accident costs, with the EIRR typically reducing to 15-20% and the NPV to RMB 40-100 million (Table 6).

Table 6 Economic evaluation sensitivity tests

Test		EIRR (%)	NPV (RMB million)
	Base	30	346
1	No maintenance benefits	14	36
2	No accident benefits	19	87
3	1 new vehicle replaces 1.5 current ones	13	37

Annex 4. Bank Lending and Implementation Support/Supervision Processes

(a) Task Team Members

Names	Title	Unit	Responsibility/ Specialty
Lending			
Syed I. Ahmed	Lead Counsel	LEGAM	
John Scales	Lead Transport Specialist	GTIDR	Team Leader
Paul Amos	Consultant	GTIDR	
Richard G. Bullock	HQ Consultant ST	GTIDR	
Jianjun Guo	Senior Procurement Specialist	GGODR	
Ying Jin	HQ Consultant ST	GSURR	
Maria Luisa G. Juico	Program Assistant	GTIDR	
Juan D. Quintero	Consultant	GENDR	
Jitendra Sondhi	HQ Consultant ST	GTIDR	
Peishen Wang	Consultant	GENDR	
Lei Wu	Program Assistant	EACCF	
Songling Yao	Senior Social Development Specialist	GSURR	
Chaohua Zhang	Lead Social Development Specialist	GSURR	
Supervision/ICR			
Gerald Paul Ollivier	Senior Infrastructure Specialist	GTIDR	Team Leader
Martha B. Lawrence		GTIDR	Co Team Leader
Syed I. Ahmed	Lead Counsel	LEGAM	
Richard G. Bullock	HQ Consultant ST	GTIDR	
Wanli Fang	Consultant	GSURR	
Yi Geng	Senior Financial Management Specialist	GGODR	
Jianjun Guo	Senior Procurement Specialist	GGODR	
Maria Luisa G. Juico	Program Assistant	GTIDR	
Jitendra Sondhi	HQ Consultant ST	GTIDR	
Ye Song	Consultant	EASCS	
Peishen Wang	Consultant	GENDR	
Lei Wu	Program Assistant	EACCF	
Ning Yang	Senior Environmental Specialist	GENDR	
Songling Yao	Senior Social Development Spec	GSURR	
Nanyan Zhou	Consultant ST	GTIDR	
Romain Pison	Transport Specialist	GTIDR	
Fatima Arroyo Arroyo	Operations Analyst	GTIDR	
Laure Albinet	Transport Analyst	GTIDR	

(b) **Staff Time and Cost**

Stage of Project Cycle	Staff Time and Cost (Bank Budget Only)	
	No. of Staff Weeks	US$, thousands (including travel and consultant costs)
Lending		
FY2006	4.48	48.28
FY2007	27.61	217.94
FY2008	8.97	119.64
Total:	36.58	337.58
Supervision/ICR		
FY2009	4.37	90.73
FY2010	4.1	54.02
FY2011	4.42	59.48
FY2012	6.65	90.1
FY2013	5.15	74.52
FY2014	5.46	86.84
FY2015	2.44	26.33
FY2016	3	37.36
Total:	35.59	519.38

Annex 5. Beneficiary Survey Results

75. From August 9 to 17, 2015, and from September 18 to 20, 2015, the Bank organized a survey with a sample of 925 interviews surveyed on-board and in stations, including 536 for HSR and 389 for conventional line. The surveys, handed out randomly, were carried out by two groups: on-board group and station group. In general, the survey yielded 219 interviews from on-board and 317 from stations for HSR, and 139 on-board and 250 from stations for conventional line. On the high speed train, the survey included about 25 samples on each train, randomly selected one or two interviewees in each car, alternately to the right and left of the aisle. The selected HSR trains covered earliest train from Shijiazhuang to Zhengzhou on weekday, and returning in the afternoon and evening, as well as the same for the other direction. On weekend, surveys were organized as round trips from Shijiazhuang to Zhengzhou in the morning and in the afternoon. For the conventional train, surveys were conducted during one round trip on weekday and one round trip on weekend. Surveys were conducted in the waiting hall of stations as well. About 40 samples were collected from the station of Xingtai, Handan, Anyang, Hebi and Xinxiang on weekday for HSR and for the conventional line separately. About 100 samples on weekends for HSR and the conventional line were separately collected from Xingtai, Handan, and Anyang stations. As the conventional rail station and the HSR station are far from each other in these cities, the surveyors usually covered morning and evening for the HSR and afternoon for the conventional line.

76. Results displayed here after show that more than 58 percent of the interviewed travelers chose the train because of the short travel time. Comfort, punctuality, and safety were other main reasons for choosing the train. When asking passenger on ordinary train why not taking HSR instead, the main reason is the high ticket price (42%). The following two main reasons are inconvenient accessing to the HSR station (17%) and indifferent between HSR and other trains (13%).

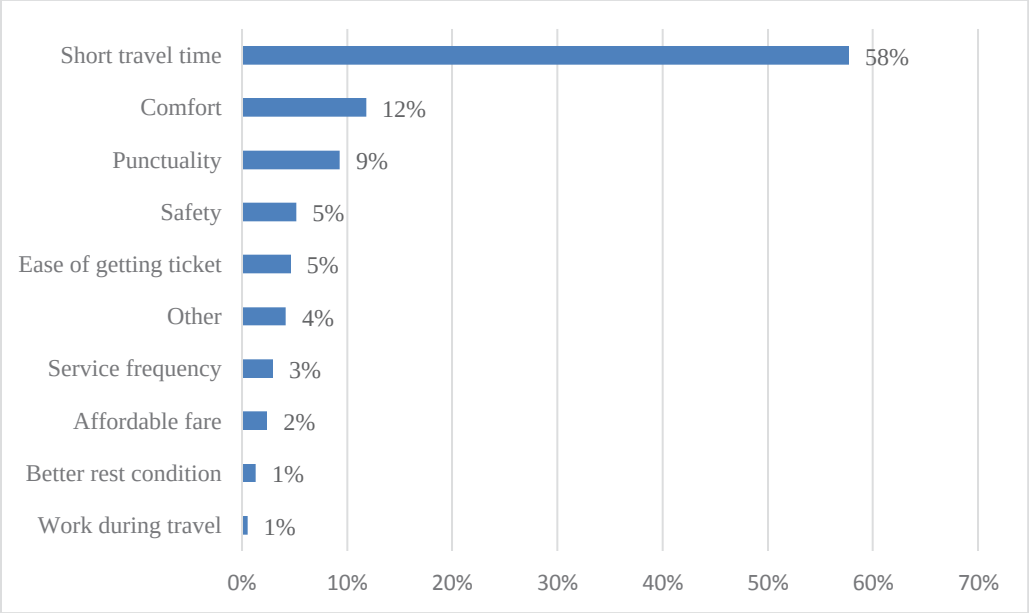


Figure 5.1. Reason to travel on HSR

77. The survey results indicated that the high speed rail services were used by a broad range of income levels, with about 55% of travelers with an average monthly income of RMB 5,000 or lower. On the HSR line, the average self-reported monthly personal income was around RMB 5700, while the number of RMB 3,700 for ordinary line.

78. The transport modes used to access HSR stations reflect the differences in the locations of the stations. All the eight stations (including Shijiazhuang and ZhengzhouDong Stations) are newly built along this line. Except in Shijiazhuang City where the HSR and conventional trains share the same station, the HSR stations are separated from the conventional stations, and are located several kilometers away from the city centers. Even though the Government's plan to extend the cities and develop new city centers around the new HSR rail stations, the current connectivity level is low, and HSR stations such as Xintai, Anyang, Hebi and Xinxiang are not well connected.

79. As a direct reflection of the transport connectivity surrounding many of the HSR stations, only 34% of travelers chose public transport to and from railway stations for HSR, while 33% of them took taxis, compared to respectively 65% and 19% for ordinary train stations.

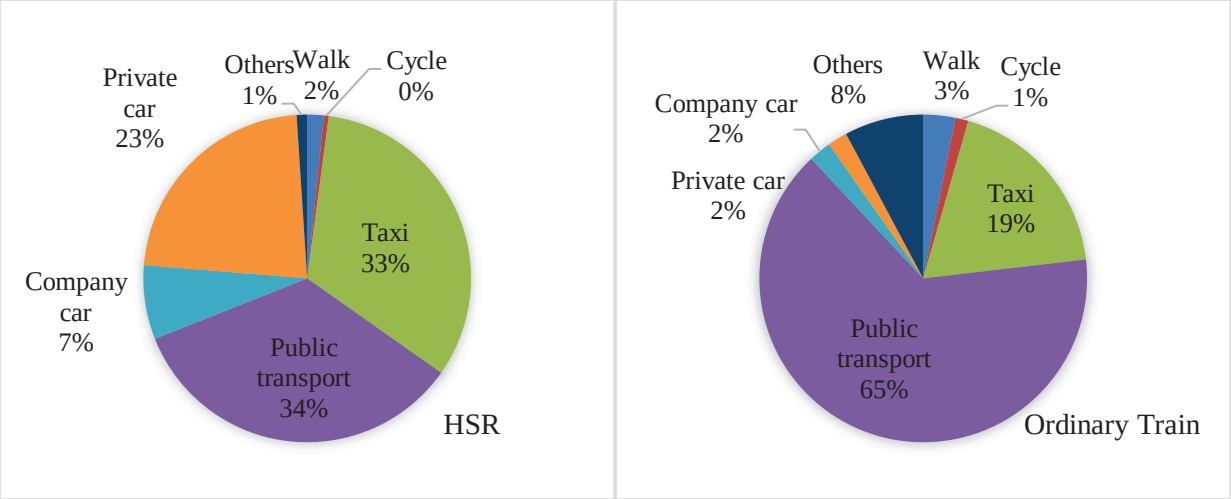


Figure 5.2. Connecting Modes to Railway Stations

80. The survey also enabled to investigate whether passengers have increased their travel frequency with HSR service by comparing travel frequencies in 2014 with the planned trip frequency in 2015. Results show that over half (56%) of passengers reported more trips in 2015 and 40% reported a similar number of trips than in 2014. Whilst such statements of future intent are often unreliable, the responses indicate that the large increase in overall trip-making that has accompanied many HSR services is due to a combination of existing travelers making trips more frequently as well as completely new travelers.

81. The survey also enabled to identify whether passengers would still have undertaken the trip if the HSR service had not been there. Only 45 out of 536 passengers said that they would not have undertaken the trip, which counted for only 8% of the total surveyed on HSR line. The rate is similar to that on Changji (11%) and on Jinghu (9%), and much lower than that on NanGuang and GuiGuang. Nearly half of short and medium distance passengers would use ordinary train, while

60% would use air for long distance trips. The share of passengers that would select bus and private car as the alternative mode reduces with increasing travel distance, as expected, as observed along the Beijing-Shanghai corridor.

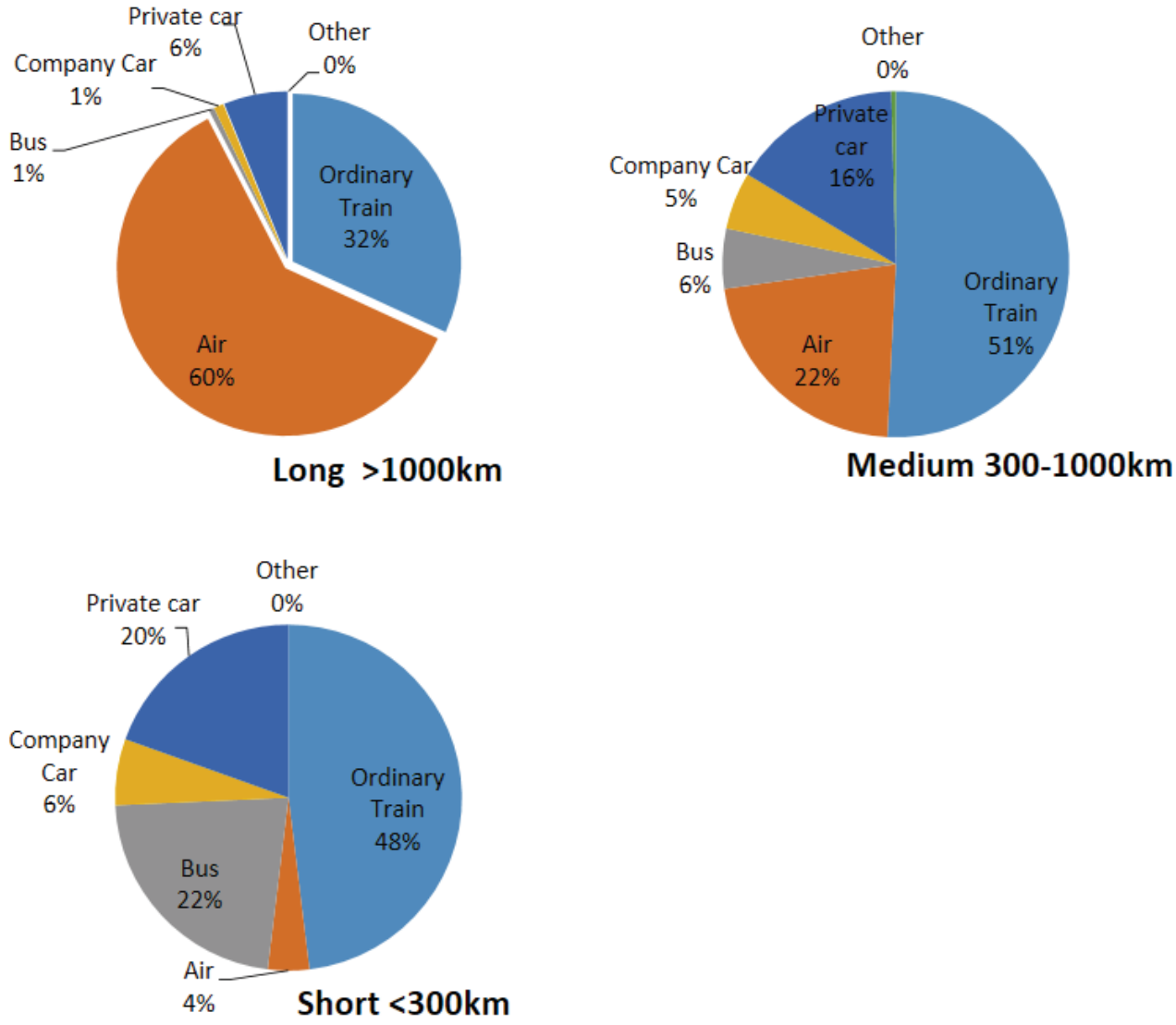


Figure 5.3. Alternative Modes If the HSR Services Were to Stop Running

Annex 6. Stakeholder Workshop Report and Results

Not applicable.

Annex 7. Summary of Borrower's ICR[23] and/or Comments on Draft ICR

Overview of the project

ShiZheng Railway (Shijiazhuang to Zhengzhou) is a double track electrified railway having a maximum speed of 350 km/h. It is a Passenger Dedicated Line (PDL) designed for 17t axle load that is appropriate for lightweight Electrical Multiple Unit (EMU) trains specially designed for high-speed operation It is part of the Beijing-Guangzhou PDL (JingGuang line-2,298 km) that has been constructed in three parts, Wuhan-Guangzhou (1,069 km, opened December 26, 2009), Zhengzhou-Wuhan (536 km, opened September 28, 2012) and Beijing-Zhenzhou (693 km, opened December 26, 2012). Although trains on the entire JingGuang line initially operated at 350 km/h, the speed was reduced to 310 km/h when ShiZheng opened, mainly to reduce energy consumption.

Land acquisition and environmental protection

The land acquisition and relocation was mostly completed in 2009, and finalized in 2010 with the station land use matters and land requisition for 8 police service areas were carried out in 2010. The design institute conducted environmental protection design in strict accordance with national standards involving noise, vibration, sewage, particle pollution, electromagnetic radiation and so on, carry out dynamic monitoring for sensitive points all the time both during construction and operation, and took environmental protection measures in time. The personnel received special environmental protection knowledge training, carry out environmental supervision and management during the construction of respective units, and assisted the environmental management department with environmental management.

Evaluation of the project success

The success of the project depends on the degree of realization of objectives and relies on the economic analysis and evaluation of the results. This evaluation relies on specialists and experts who participated in the project, through a self-evaluation and a scoring method. The method is as follows:

1. Complete success: the objectives of the project have been fully completed or exceeded, and the project achieved great economic benefits and impacts (5 points).
2. Success: the project has achieved most of the goals, the project achieved the expected benefits and impacts (4 points).
3. Partial success: the original part of the project achieved the objectives, the project achieved a certain economic benefits. (3 points).
4. Unsuccessful project: project achieved limited objectives, the project almost did not produce positive benefits and impacts (2 points).
5. Failure: the project goals were unrealistic, were be achieved, the project had to be terminated.

The project self-evaluation process, has invited the design, building, construction, supervision, operations and other units to score the project. After a comprehensive evaluation of expert scoring, the Shijiazhuang railway line special engineering composite scored more than 460 points out of a maximum of 500 points (i.e. between 4 points and 5 points for each criteria), indicating that the project is considered very successful.

[23] The borrower's report is longer than 10 pages and does not contain a summary, and therefore the task team prepared a summary.