China

Guiyang-Xinzhai Highway Construction Project

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Field Survey: February 2006

1. Project Outline and ODA Loan Assistance

Map of Project Area

Guiyang-Xinzhai Highway

1.1 Background

After the government adopted a policy of reform and openness in China in 1978, both freight and passenger transport have shown consistent growth. A look at total freight transport by transport mode in 1994 shows that although road transport (14%) was on a rising trend, the proportion of transport by water (48%) and rail (38%) remained high and, in contrast to developed countries like Japan, Great Britain, and Germany where there is a high dependence on land transport, the volume of land transport was extremely low. At the time of the appraisal, deregulation was progressing in line with the move towards a market economy, and demand for low volume, multi-destination transport was expected to increase in the wake of anticipated economic development and the expansion of international trade. However, there was a need for infrastructure improvement in China, which lacked an efficient road transport network to link its provinces and regions.

Located in the southwest region of China, Guizhou Province is rich in underground resources such as coal, phosphate ore, mercury, and gold, but railway transport capacity is limited by its complex topography and therefore there was a need to build industrial roads to transport its resources to consumption areas in China's southern coastal region. The already-existing Provincial Highway No.207 consisted of Grade 3 highways

(12.2%), Grade 4 highways (59.7%) and other miscellaneous ungraded roads[1] (28.1%) which, in spite of being narrow, were used by through traffic including a high volume of large trucks and buses, resulting in frequent congestion in urban areas. The poor conditions of the road pavement also hindered traffic in rain and bad weather. Therefore, the project was planned to alleviate these conditions.

1.2 Objective

The objective of the project was to establish the foundation of a road network in Guizhou Province by constructing an industrial trunk road of a high standard to accommodate an expected future increase in demand for road transport and thereby contribute to the economic development of China's Southwest and Guizhou province.

1.3 Borrower/Executing Agency

Ministry of Foreign Trade and Economic Cooperation[2], Ministry of Communications, People's Republic of China

Specific Executing Agency:

Transport Agency of Guizhou Province (at the time of the appraisal and evaluation)

Guizhou Expressway Development Corporation (at the time of the evaluation)

Operation and Maintenance, and Operations Division:

Guizhou Expressway Development Corporation (at the time of the appraisal)

Operation and Maintenance, and Operations Division:

High-Grade Highway Management Bureau of Guizhou Province (at the time of the evaluation)

[1] Roads in China's road network are classified according to technical and administrative aspects. Technical classifications are based on traffic volume and topographic features and according to the Official Public Road Technical Standards of China's Ministry of Transport include automobile roads (expressways, Grade 1 and Grade 2 roads) and general roads (Grade 3 and Grade 4 roads as well as ungraded roads). Administrative classifications include national arterial roads (national roads), provincial arterial roads (provincial roads), prefectural arterial roads (prefectural roads), and regional roads (regional and rural roads).

[2] In 1999, the borrower of the ODA loan to China was amended to the Government of the People's Republic of China (Ministry of Finance)

1.4 Outline of Loan Agreement

Loan Amount/ Disbursed Amount	14,968 million yen/13,790 million yen
Exchange of Notes Loan Agreement	December 1996 December 1996
Terms and Conditions - Interest Rate - Repayment Period (Grace Period) - Procurement	 2.3%/year 30 years 10 years LDC Untied
Final Disbursement Date	May 2002 November 2003 (following deferment)
Main Contractors	Local companies
Consulting Services	The Louis Berger Group, Inc. (U.S.)
Feasibility Study (F/S) etc.	Feasibility Study Government of the People's Republic of China (December 1997) Basic Design Government of the People's Republic of China (June 1997)

2. Results and Evaluation

2.1 Relevance

In the Ninth Five-Year Plan (1996-2000), the Chinese government clearly articulated its intention to promote the economic development of the country's interior as one of its objectives by giving priority to strengthening the transportation infrastructure linking the interior of the country with coastal regions. In the roads sector, the government made a commitment to promoting the construction of national highways which would become the major arteries of logistics transport and to establish a transport network that would cover all of China. A plan to construct a number of national expressways, known as the "Five Vertical, Seven Horizontal Plan," was formulated and a decision was made to lay approximately 35,000 kilometers of road along seven horizontal lines[3] that would

link the interior regions of the country with the eastern seaboard from east to west as well as five vertical routes[4] linking cities like Beijing and Huhhot with China's southern areas. In this way, the government aimed to promote economic development by linking major metropolitan areas with populations of one million people or more with the majority of cities with a population of more than 500,000 in a network that would cover 203 cities. Of the 12 roads earmarked for development, a decision was made to complete seven of them as priority infrastructure routes by 2000.

This project formed one part of the Chongqing-Zhanjiang Highway, one of the routes earmarked for development, and was positioned as an important industrial route for transporting Guizhou Province's underground resources such as coal and phosphate ore to China's southern coastal regions where consumption areas are located.

Therefore, as a project that was in line with the government's development plans and with regional needs, it was deemed to have strong relevance at the time of the appraisal. As major routes linking the province's capital Guiyang and Qiannan Buyizu Miaozu Autonomous Prefecture, the economic development region in the southern part of the province, and as an arterial road linking Guizhou Province and Guangxi Autonomous Region, it was hoped that these new roads would accommodate the increased in future traffic demand.

In the objectives of the Tenth Five-Year Plan (2001-2005) the government articulated its intentions to improve transport in response to the increasing demand for transport accompanying economic development by improving the country's entire transport infrastructure of railways, roads, sea routes, and waterways and to improve services. In its plans for road construction, the government specified that it would continue to give priority to the "Five Vertical Seven Horizontal" Plan and to create a road transport foundation by opening all seven routes and establishing a road network that would link the provinces. In 2004, the government further boosted infrastructure improvement plans with the approval of a long-term plan for a national expressway known as the 7918 Network[5] that would connect a population of more than 200,000 people in 319 cities. This project included a vertical road earmarked as a top priority road in Guizhou

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[3] Suifenhe – Harbin – Manzhouli
1) Dangdong – Shenyang – Beijing – Hohhot – Yinchuan – Lanzhou – Lhasa
2) Qingdao – Jinan – Shijiazhuang – Taiyuan – Yinchuan
3) Lianyungang – Xuzhou – Zhengzhou – Xi'an – Lanzhou – Urumqi - Volks
4) Shanghai – Nanjing – Hefei – Wuhan – Chongqin – Chengdu
5) Shanghai – Hangzhou – Nanchang – Changsha – Guiyang – Kunming – Ruili
6) Hengyang – Guilin – Nanning – Kunming

[4] Tongjiang - Dalian – Qingdao – Shanghai – Guangzhou – Haikou - Sanya
1) Beijin – Tianjin – Xuzhou – Hefei – Nanchang – Fuzhou
2) Beijin – Shijiazhuang – Zhengzhou – Wuhan – Changsha – Guangzhou – Zuhai
3) Erenhot – Taiyuan –Xi'an – Chengdu – Kunming - Hekou
4) Chongqin – Guiyang – Nanning – Beihai - Zhanjiang

[5] Construction of an expressway with seven lines extending in a radial pattern from Beijing, nine lines extending north to south, and 18 lines extending east to west and with a total length of 85,000 kilometers. This project formed part of the Lanzhou-Haikoh Line

Province's road construction plan due to be completed in 2020, "Three Vertical, Three Horizontal and Eight Crosslines," which would link the northern city of Chongqing with the southern autonomous region of Guangxi, forming a section of a major trunk line[6] going on to Beihei and Zhanjiang, and its relevance at present is also high.

Fig. 1 China's "Five Vertical, Seven Horizontal" Expressway Network Plan and the Project

2.2 Efficiency

2.2.1 Outputs

The project planned to separate traffic on the already-existing road (provincial road) from traffic in the region by constructing a through traffic road exclusively for automobiles between Guiyang and Xinzhai. The ODA loan portion was to be entirely in foreign currency. Outputs at the time of the appraisal were as follows:

Table 1. Output Plans and Performance

	Plan	Performance
(1) Intermountain Grade 1 Highway (Guiyang-Duyun)	140.5km Width 21.5m (4 lanes) Concrete pavement	143.22km Width 21.5m (4 lanes) Asphalt
(2) Intermountain Grade 2 Highway (Duyun-Xinzhai)	115km Width 12m (2 lanes) Concrete pavement	117.55km Width 12m (2 lanes) Asphalt
(3) Functional	21.59km	28.5km

[6]From the city of Chongqing in the north linking with the Chongqing- Zunyi Highway (ADB), Guiyang Loop Line, Guiyang Airport Expressway, and continuing to Guangxi Autonomous Region

compensation road (compensation for the former national road which was expropriated for the project construction work)		
(4) Branch line (compensation for the agricultural village road which was expropriated for the project construction work)	11.02km	38.1km
(5) Bridges	74 locations (Total 9,900m) Large bridges (100m or over) 43 locations Midsize bridges (50-100m) 13 location Small bridges (50m or less) 18 locations	190 location (Total 22,740m) Very large bridges (500m or over) 6 locations Large bridges (100-500m) 72 locations Midsize bridges (50-100m) 46 locations Small bridges (50m or less) 66 locations
(6) Tunnels	1 location	3 locations
(7) Interchanges	14 locations	13 locations
(8) Toll gate	15 locations	15 locations
(9) Service areas	1 location	3 locations
(10) Cubic interchange	64 locations	75 locations
(11) Accommodation for the administrative staff	Administrative building 63,614 m^2 Accommodation for the administrative staff 15,041 m^2	Administrative building 27,057m^2 Accommodation for the administrative staff 4,196 m^2
(12) Consulting Services	48M/M	50.45M/M

Major changes to the project were the following five modifications

1) Road paving

At the time of the appraisal, the entire road was to be paved with concrete but was subsequently changed to asphalt except for the bridges. The plan initially focused on the positive aspects of revitalizing the regional cement industry, inexpensive maintenance and management costs, and a road with a long life but plans were reviewed from the perspective of insuring safety and consideration of the environment by the Guiyang-Xinzhai Highway Design Specialist Meeting and a decision was made in March 2003 to amend the plan.

2) Bridges, tunnels, and overhead crossings

In response to a review of the basic plan in 1997 and to the needs of the residents of the area, some minor changes were made to the plan. Furthermore, the project area was located in a region with undulating, calcareous hills and mountains that are not only steep but also have complex, geological characteristics including a soft base.

Consequently, there was no alternative but to proceed with construction work making revisions to plans even during the road works. Revisions to plans resulted in an increase in the number of bridges from 74 to 109, the number of tunnels between Duyun and Xinzhai from one to three, and the number of overhead crossings from 64 to 75.

Daping Tunnel

Bridge

3) Interchanges

The number of interchanges was revised from 14 to 13. The interchange that was scrapped was the interchange at Jiwang Hill on a Grade 1 highway. Initially this was the location of an intersecting point with the Guiyang Outer Loop Line. However, the design for the Guiyang Outer Loop Line was modified without an intersection at Jiwang Hill. Since the volume of traffic in the area is low at 202 vehicles a day, it was decided that an interchange was not needed at present and plans for this interchange were scrapped.

4) Service areas

The number of service areas was increased from one to three. These service areas are being built in succession according to plan.

5) Lodgings for administrators

The administration building and lodgings for administrators were reduced in size from 63,614m^2 to 27,057m^2 and from 15,041m^2 to 4,196m^2 respectively. Initially there was a plan to establish a separate company, Guixin Highway Corporation of Guizhou Province, as the maintenance and management body but a decision was later made to commission this business to the High Grade Highway Management Bureau of Guizhou Province and plans to establish a new corporate entity were canceled.

2.2.2 Project period

At the time of the appraisal the construction schedule for completing the entire project was a period of 47 months running from December 1996 to October 2000 but the actual construction lasted 88 months (187% longer than the initial plan), from December 1996 to March 2003. The main factors for the extension of the construction period were: (1) Following a revision of national highway technical standards, amendments had to be made to road classifications, design speed, minimum flat and curved radii, and the steepest gradients of the roads. Therefore, it was necessary to undertake a review the basic plan and final approval by road authorities was not given until June 1997, and (2) until a decision was made on a plan to introduce a toll computation system using a standard IC card for nationwide use, there was no alternative but to put off the purchase of equipment. However, for the most part, the increase in civil engineering works had almost no effect on the construction schedule.

2.2.3 Project cost

In contrast to anticipated cost of 53,386 million yen (14,968 million yen of which was the ODA loan portion) in the initial plan, the actual cost was 75,435 million yen (13,79 million yen of which was the ODA loan portion), 141% of the initial plan. The main factors in the increase in project costs were: (1) depreciation of the foreign currency, (2) an increase in engineering works in response to geological conditions and the needs of the residents, and (3) an increase in compensation costs due to changes in payment standards for the resettlement of residents.

Due to the above, there were many unavoidable changes in outputs such as modifications to national standards and changes in geological conditions. As a result, both the project period and project costs far exceeded initial projections, making the project efficiency low.

2.3 Effectiveness

2.3.1 Infrastructure of the traffic network in Guizhou Province

Under the long-term road construction plan of the Transport Agency of Guizhou Province, a decision was made to construct by 2020 a total length of 7,400km of high-grade roads in a plan called the Three Vertical, Three Horizontal Eight Crosslines and Eight Branch Lines plan which is to link all cities and thereby establish a highway network that links all cities and provinces in China (See Fig. 2). Under the Five Vertical, and Seven Horizontal National Road Plan, Guizhou Province made a decision in 1992 to build One Horizontal, Two Vertical and Four Crosslines as the first stage. As shown

in Fig. 3, the project forms one of the most important vertical lines of the road, vertically linking Zhanjiang, Guangxi Autonomous Region from Chongqing. From the north, it traverses the Chongqin-Zunyi Highway, Zunyi-Guiyang Highway, and the Guiyang Loop Line, connecting with Guiyang Airport Highway and with the trunk line highway of the Guangxi Autonomous Region. Furthermore, it connects the most important horizontal line which starts at Nianyupu, extending west via Kaili at Majiang. Therefore, the road project forms an important part of the transport network of Guizhou Province.

Fig. 2 Guizhou Province's "Three Vertical, Three Horizontal and Eight Crosslines," Construction Plan

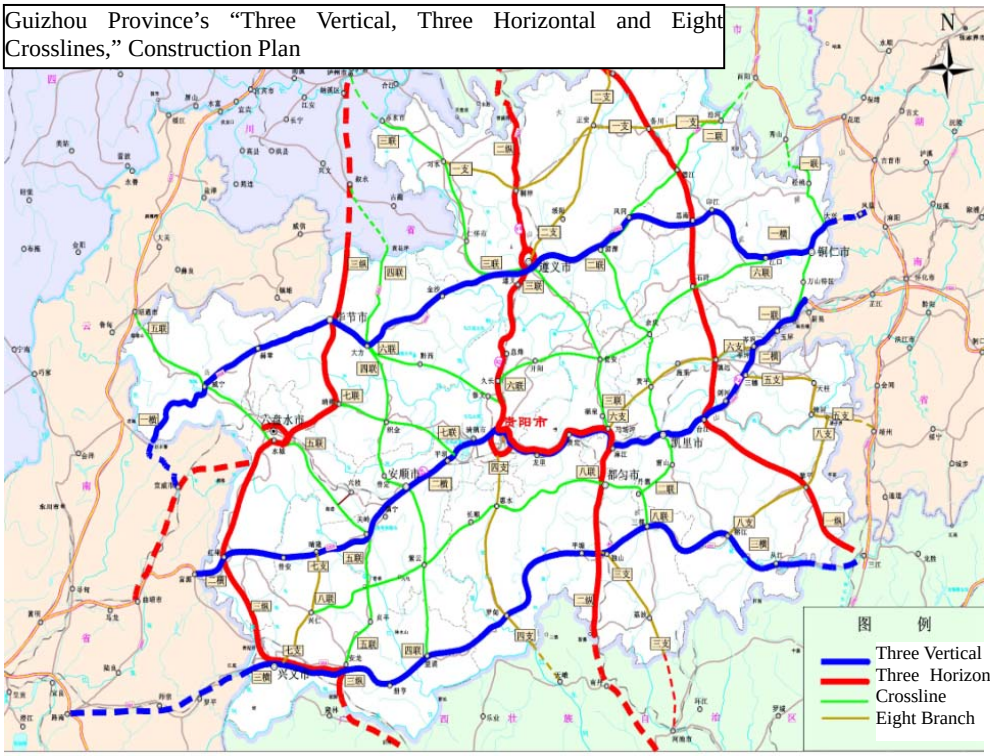
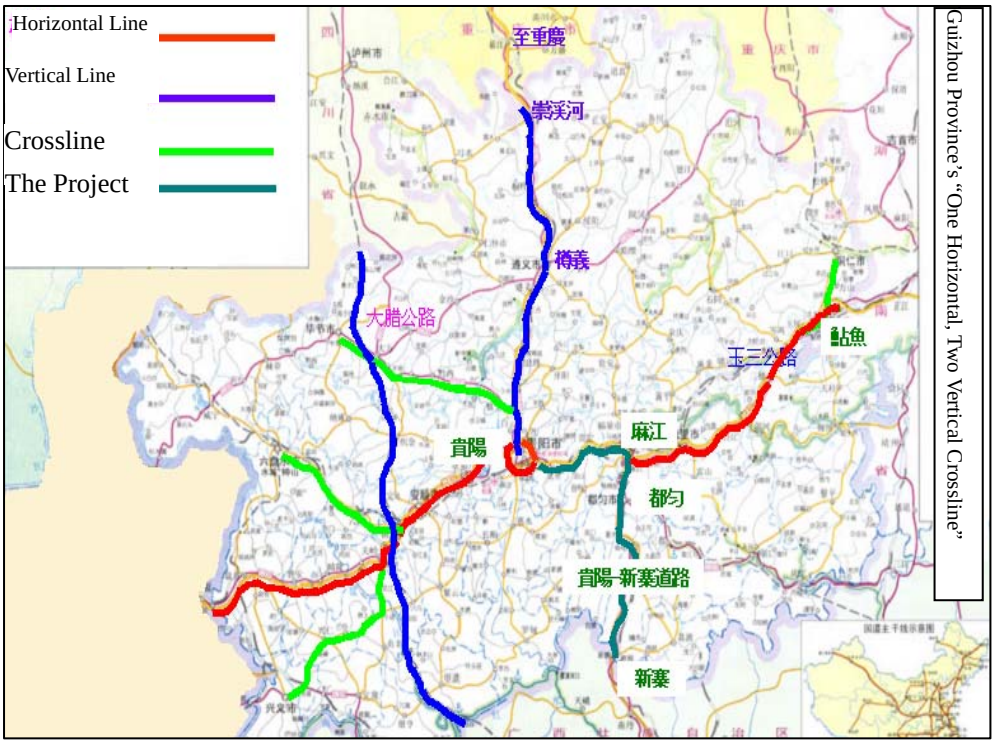


Fig. 3 Guizhou Province's "One Horizontal, Two Vertical Crossline" Construction Plan



2.3.2 Responding to the increase in transport demand between Guiyang-Duyun and Duyun-Xinzhai

2.3.2.1 Annual average daily traffic volume

The objective of this project was to ameliorate the volume of traffic in the city areas by separating the traffic volume of the former Provincial Highway 207 (present Provincial Highways 321 and 210) into through traffic and intraregional traffic and to accommodate the increasing transport demand. Table 2 shows the annual average daily traffic volume between Guiyang-Duyun and Duyun-Xinzhai. The feasibility study projections in 1994 were model projections based on traffic volume surveys of 11 locations on the highway as well as the starting and terminating points. A comparison of these with actual results shows that the project achievement rate remains low at about 53% for the Guiyang-Duyun sector and about 60% for the Duyun-Xinzhai sector in 2005. However, a comparison of projections based on results of traffic volume on the former in 1995 with projections[7] yielded approximately 103% for the Guiyang-Duyun sector and 97% for the Duyun-Xinzhai, which are almost the same as projected values.

Because there is a significant disparity between the projection based on the feasibility study and the projection based on former road traffic volume results, the question is which should be adopted. However, judgment of that depends on whether or not there have been changes in the road environment surrounding the project. The road design plan of Guizhou Province is shown in Fig. 2.3.1 and construction of roads based on the

[7] On the assumption that the annual increase will be 8%, the same rate as at the time of the appraisal

national Five Vertical and Seven Horizontal National Road Plan has been promoted since 1992; from the time of the appraisal in 1994 until the present, it is believed that there have not been any major changes in the road environment surrounding the project and projections based on traffic volume results at that time can be said to be more accurate.

The annual average growth rate in daily traffic from 2001 to 2005 was 16% for the Guiyang-Duyun sector and 37% for the Duyun-Xinzhai sector which, compared with the national average growth rate of 8%[8], has recorded a high increase. The road Nian yupu -Kaili Highway will soon be completed and as the main logistics artery of China's southwest, the volume of traffic can be expected to increase steadily as roads connecting to the main lines increase. Therefore, it can be said that the expected objective has been reached.

Table 2. Annual Average Daily Traffic Volume for Guiyang-Duyun and Duyun Xinzhai

(Unit: vehicles/day, midsize car equivalent)

	1994	1995	2000	2001	2002	2003	2004	2005
Guiyang-Duyun (F/S projection)	5,306	5,624	7,312	-	-	-	-	11,603
Guiyang-Duyun (projections based on former road results for 1995)		3,026	4,049	4,373	4,723	5,101	5,509	5,949
Guiyang－Duyun (actual performance)				3,410	4,133	4,745	5,584	6,112
Growth rate (actual performance)					21%	15%	18%	9%

	1994	1995	2000	2001	2002	2003	2004	2005
Duyun-Xinzhai (F/S projection)	2,547	2,751	4,023	-	-	-	-	6,384
Duyun-Xinzhai (projections based on former road results for 1995)	-	1,835	2,696	2,912	3,145	3,396	3,668	3,961
Duyun-Xinzhai (actual performance)				1,261	2,504	2,601	3,037	3,861
Growth rate (actual performance)					99%	4%	17%	27%

Source: Japan Bank for International Cooperation

2.3.2.2 Reduction in the amount of travel time required

Table 3 show a comparison of the average speed and average time required between the respective areas on the motorways prior to execution of the project and after the

[8] Based on the interview with Guizhou Expressway Development Corporation.

execution of the project. Average speed was 20 to 40km per hour and on the Guiyang-Duyun sector improved to 76.23km per hour and on the Duyun-Xinzhai sector to 64.99km per hour. The time required for travel was also reduced significantly. Travel on the Guiyang-Duyun sector, which in the past had taken up to 7 hrs 10 min, was reduced to 1 hr 53 min and on the Duyun-Xinzhai sector, which in the past had taken up to 5 hrs 53 min to 1 hr 48 min. These results clearly demonstrate that the project contributed significantly to increasing mobility in the region.

However, the Grade 2 road between Duyun-Xinzhai, which was designed to accommodate a daily traffic volume of 7,000 vehicles, has two lanes and there are comments from users that during peak hours there is congestion in some areas. Although it was not possible to obtain peak traffic volume data, a calculation of the volume to capacity ratio (V/C) which gives a rough indication of the level of congestion from the annual average daily traffic volume at present yields about 0.6[9] at points where there is heavy traffic and this is not high. There is also a plan to expand the two-lane road between Duyun-Xinzhai to four lanes by the end of 2006. Therefore, it is believed that traffic congestion along that sector will for the most part be resolved.

Table 3. Comparison of Average Speed and Time Required on Highway Sectors Before and After the Project

Sector	Average speed			Time for travel		
	Before	After	Difference	Before	After	Difference
Guiyang－Duyun	20-40km/h	76.23km/h	＋36.23-56.23km/h	215-430 min.	112.8 min.	-102.2-317.2 min.
Duyun－Xinzhai	20-40km/h	64.99km/h	＋24.99-44.99km/h	176～353 min.	108 min.	-68-245 min.

Source: Guizhou Expressway Development Corporation

Traffic congestion between Duyun-Xinzhai

Motorways prior to execution of the project

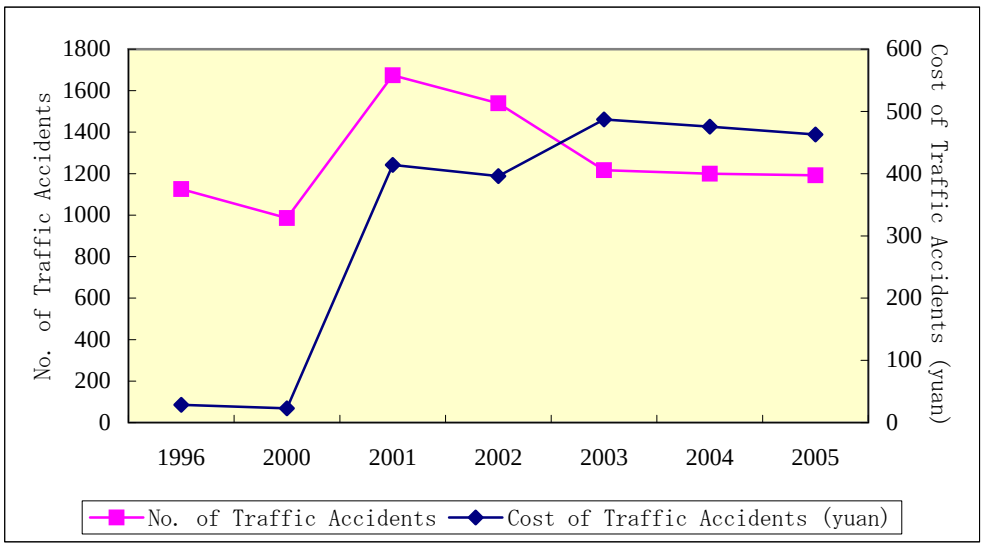
[9] Normally, V/C of 8.0-1.0 is considered “congestion,” above 1.0 “heavy congestion,” and below 0.8 “free of congestion.”

2.3.2.3 Traffic accidents and accident losses

The annual number of traffic accidents on the former road was 1,126 in 1996 and 986 in 2000, or approximately 1,000 on average. After completion of the highway, however, it rose to 1,674 in 2001 and 1,539 in 2002, an increase of about 1.5-fold. Thereafter, the rate progressively decreased to 1,217 in 2003, 1,200 in 2004, and 1,192 in 2005. Excessive speed, excessive loads, and slippery roads due to frozen road surfaces are the major causes of accidents. However, in 2001, the high incidence of accidents is believed to be due in large part to the large number of drivers on the road who were not used to driving on expressways. Since 2002, the introduction of a number of traffic safety measures such as median strips, guard rails, increased road signage and road improvement to prevent slipping, as well as tighter control of load weight measuring and speeding violations have led to a reduction in accidents.

Damages in monetary terms sustained as a result of accidents on roads completed through the project also increased significantly in comparison with losses sustained on the former road. The cost of losses on the previous road in 1996 amounted to 285,000 yuan and 228,000 in 2000. In contrast, losses on the highway completed through the project soared to 4.14 million yuan in 2001, 3.96 million yuan in 2002, 4.872 million yuan in 2003, 4.756 million yuan in 2004, and 4.63 million yuan in 2005, increasing more than 14-fold as a result. Unlike traveling on general roads, vehicles on motorways are moving at higher speeds and, as these results indicate, damages consequently become more severe.

Fig. 4 Trends in Traffic Accidents and Accident Damages



Note: Data for 1996 and 2000 is for the former road
Source: High Grade Highway Management Bureau of Guizhou Province

2.3.3 Recalculation of the Financial Internal Rate of Return

When the Financial Internal Rate of Return (FIRR) was calculated at the time of the appraisal in terms of benefits to be gained from road toll income, computation was based on a project life of 20 years and expenses included project costs and operation and maintenance costs, resulting in an FIRR of 6.6%. When the FIRR was recalculated for this study, projections and actual values were obtained from the executing agency for the project costs and for operation and maintenance costs. Projections and actual values for road toll income were also obtained; calculation, based on the same conditions as before, resulted in an FIRR of 5.5%. Based on results for 2005, calculation of the traffic volume was based on an annual growth rate of 15% and an assumption that the daily volume of the road design would be reached in 2013. The main reason for the lower result in comparison with the value at the time of the appraisal can be attributed to an increase in cost for traffic safety measures resulting in a four-fold increase in operation and maintenance costs compared with projections at the time of the appraisal.

2.3.4 Calculation of the Economic Internal Rate of Return (EIRR)

The result of a recalculation of the Economic Internal Rate of Return (EIRR) based on a project life of 20 years was 9.1%, a decrease of 16.6% compared to that at the time of the appraisal. At the time of the appraisal, the project costs and operation and maintenance costs were calculated as costs and the benefits were calculated as a reduction in vehicle running costs, reduction in congestion, reduction in distance, freight transport time saving, passenger travel time saving, and a reduction in accidents. As at the time of the appraisal, at the time of the recalculation the costs were the project costs and operation and maintenance costs. However, as the benefits of the project, time saving, travel cost saving and reduction in accidents were used as more practical indicators. Like the FIRR, the reason for the lower value in comparison with that at the time of the appraisal was due to an increase in maintenance and management costs and the lower benefits in terms of accident reduction.

As the above indicates, the project responded to the increase in transport demand and succeeded significantly reducing the time required for travel, and therefore can be said to have achieved the project objective. On the other hand, the increase in damages due to traffic accidents was to some extent unavoidable in China where expressways do not have a long history, and future safety measures are an issue.

2.4 Impact

2.4.1 Guizhou Province's economic cluster along the highway

2.4.1.1 Increase in road passenger and freight transport volume

(1) Guizhou Province

The number of kilometers of Guizhou Province's roads increased from 32,487km in 1995 to 46,128km in 2004, increasing 1.4-fold. During this time, passenger transport volume by road travel went from 343.04 million in 1995 to 560.77 million in 2004, increasing 1.6-fold while freight transport volume transported by road went from 98.06 million tons in 1995 to 135.41 million tons in 2004. A look at transport volume as ratios by transport mode during this period shows that passenger transport volume by road increased mildly from 92% to 93%, while freight fell from 64% to 56% and the ratio railway transport increased.

On a passenger-kilometer and ton-kilometer basis, passenger transport volume increased from 8.8 billion passenger kilometers in 1995 to 15.1 billion passenger kilometers in 2004, increasing 1.7-fold. Freight transport volume increased from 5.1 billion ton kilometers in 1995 to 8.4 billion kilometers in 2004, increasing 1.6 fold. A look at these figures as ratios of transport volume shows that while passenger transport volume on roads rose slightly during the period from 48% to 55%, freight transport volume fell from 17% to 15%, indicating that freight transport volume by railway remains overwhelmingly strong. The ratio of road freight transport is following a declining trend nationwide after peaking at the latter half of the 1990s but Guizhou Province's road freight transport on a hundred million ton-kilometer base is high at 4% higher than the national average.

The total number of kilometers of road laid during the project was about 327km, which is only 2.4% of the 13,641km of road laid during the past 10 years. However, it accounts for 50% of the most important single vertical highway in Guizhou Province (Chongxihe –Xinzhai), so it can be said that it has made a certain contribution to increasing passenger and freight transport volume in that province. Furthermore, while there are future plans for Qiangui Railway, which will run parallel to the Guiyang-Xinzhai Highway, at present is not double-tracked so there is a capacity overrun. Therefore, the project is also playing a significant role as a substitute for railway transport.

Qiangui Railway

(2) Qiannan Buyizu Miaozu Autonomous Prefecture

Table 4 shows trends in road transport passenger and freight transport volume in the Qiannan Buyizu Miaozu Autonomous Prefecture. The annual growth rate for 2002, the year after the project was fully completed, was higher than for other years except for passenger transport. The project highway and the regional national road which runs parallel to it are the only trunk lines in Quiannan Prefecture. Therefore, the majority of this growth can be considered as resulting from the opening of the new project highway. In terms of passenger transport, supply (number of transport vehicles) resulting from the opening of the project highway rose 11% over the previous year while demand (passenger transport volume) at 1% showed little growth over the previous year. On the other hand, transport volume on a kilometer basis rose dramatically by 24% and it can be said that the travel distance increased as a result of the project. In terms of freight, the number of transport vehicles and transport volume on a kilometer basis increased 10% over the previous year. However, transport volume rose sharply over the previous year to 22%, indicating that as a result of the project, travel for large vehicles had become more convenient and that freight destinations had expanded and that, as a result, heavy vehicle transport increased and the composition of items transported changed.

Table 4. Passenger and Freight Traffic Volume on Roads
in the Qiannan Buyizu Miaozu Autonomous Region

	1997	2000	2001	2002	2003	2004	2005
No. of passenger vehicles	1,328	2,062	2,200	2,441	2,520	2,352	2,373

（vehicle）							
Rate of Growth	-	-	7%	11%	3%	-7%	1%
Passenger transport volume (10,000 people）	3,201	4,108	3,881	3,835	3,614	3,871	4,138
Rate of Growth	-	-	-6%	-1%	-6%	7%	7%
Passenger transport volume (10,000 people / km）	99,427	123,160	121,444	150,105	144,922	145,887	155,720
Rate of Growth	-	-	-1%	24%	-3%	1%	7%
No. freight transport vehicles	5,522	6,636	6,802	7,511	7,727	7,256	8,942
Rate of Growth	-	-	3%	10%	3%	-6%	23%
Freight transport volume （10,000 tons）	1,024	1,181	1,232	1,505	1,611	1,674	1,816
Rate of Growth	-	-	4%	22%	7%	4%	8%
Freight transport volume （10,000 tons /km）	76,002	102,963	94,736	104,277	109,483	110,522	118,812
Rate of Growth	-	-	-8%	10%	5%	1%	8%

Source: Road Transport Management Bureau of Guizhou Province

2.4.1.2 Economic development of the areas along the road

The project starting point was at Huaxi District in Guiyang city and after passing mainly through two cities of Duyun and Fuquan as well as the three cities of Longli, Guiding, and Dushun in the Qiannan Buyizu Miaozu Autonomous Region before terminating in Xinzhai. Trends in the regional economies of these areas is shown in Table 5. Average annual growth for Longli and Duyun from 2001 after the opening of the project road until 2004 was 14%, surpassing the national average by 11% and the average for Guizhou Province by 13%. This surge is believed to have been influenced by a 28% annual rise in investment in Duyun and, as outcome of the project, an expansion in destinations for coal, one of the area's major resources, not only in Guizhou Province but also in the Guangxi Zhuang Autonomous Region and Guangdong Province

According to a coal company in the city of Duyun, production has increased 2.5-fold, sales 3.6-fold, and profit margins two-fold since the execution of the project. A bus company also in Duyun reports similarly that prior to the project the ordinary number of buses in operation on a daily basis was 77, the average daily number of passengers was 1,250, and the average monthly operating margin of 6,775 yuan. However, following the execution of the project, the daily average number of buses in operation rose to 120, the average daily number of passengers to 5,780, and the average monthly operating margin to 10,352 yuan. Therefore, the project had a favorable impact on the poor regional economy where many ethnic minorities live, so it was positioned as a project that would contributed to reduction in poverty in Guizhou Province, China's poorest province, and the completed highway was is called the "Poverty Reduction Highway."

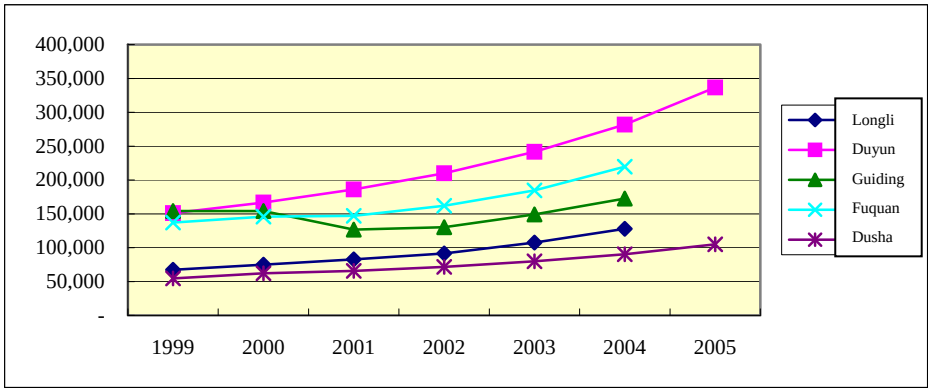
Table 5. GRP of Areas along the Guiyang-Xinzhai Highway

(Unit: 10,000 yuan)

	1999	2000	2001	2002	2003	2004	2005
Guizhou Province	9,118,600	9,935,300	10,849,000	11,850,400	13,561,100	15,919,000	N/A
Rate of Growth	—	9%	9%	9%	14%	17%	—
Qiannanzhou	940,825	1,012,779	1,062,412	1,152,950	1,266,838	1,465,548	1,682,719
Rate of Growth	—	8%	5%	9%	10%	16%	15%
Longli	67,426	75,054	82,816	91,483	107,485	127,908	N/A
Rate of Growth	—	11%	10%	10%	17%	19%	—
Guiding	154,044	154,173	126,611	130,360	149,055	172,506	N/A
Rate of Growth	—	0%	-18%	3%	14%	16%	—
Fuquan	137,000	145,805	147,100	161,931	184,742	219,658	N/A
Rate of Growth	—	6%	1%	10%	14%	19%	—
Duyun	151,103	166,720	186,106	210,021	241,557	281,728	336,657
Rate of Growth	—	10%	12%	13%	15%	17%	19%
Dusha	54,675	62,140	65,800	71,580	79,862	90,209	105,008
Rate of Growth	—	14%	6%	9%	12%	13%	16%

Source: Duyun City Government, Dusha City Government, Guizhou Expressway Development Corp.

Fig. 5 Trends in the Two-City, Three-Prefecture GRP



2.4.2. Impact on the Environment

2.4.2.1 Resettlement of residents

At the time of the appraisal, it was estimated that 14.78km^2 of land would be acquired and 7,065 residents belonging to 1,670 households would be resettled. In accordance with the Land Management Law and the Guizhou Implementation Act for Land Management, plans were made for resettlement, compensation, preparation of alternative land, and employment assistance. The actual area of land acquired was 22.97km^2 and the number of persons who received compensation totaled 6,761 residents of 1,581 households in the three districts of Huaxi District in Guiyang, Majiang Prefecture in QiandongNan Administrative Government and Qiannan Administrative Government. The Guizhou Expressway Development Corporation established a superintendent department in Qiannan Administrative Government and in cooperation with the local government land authority undertook arrangements in accordance with the Plan for the Resettlement and Compensation of Residents of Land Repossessed in Qiannan Area of the. The resettlement process had been thoroughly explained to the residents and no major problems occurred.

According to a survey in which 14[10] of the residents who received compensation about their life following resettlement were respondents, 100% responded that after resettlement their income had increased over what it had been previously. As far as the location of their residence was concerned, 57% responded that they were “extremely satisfied” while the remaining 43% responded that they were “satisfied.” The local government has established preferential policies and economic assistance for employment assistance and farmers involved in aquaculture and agriculture and it is evident that their living environment has improved. It must be noted that the questionnaire survey respondents were limited to local residents who resettled in Xiaoweizhai Town and Mochong Town in the city of Duyun and are not representative of the residents who received compensation as a result of the project.

2.4.2.2 Other environmental aspects

Aspects of environmental measures examined during the appraisal were noise, air pollution, and water contamination from sediment runoff. Conditions during the project period and in 2002 after the opening of the road are as described below. Because environmental monitoring has not been undertaken since 2002, details of conditions are unclear. However, in interviews at schools and hospitals located along the highway during our study, noise and air pollution problems as well as the view that the government is not doing enough were indicated. It is hoped that regular environmental monitoring and measures to address related problems will be implemented in the future.

The Traffic Agency of Guizhou Province and the Guizhou Expressway Development

[10] Five people who had relocated and moved, and nine people who had handed over their land.

Corporation acknowledge these problems and while the National Environmental Observation Center undertakes monitoring in accordance with the National Environmental Observation Ordinance and state-owned companies have centers for monitoring, at present neither a body for monitoring nor specific budgetary measures exist.

(1) Noise

During the construction period, nighttime construction was to be suspended as a noise control measure. After completion of the project further noise reduction measures for the nine schools located along the highway were to be taken such as soundproof reinforcement, tree planting, and the installation of soundproof barriers.

During the construction period, construction was in fact discontinued from 10:00pm until 6:00am the next morning to avoid disturbing the sleep of the residents in the environs of the construction site. After the opening of the road, a value exceeding the Urban Area Environmental Noise Standard (GB3096-93) was observed in areas requiring noise control such as schools, hospitals and residential areas. According to results of monitoring undertaken in 2002, out of the 14 locations monitored (seven residential areas, one hospital, and six schools), daytime standard values were exceeded in four locations (schools in each case) and eight locations where the nighttime standard was exceeded (residential areas and hospitals). Afterwards soundproof barriers were installed in areas near schools and hospitals and in some places soundproof windows were installed or trees planted to reduce the sound.

(2) Air pollution

Taking into consideration the coarse particulates that are released by cement mixers, a decision was made to undertake cement mixing operations during the construction period at a location at least 200m from residential areas. After completion of the project, it was anticipated that concentrations of carbon monoxide and nitrogen oxide would both be within the standard values.

Dust control measures were taken during the construction period by establishing green belts in areas along the route where residential areas were concentrated. Results of monitoring pollutant concentrations in seven locations along the highway in 2002 following the opening of the highway revealed that nitrogen oxides and total suspended particulates exceeded the Level 2 standard[11] values of the Environmental Air Pollution Standard (GB3095-82).

[11] Standards established under the People's Republic of China Environmental Preservation Law and the People's Republic of China Air Pollution Prevention Law are aimed at improvement of environmental atmospheric quality, prevention of ecological destruction, and protection of health. Air quality standards are applied to air quality by area: Level 1 (natural environmental areas), Level 2 (residential areas, commercial and traffic areas, cultural areas, general industrial areas, agricultural villages), and Level 3 (specified industrial areas).

(3) Sediment Discharge and Water Contamination

Measures to address sediment runoff due to engineering works, such as the planting of trees, were to be established as well as measures for dealing with wastewater such as arrangements for its discharge after water pollution treatment in places where it would have little impact on water for drinking and living purposes or fishing areas.

Measures were taken as planned, and monitoring undertaken in two locations in 2002 revealed that concentrations of water contaminants at both locations met the Level 2 standard [12] for both the Wastewater Discharge Standard (GB8978-96) and the Agricultural Irrigation Water Quality Standards (GB5084-92).

2.5 Sustainability

2.5.1 Execution agencies

2.5.1.1 Technical capacity

The operation and maintenance of the Guiyang–Xinzhai Highway, which is explained below, was undertaken by the Guizhou Province High Grade Highway Management Bureau. It has 371 employees, 69 of whom belong to the management department and the remainder are involved in toll collection operations. A look at the breakdown of staff in the management division shows that approximately 57 staff or 83% have an education background of vocational school level or above, 52 staff or about 75% have at least 10 years' experience, and 23 staff or 33% of employees hold qualifications of at least middle level technicians. While the ratio of technicians is somewhat low, in terms of education and experience, there are no problems.

In the period from 2001 until the Guiyang-Xinzhai Highway opened in 2005, training for 1,119 persons including toll collection staff, road repair staff, road administration patrol staff, and data processing staff was conducted in areas such as road project management technology, asphalt surface repair technology, road surface treatment technology, and bridge measurement technology. The technology required for the daily maintenance and management of the road has already been acquired by staff and opportunities for training are arranged each year. Therefore, there are no problems with respect to the sustainability of technical capacity.

[12] These are standards established under the People's Republic of China Environmental Preservation Law, the People's Republic of China Air Pollution Prevention Law, and the People's Republic of China Maritime Environmental Preservation Law and are aimed at water pollution control, insuring surface and underground water quality, health protection and maintaining the environment. Polluting substances are divided into categories: Category 1 (substances that have a significant long term effect on the human body) and Category 2 (substances that have a minor long-term effect on the human body). The two categories have three respective levels and a standard of Level 2 or above applies to urban areas.

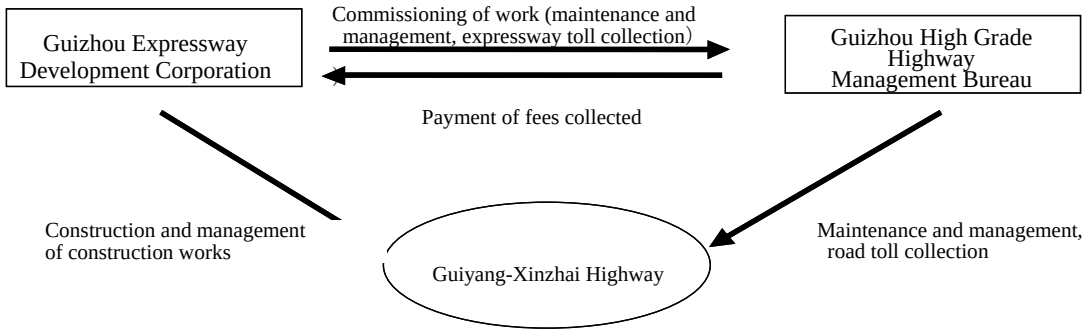
2.5.1.2 Structure

As Table 6 shows, there were partial changes in the specific executing agency of the project and its operation, maintenance, and management. At the time of the appraisal, the plan was for the Transport Agency of Guizhou Province to be the sole specific executing agency and for the Guizhou Expressway Development Corporation to be responsible for the operation, maintenance and management of the highway. At the time of the evaluation, the Guizhou Expressway Development Corporation was engaged in the management of construction and construction operations during the execution of the project as the specific executing agency and has been involved in the management and administration since completion of the construction. However, the operation and maintenance of the highway and the collection of road tolls have been subcontracted to the Guizhou Province High Grade Highway Management Bureau.

Table 6. Changes in the Framework at the Time of the Appraisal and at the Time of the Evaluation

	At the Time of the Appraisal	At the Time of the Evaluation
Executing Agency	Ministry of Communications	Ministry of Communications
Specific Executing Agency	Transport Agency of Guizhou Province	Transport Agency of Guizhou Province Guizhou Expressway Development Corporation
Operation, Maintenance and Management	Guizhou Expressway Development Corporation	High Grade Highway Management Bureau of Guizhou Province

Fig. 6 Relationship of the Guizhou Expressway Development Corporation and Guizhou Province High Grade Highway Management Bureau



Established in 1993, the Guizhou Expressway Development Corporation is a state-owned company which builds and manages expressways in Guizhou Province. At present, it is responsible for the management of 10 expressways within the province including management of the Guiyang-Xinzhai Highway and the construction of two expressways. As of February 2006, it consisted of nine departments, four offices, and the Expressway Toll Computer Management Center and has a staff of 400.

Established in 1992, the Guizhou Province High Grade Highway Management Bureau is a state-owned company consisting of the Guiyang Expressway Management Unit, the Duyun Expressway Management Unit, the Guizhou Province Expressway Maintenance Center, and the Computer Network Center. The bureau subcontracts the maintenance and management, road toll collection, and road patrolling of the 12 high grade roads within Guizhou including the Guiyang-Xinzhai Highway. As of February 2006 it had 371 staff including operation and maintenance technicians, road toll collection staff, managers, and office staff.

Fig. 7. Guizhou Expressway Development Corporation Organization Chart

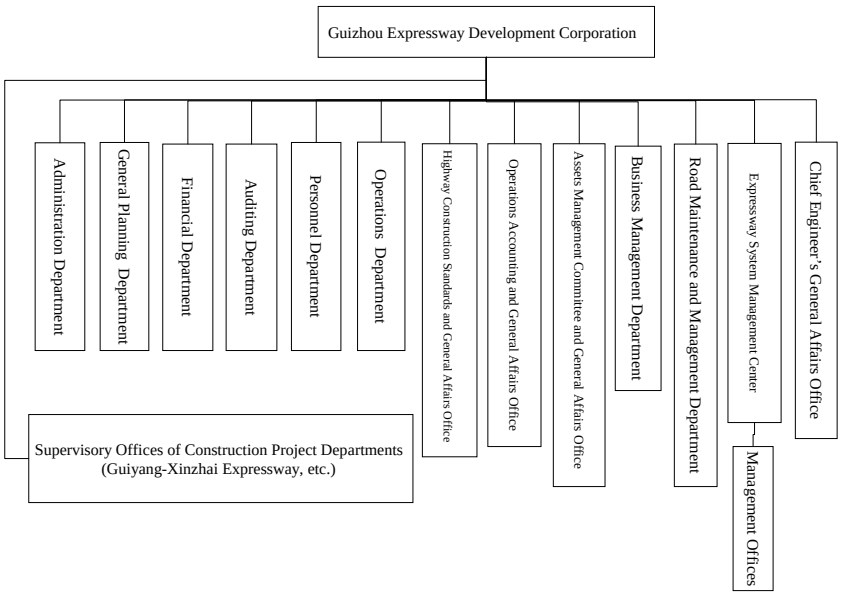
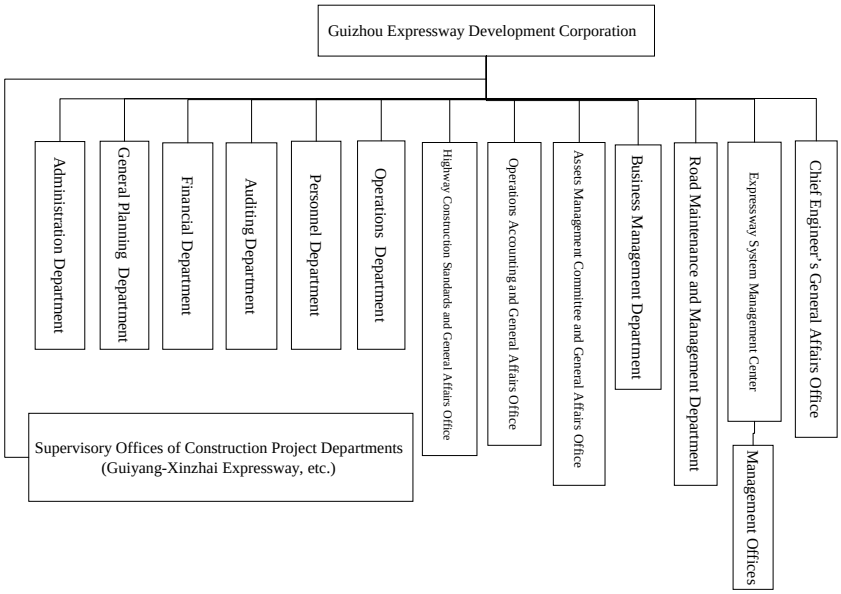


Fig. 8. Guizhou Province High Grade Highway Management Bureau Organization Chart



2.5.1.3 Financial status

Operational income of the Guizhou Expressway Development Corporation for the three years from 2002 to 2004 was 237 million yuan, 408 million yuan, and 599 million yuan respectively, showing a high year-on-year growth rate of 72% and 47% respectively. In fiscal 2004, the trend in financial improvement became evident when gross profit to sales moved into the black. However, enormous deficits continue to be recorded for net profit/loss due to the interest burden, which places a strong demand on funds, and an increase in general administrative costs. Since the corporation is planning to invest approximately 9.0-9.5 billion yuan annually until the year 2020, this trend can be expected to continue. If future returns on funds can be expected, there will be no problem with the sustainability of the project but specific measures have not yet been indicated as of the writing of this report. In view of plans for the “great development of western China,” the central government acknowledges that there will be a need for public support if it deems that deficit conditions will be difficult to improve.

Table 7. Guizhou Expressway Development Corporation

Financial Indicators

(Unit: Million Yuan)

	2002	2003	2004		2002	2003	2004
Total Capitalization	21,264	24,940	31,159	Return on Total Assets (%)	0%	-1%	-1%
Current Assets	5,785	4,746	6,693	Gross Profit to Sales (%)	-6%	-5%	1%
Long-term Assets	15,477	20,191	24,463	Net Profit to Sales (%)	-24%	-70%	-49%
Current Liabilities	1,884	2,217	1,779	Total Assets Turnover (No. of times)	1	2	2
Long-term Liabilities	11,193	13,189	17,671	Current Ratio (%)	307%	214%	376%
Capital	8,187	9,534	11,710	Fixed Assets to Net Worth (%)	189%	212%	203%
Operating Income	237	408	599	Equity Capital Ratio (%)	39%	38%	38%
Gross losses	-15	-19	7				
Net losses	-56	-285	-291				

2.5.2 Operation and maintenance

Since 2001, the Guizhou Province Expressway Development Corporation has commissioned the operation and maintenance of the project to the Guizhou Province High Grade Highway Management Bureau. Ordinary operation and maintenance expenses and large-scale operation and maintenance works including personnel expenses and staff training are included in the contract. Every year the bureau draws up an annual operation and maintenance plan which is approved by the Guizhou Expressway Development Corporation. Two centers under the jurisdiction of the Guizhou Province Expressway Maintenance Center (Guiding and Duyun) check the road operation and maintenance, repair, construction, disaster prevention, emergency repairs, and surface conditions of the respective sections for which they are responsible as well as undertaking greening and beautification measures.

Inspections and repairs of facilities are undertaken in the course of routine daily, weekly and semiannual inspections. In line with completion of the project, manuals on inspection and appraisal methods of road operation and maintenance, expressway, bridge and tunnel operation and maintenance methods, quality control methods, and promotion of daily greening management were prepared. At present daily work practices follow these manuals, and procedures for emergencies and abnormal conditions have already been established, so no major problems have occurred.

Since the completion of the project, in addition to daily operation and maintenance work, various measures necessary for traffic safety have been taken. These include road

repair due to sediment disasters and rain, bridge upgrades and repairs, the establishment of median strips, asphalt surface works, and landslide prevention measures. All funds and materials required for this maintenance and management are supplied by the Guizhou Province Expressway Development Corporation. A current problem in maintenance and management is that seismic resistance measuring instruments for bridges, which was included in the project plans, have not been purchased, so ordinary road equipment must be used. According to the Guizhou Expressway Development Corporation, general road equipment cannot be used effectively for large-scale expressway pavement; thus, detailed operation and maintenance for road surfaces is inadequate and there is a possibility that the life years of the surface will be reduced. The corporation is giving serious consideration to this problem and is presently considering purchasing the equipment through a separate expressway loan and using it for this project.

At present, there have been no major problems with the technology, framework, financial status, or maintenance and management of this project. However, a planned, proactive response by the Guizhou Expressway Development Corporation with respect to measures including safety measures, the introduction of equipment, and the conducting of training necessary for road management and maintenance is requested.

3. Feedback

3.1 Lessons Learned

None

3.2 Recommendations

<u>To the Central Government of the People's Republic of China</u>

- The incidence of traffic accidents following the completion of the road in this project rose above the incidence of accidents on the previous road. To a large extent, the manner of driving was a contributing factor in the accidents, such as lack of paying attention, driving too fast, or inappropriate handling of the steering wheel or brakes. To reduce the number of accidents in the future and thereby enhance the benefits of the project, promotion of traffic safety education and the provision of traffic information to raise driver awareness are essential as well as measures to promote the observance of safe speeds by drivers, maintain safe distances between cars, and improve driver etiquette. It is hoped that the Guizhou Expressway Development Corporation and the Guizhou Province High Grade Highway Management Bureau will join forces to conduct safety campaigns

centering on the Guizhou Traffic Agency.

- In the environmental impact study in 2002 it was indicated that noise and air pollution levels in certain areas along the highway exceeded the environmental standards. Because an environmental monitoring system has not been established, monitoring and surveys have not been undertaken since 2002. During this study, there were indications from schools and hospitals along the highway that noise was a problem. Determining the actual conditions and taking appropriate measures are necessary. Therefore, the relevant organizations are asked to quickly establish and implement a monitoring system following discussion.

Comparison of the Original and Actual Scope

Item	Plan	Actual
(1) Project Scope		
1) Intermountain Grade 1 Highway (between Guiyang and Duyun)	140.5km Width 21.5m (4 lanes) Rmin=255m Imax＝4.9% Full access control Concrete pavement	143.22km Width 21.5m (4 lanes) Asphalt paving
2) Intermountain Grade 2 Highway (between Duyun and Xinzhai)	115km Width 12m (2 lanes) Rmin=200m Imax＝5.0% Full access control Concrete pavement	117.55km Width 12m (2 lanes) Asphalt paving
3) Function compensation Highway	21.59km	28.5km
4) Branch line	11.02km	38.1km
5) Bridges	74 locations（Total 9,900m） Large bridge (100km or more) 43 locations (8,346.7m) Midsize bridge (50-100km） 13 locations (899.3m) Small bridges (50m or less) 18 locations (654m)	190 locations (Total 22,740m) Super large bridge (500m or more) 6 locations (3,299m) Large bridge (100-500m) 72 locations (14,600m) Midsize bridge（50-100m） 46 locations (2,893m) Small bridges (50m or less) 66 locations (1,948m)
6) Tunnel	1 location (Daping tunnel 310m)	3 locations
7) Interchanges	14 locations	13 locations
8) Toll-gates	15 locations	As planned
9) Service areas	1 location (Duyun)	3 locations
10) Cubic interchanges	64 locations	75 locations Administrative building 27,057m^2
11) Accommodation for administrative staff	Administrative building 63,614 m^2 Accommodation for administrative staff 15,041 m^2	Accommodation for administrative staff 4,196m^2
12) Consulting services	48M/M (Guidance and support in design, procurement, construction, maintenance and management; staff training for 80 staff of the executing agency)	50.45M/M (Consulting for road surface and foundation construction; staff training for the Transport Bureau and Guizhou Highway Development Corporation; for U.S. and Japan on two occasions for each party; total 61 persons for 99 days.
(2) Construction	December 1996-October 2000 (47 months)	December 1996-March 2004 (88 months)

Period Detailed Design Land Acquisition and Resettlement Preparatory Engineering Works Construction of Guiyang-Duyun Sector Construction of Duyun-Xinzhai Sector	January 1996-December 1997 October 1996-December 1998 October 1997-December 1997 April 1997-September 1999 January 1998-October 2000	July 1997-March 1998 October 1997-December 1998 June 1998-December 2000 June 1998-June 2001
(3) Project Cost Foreign Currency Local Currency Total ODA Loan Portion Exchange rate	 14,968 million yen 38,41 million yen 3,201.440 million yuan 53,386 million yen 14,968 million yen 1 Yuan＝12 yen	13,790 million yen 61,645 million yen 4,215.010 million yuan 75,435 million yen 13,790 million yen 1 Yuan＝14.67 yen (Civil engineering) 1 Yuan＝14.14 yen (Emergency facilities) 1 Yuan＝14.4 yen (Others)