

Plurinational State of Bolivia

Ex-Post Evaluation of Japanese Technical Cooperation Project  
“The Project for Capacity Development of Road Disaster Prevention  
and Bridge Management and Maintenance”

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## 0. Summary

The Project for Capacity Development of Road Disaster Prevention and Bridge Management and Maintenance (hereinafter, referred to as “the Project”) was implemented with the objective of improving the road disaster prevention and bridge maintenance and management capacity of the Bolivian Road Administration (ABC) through strengthening the organizational basis of the Disaster Prevention Unit (UPD) that has been established in the ABC and improving the technical and information basis related to roads and bridges, and thereby reducing the closure of national roads caused by natural phenomena<sup>1</sup>. Being a landlocked nation with high demand for road transportation and harsh natural conditions, Bolivia has a high need for road disaster prevention, and the Project had a high degree of relevance to the development policy and development needs both at the time of ex-ante evaluation and the time of completion. Since it was also consistent with Japan’s aid policy at the time of ex-ante evaluation, it had a high degree of relevance. The project purpose of improving the road disaster prevention and bridge maintenance and management capacity of ABC has largely been achieved; moreover, because the Project’s contribution towards the overall goal of reducing the number of days of closure on national roads has been confirmed and effects have been observed as planned, the Project has had high effectiveness and impact. Due to the effects of the organizational reform which were being advanced by ABC and delays in the pilot projects and so on, the Project period was extended by six months, and the Project cost exceeded the planned amount due to additional dispatch of experts and supply of equipment. Accordingly, efficiency of the Project was low. The UPD was disbanded following completion of the Project. Moreover, because there have been issues regarding the utilization of rainfall observation data and technical dissemination to all of ABC, the Project’s sustainability is moderate. Summing up, the Project is evaluated to be partially satisfactory.

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<sup>1</sup> “Disaster prevention” in wide sense includes various preventive measures, such as construction of civil structures for mitigation (including restoration of structures with improvement), disaster prevention planning, strengthening of risk management organization, education and awareness raising, improvement of warning and communication system and other measures to be taken at the time of disaster (emergency response, relief, etc.) and post-disaster period (rehabilitation, restoration). The Project mainly focused on the preventive measures to be taken in pre-disaster period. In this report, unless otherwise specified, “disaster prevention” and “road disaster prevention” refers to those preventive measures.

## 1. Project Description



Project Location



Slope Protection Works on National Road 1  
in Variante, Tarija Department (Pilot Project)

### 1.1 Background

Bolivia has 60,000 km of roads, but less than 30% of national highways are paved. As maintenance is inadequate, so many of the roads are old and deteriorated with damaged road surface, shoulders, lost traffic signs, etc. Moreover, because Bolivia is a mountainous country with a harsh climate and rough terrain, it suffers substantial damage from major landslides, falling rocks and washed-out bridges during its rainy season lasting from November through March. However, the technology to restore roads is inadequate even when emergency measures are taken, resulting in similar and repeated damage in the same areas.

Given this situation, JICA carried out the development study titled Survey on Prevention of Disasters on Major National Highways and Roads from 2005 through 2007 to encourage drastic improvements in disaster prevention on Bolivia's national roads. As part of this, JICA proposed a capacity development plan that laid out the issues that Bolivia should address and the measures that should be taken to prevent disasters, and also recommended the establishment of an organizational structure to handle these measures. In response to this plan, Bolivia made the decision to set up the Disaster Prevention Unit (UPD) in ABC and to promote capacity strengthening on an organized basis. However, since ABC was lacking in experience and expertise regarding disaster prevention measures, it was unable to independently carry out this work.

Bridges, just like roads, were being affected by natural disasters in different parts of the country, being destroyed by undermining and erosion of riversides and riverbeds. Although many of the deteriorated bridges were in need of maintenance, ABC was unable to take fundamental improvement measures. In order to continue using the existing bridges within the limit of the available budget, it became necessary to perform routine inspections and rational management based on the results of such inspections. However, because there was no updated and complete inventory of the bridges of Bolivia, the measures that were taken were mainly corrective and limited to the repair of destroyed structures.

Within this context and in response to the request presented by the Government of Bolivia, the

Government of Japan decided to perform technical cooperation on the subject of management of roads and bridges based on the approach of preventive maintenance. So, JICA sent a team for a preliminary study in December of 2007 and an agreement with the Bolivian authorities was established about the profile and the basic policy of the Project. The Record of Discussions (R/D) was signed and the Project was commenced in December of 2008.

## 1.2 Project Outline

Overall Goal		To enable constant travel on national roads
Project Purpose		To improve ABC's capacity to prevent road disasters and maintain and manage bridges
Outputs	Output 1	Activity policies for the UPD are established.
	Output 2	A road disaster prevention system is established.
	Output 3	The road disaster prevention management capacity within ABC is improved.
	Output 4	A bridge maintenance and management system is established.
	Output 5	Bridge maintenance and management capacity is improved.
Total cost (Japanese Side)		519 million yen
Period of Cooperation		March 2009 ~ September 2012 (including extension from April to September 2012)
Implementing Agency		Bolivian Road Administration (ABC)
Other Relevant Agencies / Organizations		None
Supporting Agency/Organization in Japan		Joint venture (JV) of Earth System Science Co., Ltd. and Central Consultant Inc.
Related projects		Development study: Survey for Prevention of Road Disasters on Major National Roads (JICA, 2005~2007) Dispatch of individual experts (JICA) Subject of guidance: Road management, January 2010 ~ March 2012 Subject of guidance: Advisor on road disaster prevention measures, October 2014 ~ September 2015 Grant aid: Project for Road Disaster Countermeasures for National Highway No. 7 (JICA, scheduled for 2015~2017)

## 1.3 Outline of the Terminal Evaluation

### 1.3.1 Achievement Status of Project Purpose at the time of the Terminal Evaluation

With the establishment of concepts on disaster prevention within ABC, construction of the institutional base and technical base of the UPD, and technical capacity building of employees in the UPD and regional offices, progress was made on the Project goals. However, due to the influence of organizational reform in ABC and so on, it appears that some of the outputs and Project purpose have not been achieved.

### 1.3.2 Achievement Status of Overall Goal at the time of the Terminal Evaluation (Including Other Impacts)

Multiple disaster prevention projects that benefited from advice from the UPD and team of

Japanese experts were confirmed. Therefore, the impact was extremely large and the overall goal was on course to being attained. No negative impacts were recognized.

### 1.3.3 Recommendations at the time of the Terminal Evaluation

- Promptly begin collection of baseline data regarding the indicator for the overall goal, i.e. to reduce road closures on arterial roads in terms of number and duration.
- Appropriately modify the indicators for the Project purpose.
- Build an appropriate management system for self-recording rain gauges by the end of the Project. ABC should conduct appropriate maintenance and management of these and other equipment.
- Quickly finalize the contents of manuals and guides prepared in the Project; distribute them to regional offices, and take steps to improve the understanding of ABC employees.
- When the organizational setup has been finalized, ABC should review and revise the UPD activity guidelines and operational plans.
- ABC should utilize the disaster prevention database, manuals and guides prepared by the Project and promptly initiate initiatives for disseminating technology and strengthening capacity in headquarters and regional offices.
- JICA should consider extending the Project period concerning those activities for which it is likely that outputs can be achieved through making additional inputs.

## 2. Outline of the Evaluation Study

### 2.1 External Evaluator

Takeshi Yoshida<sup>2</sup> (Global Group21 Japan, Inc.)

### 2.2 Duration of Evaluation Study

Study was implemented as follows for the ex-post evaluation:

Duration of the Study: September 2014 -July 2015

Duration of the Field Study: November 9-November 28, 2014, April 20-April 25, 2015

## 3. Results of the Evaluation (Overall Rating: C<sup>3</sup>)

### 3.1 Relevance (Rating: ③<sup>4</sup>)

#### 3.1.1 Relevance to Development Policies of Bolivia

At the time of the ex-ante evaluation, roads were regarded as vital for maintaining the unity of national land, promoting domestic passenger and freight transport, economic activities and industry, and integrating local economies; in particular, concerning the strengthening of productivity and competitiveness, which are regarded as priorities of economic policy, there were plans to give priority to investing in the

<sup>2</sup> Affiliated with Trea Co., Ltd. (reinforcement)

<sup>3</sup> A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

<sup>4</sup> ③: High, ② Fair, ① Low

construction of infrastructure for physical distribution, etc. The Project aims to support the construction of infrastructure for physical distribution, etc. including the arterial road network (national roads) in respect to the policy issue of “strengthening productivity and competitiveness” within the core theme of “improvement of production capacity” in the National Development Plan of Bolivia (2006-2011). In the strategic road plan at that time, in addition to development of the national road network, it was anticipated that the implementation of public works for road construction and maintenance would lead to an employment creation effect and generate cash income for impoverished people in the short term. The national development policy and strategic road plans of the Government of Bolivia were continued unchanged between the start and the end of the Project.

Accordingly, the Project retained high consistency with development policy from the time of ex-ante evaluation to its completion.

### 3.1.2 Relevance to the Development Needs of Bolivia

As was already mentioned in 1.1 Background, at the time of the ex-ante evaluation, Bolivia was suffering from repeated road closures due to harsh natural conditions and the promotion of preventive maintenance on roads and bridges was an extremely important development issue. By the time of Project completion, although the number of days of road closure caused by natural phenomena was decreasing (see the section on Impact), repeated national road closures were still occurring with major impacts on physical distribution, and the promotion of disaster prevention was an important issue for ABC.

Therefore, relevance of the Project to development needs was high both at the time of ex-ante evaluation and the time of Project completion.

### 3.1.3 Relevance to Japan’s ODA Policies

Japan’s ODA policy with respect to Bolivia at the time of the ex-ante evaluation comprised the two pillars of “supporting social development for reduction of poverty” and “supporting sustainable economic growth,” and it intended to support infrastructure development and human resources development regarding the latter of these. Priority sectors were “Social development,” “Improvement of productivity” and “Strengthening of governance,” and development of economic infrastructure was identified as the means for improving productivity.

Therefore, the Project had high relevance to Japan’s ODA policies.

To sum up, the Project was highly relevant to the Bolivia’s development plan and development needs, as well as Japan’s ODA policy. Therefore, its relevance is high.

### 3.2 Effectiveness and Impact<sup>5</sup> (Rating: ③)

#### 3.2.1 Effectiveness

The Project purpose was to “improve ABC’s capacity to prevent road disasters and maintain and manage bridges.” In order to achieve this, activities were conducted over the Project duration of three and a half years with respect to five full-time employees of UPD (the counterparts) with a view to establishing the organizational basis of UPD, which is the core agency for promoting road and bridge disaster prevention in ABC (Output 1), establishing the technical and information basis for promoting road disaster prevention (Output 2) and improving the technical capacity of employees of ABC in this regard (Output 3), establishing the technical and information basis for promoting bridge disaster prevention (Output 4) and improving the technical capacity of ABC in this regard (Output 5). The following sections summarize the results of the joint work conducted by the team of Japanese experts and UPD and analyze the degree of attainment of the Project purpose in the fields of UPD organizational strengthening, road disaster prevention, and bridge disaster prevention.

##### 3.2.1.1 Attainment of the Outputs

###### (1) Establishing the organizational basis of UPD (Output 1)

In response to the recommendations of the JICA development study, the UPD was established in order to promote disaster prevention within ABC, however, at the time of the ex-ante evaluation, its recognition within ABC was low and its activities were sluggish because there were no policies, operational plans nor its own budget. In the Project, the UPD’s policies and operational plans were compiled and a budget for activities was secured with the approval of the ABC president.<sup>6</sup> The following four responsibilities were specified in the UPD’s policy approved in 2011.

- Establishment of policies, principles and systems concerning disaster prevention in ABC.
- Training for road disaster prevention and bridge maintenance and management inside and outside of ABC
- Operation of technical mechanism and work systems for disaster prevention
- Support for ABC employees in emergencies

ABC has rapid turnover of employees; in particular, turnover is high among road and bridge management engineers at local sites because they are recruited on short-term contracts. It was thus proposed that a qualification system be introduced whereby engineers who receive road disaster prevention and bridge maintenance and management training in the UPD are given a completion certificate and recognized qualification by ABC and this is taken into account when ABC recruits engineers<sup>7</sup>. It was anticipated that this would enable ABC to maintain technical levels in spite of the high turnover of engineers. However, the Project finished before all the arrangements for

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<sup>5</sup> When assessing effectiveness, rating is given upon also taking impact into account.

<sup>6</sup> This output was added following the revision of plans after the start of the Project.

<sup>7</sup> According to the Project Design Matrix (PDM), the qualification system is included in Output 3 and Output 5, however, here it is described together with Output 1 for easier understanding.

securing an approval of ABC's board of directors could be obtained, so the system did not come to fruition.

(2) Road disaster prevention (Outputs 2, 3)

In the development study that preceded the Project, a manual for road disaster prevention (Manual de Gestión y Prevención de Desastres en Carreteras, 2007) was compiled and widely used in ABC. This was an introductory level manual introducing the concept and outlining the technologies of road disaster prevention. In the Project, more detailed technical guidelines were prepared concerning design of road disaster prevention measures, diagnosis and evaluation of hazard spots and so on, and these were used as the basis for conducting training with employees of ABC headquarters and regional offices. The UPD counterparts worked as lecturers during the training for regional engineers. Also, in addition to various indoor training and on-site training for UPD, pilot projects were implemented under the ABC's budget at two locations, making it possible to conduct practical training on a wide range of tasks from the planning and design of road disaster prevention works to procurement, execution management, and handover.

In order to pertinently advance road disaster prevention while utilizing limited resources, it is important to establish an information basis for determining what kinds of measures should be adopted, where and when. In the Project, in order to identify, diagnose and verify the risk locations within the arterial road network, survey formats and a database for recording road disasters and diagnosing hazard spots (slopes) were created. Moreover, a start was made on gathering rainfall observation data through installing a rainfall observation network comprising self-recording rain gauges and simple rain gauges (approximately 120 locations in total), while a landslide observation device using slope gauge (1 location) was installed and operated on a model basis. Also, based on the ABC database, a road pass-ability database open to the public via the internet was prepared through linking with the disaster ledger and gathering information on road closures on arterial roads. Furthermore, precise topographical information was gathered using aerial laser on sections that were previously regarded as difficult to conduct road disaster prevention. The technology transfer to UPD was implemented via these activities, indoor training and site training. On the other hand, for employees of ABC regional offices engaged in the collection of data, the manuals were introduced and training on data collection was conducted..

(3) Bridge disaster prevention (Outputs 4, 5)

There are approximately 800 bridges under ABC management on arterial roads throughout Bolivia. However, when the Project was started, there was no proper inventory of bridges, and bridge works completion drawings were scattered and lost. Moreover, because ABC had so few bridge engineers, it had no choice but to assign its road engineers to work on bridge maintenance and management. Accordingly, at the time of the preliminary survey (May 2008), it was deemed effective to introduce a Bridge Management System (BMS) that included bridge inventory functions and to

simultaneously promote the improvement of bridge inspection and diagnosis technologies, and these contents were included in the activity plan of the Project<sup>8</sup>.

However, following the start of the Project, it was discovered that ABC had already made a beginning on developing its own bridge maintenance system, namely Sistema Gestion de Puentes (SGP). Therefore, introduction of the planned BMS was omitted from the scope of assistance in order to avoid redundancy. Therefore, in the Project, activities were limited to monitoring and evaluating the system autonomously being developed by ABC and offering recommendations on its utilization<sup>9</sup>.

By the end of the Project, an inventory of bridge works completion drawings (a database including digital image drawings) had been compiled. Also, a bridge disaster prevention and reinforcement guide, simplified bridge inspection guide and routine inspection guide, etc. that could even be used by road engineers were prepared and used in conducting training for employees of ABC headquarters and regional offices. The UPD counterparts worked as lecturers during the training for regional engineers.

In addition to various indoor training and on-site training for the UPD, pilot works were implemented under the ABC budget at two locations, making it possible to conduct practical training on a wide range of tasks from the planning and design of bridge disaster prevention works to procurement, execution management, and handover.

### 3.2.1.2 Achievement of Project Purpose

Looking at the situation regarding achievement of eight indicators for the project purpose following the period of extension, as is shown in Table 1, five of the indicators (①, ③, ④, ⑤, ⑦) were achieved, two (②, ⑧) were mostly achieved, and one (⑥) was partially not achieved, and it is deemed

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<sup>8</sup> The Bridge Management System referred to here is a system for assisting the gathering of data on bridge inspection results and repair works and compiling optimum maintenance and management plans according to budget, and it intends to extend the service life of bridges with limited investment. In this system, field inspections of bridges are implemented, the soundness of bridges is determined from the results, the necessary repair contents are presented, and the order of priority of repairs is calculated for multiple bridges. Moreover, the future degradation over time of bridges is forecast, and maintenance and management plans are compiled for the coming years. So long as the field inspection structure can be established, such a system can be operated by a small number of engineers. The preliminary study report stated the following: "It is necessary to augment staff shortages through gathering and integrating general bridge information and routine inspection and diagnostic information in the bridge management system and adding a function for calculating the degree of urgency and rough cost of bridge repair works."

<sup>9</sup> The bridge maintenance system autonomously developed by ABC includes many of the functions of the aforementioned Bridge Management System, but it does not possess the function for forecasting the future degradation over time of bridges and compiling maintenance and management plans for the coming years. As a result of evaluation, the ABC system was found to be difficult to use because it contains very many inspection items, some of which are hard to understand even for bridge experts, it has no expandability and lacks integrity. Accordingly, it was proposed that this system be limited in function to a bridge database. Subsequently, the idea of introducing the Bridge Management System that was initially planned in the Project was considered, however, negotiations between ABC and JICA were too time-consuming and this idea was abandoned due to a lack of time in the Project. As a result, the Project activity did not include a Bridge Management System. The detailed background about how it had been initially planned to introduce a Bridge Management System in the Project but it was revealed that ABC had already started introduction of its own system just before the start of the Project did not come to light. Moreover, ABC, facing to a difficulty to utilize the bridge maintenance system simply as a database due to restriction of programming language, and having desire to re-introduce the Bridge Management System that couldn't be implemented in the Project, was considering making a request to JICA for cooperation in this respect at the time of the ex-post evaluation



that the general degree of achievement was high (Table 1)<sup>10</sup>.

Table 1 Achievement of Project Goals

Project Purpose	To improve ABC's capacity to prevent road disasters and maintain and manage bridges	
	Indicator	Performance
①	Establishment of the ABC road disaster prevention and bridge maintenance and management systems and clarification of the role of UPD	(Achieved) The UPD activity guidelines and operational plans were prepared, and the central and regional work structures were established.
②	Operating conditions of the rainfall observation network and form of transmission of rainfall information	(Mostly achieved) The rainfall observation network was established. However, there are maintenance and management issues with some of the self-recording rain gauges.
③	Listed contents of risk locations on priority sections, and inspection locations in the road disaster ledger	(Achieved) The risk points on arterial roads were confirmed and slope risks were assessed.
④	Quantity of modules and data in the road disaster prevention information database system	(Achieved) Data gathering was commenced on the four modules of pass-ability, disaster ledger, rainfall hydrology, and slope risk.
⑤	Quantity and contents of manuals required for road disaster prevention and bridge maintenance and management	(Achieved) Seven road disaster prevention manuals and five bridge maintenance and management manuals were prepared.
⑥	Establishment of the training completion certification system and certification of completing trainees	(Partially not achieved) Completion certificates were issued, but the qualification system wasn't realized.
⑦	Training contents of engineers in UPD and regional offices and level of understanding of trainees	(Achieved) 86% of trainees adequately understood road disaster prevention, and the figure was 90% for bridge maintenance and management.
⑧	Contents of works leading to the pilot projects, and quality of the completed works	(Mostly achieved) Due to delays in the pilot projects, some of the practical training was conducted at other sites.

Source: Prepared by the evaluator based on materials provided by JICA.

In the terminal evaluation, specific goals of the Project separate from the indicators were arranged as shown below. The conditions regarding achievement of those goals at the time of Project completion are also described, and it is thought that the degree of achievement was generally high.

- To promote the concept of disaster prevention within ABC: The concept of disaster prevention was permeated widely owing to the existence of UPD, the wide-ranging training for ABC engineers, public information activities based on the issue of “engineering handbooks” and the implementation of pilot projects. (Achieved)

<sup>10</sup> The indicators of Project goals are based on the PDM that was used at the time of the terminal evaluation. Because the terminal evaluation pointed out that “these indicators are a different way of saying the five outputs and their indicators,” the indicators were revised just before the end of the Project. However, because many of the new indicators were undoubtedly set at achievable levels judging from the state of progress at that time, they were not well recognized among Project officials, and no performance data concerning the indicators could be gathered by the end of the Project, they were deemed to be inappropriate as indicators for the ex-post evaluation and have not been adopted here.

- To build the institutional base of UPD, which will be the core agency of disaster prevention in practice: UPD's role was clarified and its own budget was secured, while the certification system for persons completing the training was not realized. (Mostly achieved)
- To prepare the basic technical tools for disaster prevention: The planned technical tools (manuals, database, etc.) were all prepared. (Achieved)
- Through strengthening the technical capacity of individual UPD members, to prepare the foundation for disseminating road disaster prevention and bridge maintenance and management technologies within UPD: The UPD members acquired sufficient capability to implement training for engineers in regional offices. (Achieved)

When the ABC engineers who were involved in the Project were asked about the degree of achievement of the Project goal (to improve the road disaster prevention and bridge maintenance and management capacity of ABC) by questionnaire, 39% responded that the Project had been successful and 33% responded that it had been rather successful<sup>11</sup>.

To sum up, it is deemed that the Project largely achieved its purpose.

### 3.2.2 Impact

#### 3.2.2.1 Achievement of Overall Goal

The overall goal of the Project was to “enable constant travel on national roads” and the indicator for that was the “reduction of road closures on arterial roads in terms of number and duration.” In order to improve the pass-ability of national roads, it is necessary to speed up emergency responses when disasters occur, and also to advance disaster prevention through implementing road projects geared to preventing disasters before they happen or reducing the scale of disasters when they do occur. The Project primarily consisted of technical cooperation geared to the promotion of disaster prevention, but it also included contents that could make a contribution to improving emergency responses, for example, the clarification of disaster risk sections and so on. Investment in road works is also needed for achieving disaster prevention, while, this is an external condition beyond the scope of the Project assistance. Moreover, in order to fully achieve the overall goal, disaster prevention investment needs to be conducted over the entire national road network, and such efforts will need to be implemented over an extended period. Therefore, at the time of the ex-post evaluation, the degree of achievement of the overall goal was judged from the viewpoints of whether the pass-ability of national roads was improved, and whether the contribution of the Project could be confirmed.

As is shown in Table 2, the number of days of road closure on national roads has decreased following the end of the Project. Therefore, since the indicator of the overall goal has been realized, it is

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<sup>11</sup> As part of the ex-post evaluation, a questionnaire survey was implemented targeting 50 engineers in the four ABC regional offices in La Paz, Cochabamba, Santa Cruz and Tarija.

judged that the overall goal has been achieved.

According to the questionnaire survey of ABC engineers, 84% think that the number of days of road closure decreased following the Project; moreover, 44% believe that the Project was successful in achieving the overall goal (to enable constant travel on national roads), while 44% believe that it was successful to a degree.

Table 2 Degree of Achievement of the Overall Goal

Overall Goal	To enable constant travel on national roads.
Indicator	Performance
Reduction of road closures on arterial roads in terms of number and duration	(Achieved) The total number of days of closure on the national road network (total number of days of closure of national roads in a year): 2011: 1,062 days 2012: 589 days 2013: 636 days

Source: Prepared by the evaluator based on materials provided by ABC.

Note: No reliable data was available concerning the number of national road closure locations.

It can be thus seen that the pass-ability of national roads has been improved, with faster responses to emergencies and promotion of disaster prevention being the factors behind that. These factors are described in detail in the following paragraphs.

#### Faster responses to emergencies

According to hearing survey of ABC engineers, transport operators, and regional governments, citizens living along national roads and so on<sup>12</sup>, ABC's response to emergencies has recently become much faster than before, and this is thought to be greatly contributing to the reduction in the number of days lost to road closures. According to the hearing with ABC, the following reasons are given for the improved speed of responses.

- a) Because the disaster risk sections on national roads were clarified, the necessity of budget for emergency responses was clarified and it became easier to secure funds<sup>13</sup>.
- b) Previously it was necessary to apply for the budget to respond to emergencies to ABC headquarters every time an emergency happened, however, it is now possible to immediately mobilize the budgets that have been allocated to the regional offices.
- c) Because the budget for road maintenance has been increased in size, ABC is now able to sign contracts with construction firms that have larger heavy equipment. (ABC binds three-year contracts with construction companies for conducting road maintenance and management, and these firms are the first to respond when emergencies occur).

<sup>12</sup> See the box on <National road closures caused by disasters, and their impacts>.

<sup>13</sup> Before, a uniform budget amount was allocated based on the length of road.

- d) When disasters occur, because drivers and the micro-enterprises that conduct road maintenance provide information by mobile telephones, it has become easier to obtain information on disasters<sup>14</sup>. Mobile phones have also made it easier for ABC employees to communicate with each other.

#### Promotion of disaster prevention

Except for some road sections, the awareness that the number of disasters had declined could not be recognized<sup>15</sup>, however, according to ABC, the frequency of disaster occurrence is thought to have declined for the following reasons.

- e) On important roads, landslide observation instruments (slope gauges) modeled on the Project have been installed and monitor for signs of disasters, thereby enabling measures to be taken in advance.
- f) ABC's investment in road maintenance increased fivefold over the seven years between 2008 and 2013, and some of this has been investment in disaster prevention. Owing to the technology transfer in the Project, the available scope of disaster prevention methods and disaster prevention works has become wider and it has also become possible to conduct more pertinent survey and design<sup>16</sup>.

Concerning the items a), e), and f) above, it is thought that the Project has made a technical contribution as described below.

- a) In the Project, in order to identify, diagnose and verify the risk locations within the arterial road network, survey formats and a database for recording road disasters and diagnosing hazard spots (slopes) were created. Through collecting information in this database, important disaster risk sections for preparing emergency responses were made clear.
- e) On important roads, ABC has installed multiple landslide observation instruments (slope gauges) modeled on the slope gauges installed in the Project, thereby enabling measures to be taken in advance.
- f) In the Project, indoor training on disaster prevention, field training, and practical training via

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<sup>14</sup> Micro-enterprises have no more than 10 roadside residents as employees and they conduct routine maintenance activities such as grass cutting, drainage ditch cleaning and so on. These micro-enterprises also monitor the daily measurements by the simple rain gauges installed in the Project.

<sup>15</sup> According to the ABC Cochabamba office, the El Sijar section, which is the most challenging section on the vital National Route 4, previously experienced prolonged closure due to major disasters every two years or so, however, there was no such incident over the four years between 2011 and 2014. According to the office manager, this is because the risk sections were clarified and pertinent disaster prevention works were implemented.

<sup>16</sup> Road maintenance not only includes road maintenance and management and repair works but also various disaster prevention works, however, data couldn't be obtained on the separate investment amounts in each activity. Concerning methods of disaster prevention, for example, locations that had been prone to frequent damage despite repeated works were improved through making major investments into changing bridges or road alignment and so on.

pilot works were implemented for UPD; and the counterparts participated in the creation of manuals and acted as lecturers in the training of regional engineers. In doing so, they acquired a high level of technical capacity for surveying, planning, designing and implementing disaster prevention activities. In the disaster prevention activities of ABC, the headquarters prepares and implements a lot of large-scale and technically difficult works, and in the course of such work the Project counterparts who now belong to the engineering headquarters and road maintenance department offer technical instruction. Moreover, in the disaster prevention activities that are independently conducted by regional offices, the Project counterparts sometimes offer technical guidance in response to the requests by regional offices.

Furthermore, a number of road maintenance works were planned and designed during the Project with the help of the UPD and the team of Japanese experts, and it is thought that these also contributed to the reduction in road closures. Moreover, the pilot works (on two locations for road, two bridges) that were implemented under ABC as part of the Project activities, although small in scale, directly contributed to reducing disaster damage on the roads and bridges in question<sup>17</sup>.

It is thus confirmed that the overall goal of improving the pass-ability of national roads was achieved and that the Project made a contribution towards this. However, landslides and other disasters still occur and impart a major impact on society and economy (see the boxed section). The Project aimed to achieve the overall goal mainly through promoting road disaster prevention works and conducting proper maintenance and management of bridges, however, in order for the impact of these efforts to be fully realized, ABC will need to make ongoing investment and more time will be required.

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<sup>17</sup> According to the hearings of roadside residents, there were voices that said that the pilot works had contributed to preventing disasters.

#### <National road closures caused by disasters, and their impacts>

In order to gather information on the trends in recent five years on road closures and other issues of national road utilization, as well as their socio-economic impacts, a questionnaire survey targeting bus and transportation companies (40 companies) across the country and bus and truck drivers (64) in four locations; hearings at four local governments along arterial roads; and group interviews with residents in six locations were conducted.

#### Main results of the questionnaire survey of transportation companies and drivers

- Although closures of arterial national roads have declined since the Project, landslides are still a major problem, and poor road conditions and accidents on certain sections are still regarded as major issues.
- Roughly 70% of the bus and transportation companies and half of the drivers responded that closures of arterial national roads had decreased.
- Half of the bus companies and approximately 85% of the transportation companies point to landslides as one of the main current problems. Landslides, together with poor road surface conditions (83% of bus companies and 65% of transportation companies) are viewed as one of the main problems on arterial roads. In contrast, 69% of drivers pointed to poor road surface conditions, and 55% cited landslides as problems.
- In view of the high frequency of accidents caused by overtaking, etc. on sections with heavy traffic volume (Cochabamba City - Santa Cruz City), there are numerous calls for construction of additional traffic lanes (increase from two to four). Meanwhile, road closures caused by landslides on such sections have been greatly reduced.

#### Main results of hearings with local governments and residents

- Road closures still occur in various places, however, it was reported that the time taken for roads to re-open has been greatly shortened. Some voices said that the reduced closure times have been achieved thanks to better responses to emergencies by ABC and the road maintenance inspections by micro-enterprises that started around 2007.
- Previously, long-term road closures meant that farm products were ruined because they could not be shipped. Moreover, whenever roads were closed, prices in villages would rise and place a burden on residents; however, it was reported that these conditions have also been largely improved.
- However, the old road between Cochabamba City - Santa Cruz City still sometimes becomes impassable during the rainy season.
- In addition, numerous voices called for the improvement of road signs on curves and at landslide risk points.

### 3.2.2.2 Other Impacts

#### (1) Environmental and social impacts

Through stabilizing slopes, the pilot works in the Project have had a positive impact on the natural environment, for example, conservation of vegetation and soil. According to ABC and local residents, there have been no negative environmental impacts in particular. Moreover, the pilot projects did not entail any relocation of residents or expropriation of land.

#### (2) Other socioeconomic impacts

It is thought that the decline in road closures has contributed to reduction of losses and prices rises in isolated areas caused by delayed shipments of farm products (see the boxed section).

Implementation of the Project largely achieved the Project purpose of improving the road disaster prevention and bridge maintenance and management capacity of ABC. Moreover, since the Project's contribution towards realizing the overall goal of reducing days of closure on national roads was also confirmed, the effectiveness and impact of the Project are high.



Site of slope failure on National Road 4  
Due to the extensive slope failure, the road width is much larger than usual.



Repair of Popo Bridge on National Road 7  
Cracks in the main girders and floor plates were repaired, giving the bridge the strength to withstand the weight of large vehicles. (Pilot project)

## 3.3 Efficiency (Rating: ①)

### 3.3.1 Inputs

Table 3 shows the planned and actual inputs (based on terminal evaluation) to the Project at the time of ex-ante evaluation.

Table 3 Planned and Actual Inputs

<b>Input Element</b>	<b>Plan</b> (based on ex-ante evaluation)	<b>Actual</b> (based on terminal evaluation)
(1) Experts	Planned number of experts: unknown Planned man-months: unknown (Dispatches for Project management / organizational strengthening, road disaster prevention management, geology, road design, database / information and telecommunications, bridge management system, bridge inspection/ diagnosis / repair, bridge design, and other necessary fields)	13 persons 112.8 man-months (Project management / organizational strengthening, Deputy Project management / road disaster prevention management, geology 2 experts, road design, road disaster prevention database / information and telecommunications, bridge management system, bridge design 2 experts, work coordination / GIS 2 experts, work coordination)
(2) Trainees received	Planned number of trainees: unknown (road disaster prevention and bridge maintenance and management)	12 trainees (road disaster prevention and bridge maintenance and management)
(3) Equipment	Planned amount: unknown Investigation equipment, monitoring equipment, bridge inspection equipment, etc.	11.9 million yen Investigation equipment, monitoring equipment, bridge inspection equipment, software, vehicles, PCs, etc.
(4) External works strengthening cost	unknown	6.1 million yen
Grant from the Japanese side	Total approximately 300 million yen	Total 519 million yen
Inputs by the Government of Bolivia	Assignment of counterparts Project field activity expenses Office for experts	Assignment of 8 counterparts (including 5 UPD members) Project field activity expenses US\$1,453,000 (as of October 2011) Office for experts

Source: Prepared by the evaluator based on materials provided by JICA.

### 3.3.1.1 Elements of Inputs

The quantity of input of Japanese experts was increased due to the addition of Output 1 and extension of the Project period. Experts in numerous fields were dispatched over a short period in order to conduct wide-ranging cooperation concerning roads and bridges, however, according to the Experts and the counterparts, it seems that the quantity of inputs and Project duration were not enough in order to carefully implement the capacity building activities.

It took time at the start of the Project to form consensus on the approach to activities between the team of Japanese experts, the counterparts, JICA and ABC, and there were repeated miss-communications



regarding the coordination of activities. Accordingly, the team of Japanese experts and counterparts were unable to build an adequate trust relationship and this impeded the smooth implementation of activities. As the background to this, at the start of the Project, it seems there was poor understanding among the Bolivian side regarding the JICA's approach of transferring technology via joint work; the ABC side believed that the experts should be like consultants and take responsibility for all the output; and there were no core experts on long-term dispatches who could coordinate the technical and operational affairs.

The organizational reform and personnel changes in ABC headquarters that were conducted in tandem with the Project exerted a major impact on the Project activities<sup>18</sup>. At the start of the Project, ample inputs were made with the assignment of five full-time employees to UPD. However, the organizational reforms brought about serious personnel shortages in ABC headquarters, meaning that the counterparts were gradually assigned to unrelated work away from the UPD, and this hindered the Project activities.

### 3.3.1.2 Project Cost

The Project cost was originally planned as approximately 300 million yen, but it eventually increased to 520 million yen or 173% of the planned total. The main reasons for this were the addition of Output 1, the additional input of experts and the addition of observation instruments and aerial laser when the Project was extended,.

### 3.3.1.3 Period of Cooperation

The Project period was originally planned as 36 months, however, it was eventually extended to 42 months (117% of the original period). In addition to the various factors described in the section on Input Elements, delays in the pilot projects (four locations) were the direct cause for the delay of the Project.

The pilot projects were implemented under the budget of ABC. ABC conducted the budget application, survey design, procurement and execution management. However, the organizational reform slowed the ABC side down in each stage of work and procedures. Moreover, in some of the works, delays were also caused by disaster damage occurring in nearby areas, renewed procurement due to non-performance of contracts by operators, renewed tender caused by the absence of bidders, time lags made necessary by the need to synchronize works periods with the dry season and so on.

Therefore, because the Project cost and Project period both exceeded the plan. Therefore, efficiency of the Project is low.

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<sup>18</sup> Around the start of the Project, ABC embarked on organizational reform aimed at improving efficiency through decentralizing work. This intended to establish around three regional headquarters and evenly spread personnel and resources among these, and it initially entailed redeploying numerous engineers from the central headquarters to the regional offices. However, it took ABC a long time to decide the respective locations of the regional headquarters and the issue was still not resolved when the Project was finished in September 2012, meaning that the organizational reform couldn't be fully effected. As a result, the number of engineers in ABC headquarters was greatly reduced, and the remaining personnel including the counterparts became inundated with work. Moreover, the repeated organizational and personnel changes that took place between headquarters and the regional offices impeded the efficiency of clerical processing in ABC.

### 3.4 Sustainability (Rating: ②)

In the Project, with the objective of strengthening the road disaster prevention and bridge maintenance and management capacity of ABC, the organizational basis of UPD and technology and information basis for road disaster prevention and bridge maintenance and management were established and the technical capacity of ABC employees was improved. Here, sustainability of the Project is analyzed while confirming conditions regarding the maintenance and utilization of such results.

#### 3.4.1 Related Policy and Institutional Aspects for the Sustainability of Project Effects

According to ABC, its policy of emphasizing road disaster prevention has remained the same since the end of the Project. Bolivia enacted the Risk Management Law in November 2014, marking the start of a national effort to establish systems and build capacity with emphasis on disaster prevention. It is anticipated that ABC's disaster prevention efforts will be further strengthened in accordance with this law. Accordingly, the sustainability of the Project's policies and systems is deemed to be high.

#### 3.4.2 Organizational Aspects of the Implementing Agency for the Sustainability of Project Effects

Following completion of the Project, the UPD was disbanded in 2012 and the counterparts were redeployed to the engineering headquarters and the road maintenance department of ABC. According to ABC, disaster prevention should be absorbed into the engineering headquarters and the road maintenance department because it is a part of road maintenance, however, this thinking is underpinned by a critical shortage of personnel in headquarters<sup>19</sup>. As a result, due to the disbanding of ABC, the amount of time that counterparts can spend on disaster prevention-related work has been reduced and the system for sustaining the Project effects has been weakened. On the other hand, according to the counterparts, it has become easier in some respects to work on disaster prevention through treating it as part of road maintenance as opposed to a separate activity, and it is necessary to monitor conditions a little more to see how the dissolution of the UPD affects the sustainability of the Project effects. In any case, disbanding of the UPD has meant that the organizational setup for disaster prevention that was constructed in the Project was not maintained.

To sum up, there are deemed to remain some uncertainty regarding the organizational setup for sustaining the effects that were manifested in the Project.

#### 3.4.3 Technical Aspects of the Implementing Agency for the Sustainability of Project Effects

This section sorts the conditions following Project completion and examines sustainability concerning utilization of the various databases that were improved and expanded in the Project, utilization of manuals and guides, retention of engineers, continuation of technical training, and operation of supplied equipment.

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<sup>19</sup> As was explained in the section on Efficiency, in the second half of the Project, counterparts who were supposed to be full-time UPD personnel started to be assigned to work other than disaster prevention in order to make up for the critical manpower shortage in ABC headquarters.

(1) Utilization of databases

The disaster ledger and databases of risk spots and slope diagnoses are successively updated and have been utilized for preparing disaster prevention master plan in ABC headquarters and road maintenance plans in regional offices.

The observation data from simple rain gauges is recorded everyday by the micro-enterprises that implement road maintenance, and it is then compiled and sent to the regional offices and provided to ABC headquarters and the Bolivia National Meteorological & Hydrological Service once per month. The rain gauge observation network that was installed in the Project was mainly intended to analyze the relationship with disaster occurrence. However, no such analysis has been carried out. Moreover, because rainfall data is only reported once per month, it is not utilized for determining warnings on heavy rainfall or road closures and so on.

Data on pass-ability (road closures, warnings, etc. due to natural phenomena and other reasons) is constantly updated via the website by engineers (supervisors) assigned to each road section and it is provided to the general public as road traffic information<sup>20</sup>. Moreover, ABC periodically holds press conferences to convey road information and advisories for the newspapers, TV, etc.

The inventory of bridge works completion drawings is utilized for examining the maintenance, management and repair of bridges. The Bridge Maintenance System that was independently introduced by ABC is used as a bridge database according to the recommendation made in the Project.

(2) Utilization of manuals and guides

Based on the questionnaire survey of ABC engineers, roughly half of those who received training in the Project responded that they possess manuals and guides, while around 40% said they used them. In contrast, ownership and utilization rates are low among engineers who didn't receive training (Table 4)<sup>21</sup>. Incidentally, hard copies of manuals and guides were not distributed to engineers in regional offices. In this way, distribution of manuals and guides has not been adequately conducted throughout the entire organization of ABC.

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<sup>20</sup> According to the questionnaire survey of bus and transportation companies and drivers, not many people use the website to directly obtain information.

<sup>21</sup> Bridge inspection guides were initially prepared in consideration of the bridge management system that was planned for introduction, however, because ABC introduced a different system, the information acquired from inspections has not been utilized to the fullest extent.

Table 4 Ownership and Frequency of Use of Manuals and Guides

	Road disaster prevention		Bridge maintenance and management	
	Trainees	Non-trainees	Trainees	Non-trainees
Owned	49%	13%	43%	15%
Not owned	51%	87%	57%	85%
Frequently used	21%	6%	17%	5%
Sometimes used	27%	10%	25%	8%
Not used	51%	84%	58%	87%

Source: Questionnaire survey of ABC engineers

### (3) Maintenance of technical capacity

It is thought that the five counterparts who belonged to the UPD acquired sufficient technical capacity to act as training lecturers (see the section on Effectiveness), however, since two of these retired after 2014, only three members were still working for ABC at the time of the ex-post evaluation.

Supervisors and chief engineers who are responsible for specific road sections are assigned to the ABC regional offices. When supervisors discover abnormalities in their daily road inspections, they report to chief engineers and update road information on the website. However, since they work on one-year contracts, their turnover rate is very high<sup>22</sup>. According to the questionnaire survey, roughly 60% of the engineers in employment at the time of the ex-post evaluation had not received training by the Project, and it is thought that they were employed following completion of the Project. Moreover, In the Project, whereas the counterparts in headquarters received On-the-Job-Training and other technical training, the engineers in regional offices only received a few days of seminars.

Opportunities for ABC employees to receive training are limited; the only training available is that conducted in relation to various investment projects. In particular, supervisors on short-term contracts have hardly any opportunities for technical training. The only confirmed disaster prevention training conducted following completion of the Project has been the training on operation and management of slope gauges newly installed by ABC. Only the three counterparts who have stayed with ABC are able to serve as lecturers, however, they are so busy that it isn't easy to provide training opportunities.

In this way, training for engineers is not conducted fully over the entire organization of ABC and the dissemination of technology to the entire organization of ABC had not progressed.

### (4) Operation of supplied equipment

The road maintenance department owns and uses survey equipment, road disaster prevention equipment, bridge inspection equipment, vehicles, software and so on. However, according to ABC, concerning the rainfall observation network that was installed in the Project, engineers in regional offices are too busy to conduct the proper operation, maintenance and management of

<sup>22</sup> From June 2015 onwards, it is scheduled to shift to three-year contracts.

self-recording rain gauges, so these are not fully functioning.

To sum up, there are issues regarding the operation, maintenance and management of self-recording rain gauges, utilization of rainfall observation data, and dissemination of technology throughout the entire organization of ABC, and it is deemed that there are some problems regarding the technology that is needed for sustaining the effects manifested by the Project.

#### 3.4.4 Financial Aspects of the Implementing Agency for the Sustainability of Project Effects

The Project was implemented with the aim of enabling constant travel on national roads through utilizing the technical capacity that ABC acquired via the Project. However, in order to realize this, it is necessary for ongoing investment to be made in disaster prevention activities. Moreover, the repeated implementation of various disaster prevention works will lead to the maintenance and furtherance of ABC's road disaster prevention and bridge maintenance and management that was improved in the Project.

In the terminal evaluation, it was found that ABC was allocating more budget to disaster prevention works than to disaster recovery following the start of the Project. In reality, ABC itself is securing more budget because it realizes the importance of the Project pilot works.

Looking at ABC's road maintenance budget before and after the Project, the budget increased fivefold over seven years from 160 million Boliviano in 2008 to 830 million Boliviano in 2013. Road maintenance works include road maintenance and management, improvements other than increase in the number of lanes, disaster works such as slope protection and stabilization, rerouting around landslide zones and debris flow zones, bridge repair works and so on, and it is surmised that the amount of investment in disaster prevention has increased greatly in recent years<sup>23</sup>.

Accordingly, there are deemed to be no problems in particular regarding the finances for sustaining the effects that were manifested in the Project.

Summing up, there are some minor issues in terms of the institutional and technical aspects. However, as there are no particular problems in terms of finance, the sustainability of the effects manifested in the Project is fair.

## **4. Conclusion, Lessons Learned, and Recommendations**

### **4.1 Conclusion**

The Project was implemented with the objective of improving the road disaster prevention and bridge maintenance and management capacity of ABC through strengthening the organizational basis of the UPD that has been established in the ABC and improving the technical and information basis related to roads and bridges, and thereby reducing the closure of national roads caused by natural phenomena. Being

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<sup>23</sup> No detailed information indicating the breakdown of spending on disaster prevention within the road maintenance budget was available.

a landlocked nation with high demand for road transportation and harsh natural conditions, Bolivia has a high need for road disaster prevention, and the Project had a high degree of relevance to the development policy and development needs both at the time of ex-ante evaluation and the time of completion. Since it was also consistent with Japan's aid policy at the time of ex-ante evaluation, it had a high degree of relevance. The project purpose of improving the road disaster prevention and bridge maintenance and management capacity of ABC has largely been achieved; moreover, because the Project's contribution towards the overall goal of reducing the number of days of closure on national roads has been confirmed and effects have been observed as planned, the Project has had high effectiveness and impact. Due to the effects of the organizational reform which were being advanced by ABC and delays in the pilot projects and so on, the Project period was extended by six months, and the Project cost exceeded the planned amount due to additional dispatch of experts and supply of equipment. Accordingly, efficiency of the Project was low. The UPD was disbanded following completion of the Project. Moreover, because there have been issues regarding the utilization of rainfall observation data and technical dissemination to all of ABC, the Project's sustainability is moderate. Summing up, the Project is evaluated to be partially satisfactory.

## **4.2 Recommendations**

### **4.2.1 Recommendations to ABC**

- Capacity building of the ABC engineers in regional offices: In order for ABC to pertinently advance road and bridge disaster prevention, it is important to strengthen the capacity of regional engineers for whose turnover rates are high. Therefore, it is desirable to make use of the Project outputs to continue implementing disaster prevention training for new and existing engineers. Considering the busy schedules of the three counterparts who received training in the Project, it is necessary for ABC to compile an interim disaster prevention training plan that includes the training of trainers and secure the necessary budget and human resources for putting it into effect.
- Utilization of rainfall observation data: The rainfall observation data that is collected by micro-enterprises is delivered to the regional offices once per month, however, this does not allow it to be used for issuing early warnings or preventing damage at times of heavy rainfall. At least on the most important road sections, rainfall observation data should be utilized through coordinating and cooperating with related agencies to immediately go on alert when rainfall exceeds standard levels or conduct road closures in order to avoid risk when the need arises. At the same time, it is important to clarify the relationship between rainfall and disaster occurrence through conducting statistical analysis. It is also necessary to reconstruct the setup for conducting the operation, maintenance and management of self-recording rain gauges.

### **4.2.2 Recommendations to JICA**

- In the Project for Road Disaster Prevention Measures on National Route 7, which is planned as a grant aid undertaking to start in 2015, a soft component targeting the ABC engineers is planned. In

this, it will be desirable to conduct technology transfer by making full use of the manuals and guides and other outputs of this Project.

- At the time of the ex-post evaluation, based on the history that the bridge maintenance system autonomously developed by ABC could not be fully utilized, ABC was seeking Japanese cooperation for introduction of the Bridge Management System that could not be implemented in the Project. Through introducing such a system, with a view to enabling ABC to further enhance bridge maintenance and management while utilizing the bridge inspection manuals prepared in the Project, it is desirable for JICA to consider ABC's request and examine possible cooperation regarding the introduction of the Bridge Management System and the training of ABC employees for its operation.

### **4.3 Lessons Learned**

#### Preliminary Explanations and Consensus Building regarding the Approach to Advancing the Technical Cooperation Project

In the Project, the activities did not start smoothly because there were differences of opinion between the ABC employees and the team of Japanese experts concerning how to advance the technical cooperation. JICA technical cooperation projects are intended to transfer technology based on joint work between the experts and counterparts, however, in this case the ABC side seemed to think that the team of Japanese experts are consultants contracted by JICA and all they need was that the consultants would produce the outputs. The team of Japanese experts and JICA explained the situation on numerous occasions, however, the initial misunderstanding was hard to rectify and made it difficult to secure ABC's cooperation when conducting joint activities for a long time after the Project started. Such misunderstanding could have been prevented if sufficient explanations and preliminary consensus building had been conducted in the preparatory stage. Therefore, before dispatching the team of Japanese experts, it is important for JICA to conduct adequate explanations and consensus building concerning the approach to advancing the technical cooperation project. Also, after the start of activities, it is important for the team of Japanese experts and counterparts to jointly advance work while maintaining communications on a daily basis.

#### Long-term Dispatch of Core Experts

In the Project, one of the factors that impeded communication between the team of Japanese experts and the counterparts was the fact that the experts were responsible for numerous fields of guidance and they were only dispatched for short periods. In technical cooperation projects such as this, which require numerous fields of expertise, it is important to smoothly conduct routine technical and operational liaison with counterparts based on long-term dispatches of experts who are knowledgeable in a wide range of technical fields and have good communication and coordination ability. In fields such as disaster prevention where there is not much history of international cooperation and it is hard to find experienced personnel on the Japanese side, it is necessary to avoid over-reaching through taking steps such as limiting the scope of cooperation and allowing plenty of time for the Project duration.

### Technology Dissemination Activities

The intended flow of technology transfer in the Project was from the team of Japanese experts to the UPD engineers, and then from the UPD to the other engineers of ABC. However, due to the frequent turnover of engineers and fact that hard copies of manuals and guides were not widely distributed to them, the extent of technology dissemination to other engineers was not sufficient. Therefore, in order to make the technology dissemination following the end of the Project more certain, it is considered important to print and distribute copies of manuals and guides within the Project, and after the Project to jointly examine with counterparts specific plans for disseminating technology within organizations. Also, in order to complement this flow, it is important for projects to take initiative in conducting more frequent technical training, seminars, etc. for engineers before the end of the projects.