



# Technical Assistance Report

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Project Number: 42524  
Capacity Development Technical Assistance (CDTA)  
June 2009

## Mongolia: Road Database Development Using Geographic Information System (Financed by Republic of Korea e-Asia and Knowledge Partnership Fund)

## CURRENCY EQUIVALENTS

(as of 1 June 2009)

Currency Unit	–	togrog (MNT)
MNT1.00	=	\$0.00070
\$1.00	=	MNT1,426.50

## ABBREVIATIONS

ADB	–	Asian Development Bank
DOR	–	Department of Roads
GIS	–	geographic information system
ICT	–	information and communication technology
ICTA	–	Information and Communication Technology Agency
ITS	–	intelligent transport system
MRTCUD	–	Ministry of Roads, Transport, Construction, and Urban Development
TA	–	technical assistance

## TECHNICAL ASSISTANCE CLASSIFICATION

<b>Type</b>	–	Capacity development technical assistance (CDTA)
<b>Targeting classification</b>	–	General intervention
<b>Sector (subsector)</b>	–	Transport and information and communication technology (transport management and policies)
<b>Theme (subtheme)</b>	–	Capacity development (institutional development)
<b>Location impact</b>	–	National (high)
<b>Partnership</b>	–	e-Asia Knowledge and Partnership Fund (the Government of Republic of Korea)

## NOTE

In this report, "\$" refers to US dollars.

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## I. INTRODUCTION

1. The Government of Mongolia has made significant efforts to develop information communication technology (ICT). In 2004 it established the Information and Communication Technology Agency (ICTA) under the direct auspices of the prime minister as the lead agency for ICT policies, coordination, and implementation. Mongolia's Parliament has endorsed the ICT Vision-2010 which aims to build up a citizen-centered, result-oriented, and market-based government by utilizing ICT through (i) back office development (record keeping, inventory, human resource management, finance and accounting, and budgetary works), (ii) front office development (providing services online), and (iii) tools to create more transparent government. With the assistance of the Government of Korea, the ICTA is constructing a government information data center. The center is expected to be completed in September 2009 and be connected with all government agencies and ministries by 2010. The ICT revolution is affecting all sectors of the economy in Mongolia and enabling new and improved business processes to be used for the delivery of products and services. Currently all *aimags* and *sums*<sup>1</sup> have internet access and cellular network coverage. There are eight communication service providers.

2. The Government has asked the Asian Development Bank (ADB) for technical assistance (TA) to upgrade the existing road database by applying a geographic information system (GIS). After a reconnaissance mission in November 2008, the Government of the Republic of Korea indicated its agreement to finance the TA in February 2009. This report is based on the understandings reached with the Government of Mongolia during the TA Fact-Finding Mission fielded in March 2009 on the impact, outcome, outputs, implementation arrangements, cost, financing arrangements, and terms of reference for consulting services for the TA,<sup>2</sup> and the mission's observations in the field. The design and monitoring framework is in Appendix 1.

## II. ISSUES

3. The demand for transport infrastructure in Mongolia has been increasing. Over the past decade great emphasis has been placed on expansion of the road network in the country. The current road network comprises 49,250 kilometers (km) of which 11,218 km are national roads. As of the end of 2008, there was 2,600 km of national paved roads. The growing road network requires proper maintenance to sustain the asset base, and there is a significant need to improve Mongolia's road asset management system. A sound road asset management system requires (i) a sufficiently detailed road database for planning and budgeting of maintenance works, (ii) a system for identifying and prioritizing maintenance works, and (iii) a system for optimal allocation of the given funds. Sound maintenance planning is a necessary condition for performance-based maintenance contracts and concessions that eventually increase private sector participation in the road sector and improve the quality of maintenance works.

4. The existing road database, developed in 2004 by the Government, stores data on the road inventory and limited data on national road conditions in the form of a Microsoft Excel spreadsheet. This database was not designed as a tool for maintenance planning and budgeting. Due to the type of database software, updating of data often takes a long time, and the database does not provide information on ongoing road works and road closures. As the database is not accessible to road users, travelers have no opportunity to use it to be informed in advance about road conditions.

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<sup>1</sup> An *aimag* is equivalent to a province; a *sum* is a local administrative subdivision within an *aimag*.

<sup>2</sup> The TA first appeared in the business opportunities section of ADB's website on 8 January 2009.

5. Road condition data acquisition equipment for assessing and/or measuring road surface roughness, pavement structure, and skid resistance was purchased during 1999–2002 under a World Bank-financed project. The Government started a road condition survey to assess and monitor the changes in road asset value in 2001, and completed data collection on 46.3% of the national road network. The Government also introduced a new process to utilize road condition data acquisition equipment for assessing the quality of newly built roads before opening them to the public. The Government has found this approach useful for evaluating the performance of contractors while expanding the road database by inputting the new data. However, most road condition data acquisition equipment is outdated and data collection has therefore fallen behind in recent years.

6. ICT has been recognized as an excellent way to improve the accuracy of information in the existing database and to disseminate road information to road users. Thus, the Government wishes to upgrade the existing database through the application of a GIS so that it can provide accurate information for sound maintenance planning and budgeting. It also aims to make the road information in the database accessible to road users through the internet. However, due to lack of funds and expertise, little progress has been made.

7. Mongolia's deteriorated roads are contributing to unsafe, inefficient, and uncomfortable travel. The proposed TA aims to assist the Government in addressing the issue by improving its road asset management system. The TA will (i) upgrade the existing database through the application of a GIS, (ii) initiate the process of sound maintenance planning and budgeting through demonstration of pilot activities on national paved roads, and (iii) enable a new e-service to road users by establishing a web server in Mongolia. The Government understands the importance of sustainability of the upgraded database and the data center and web server and is committed to provide adequate human and financial resources for their maintenance and operation.

8. ADB has been a key external development partner for the Mongolian transport sector. In 2008, the Independent Evaluation Department evaluated ADB's sector assistance program in Mongolia over the period 1993–2007. The assessment concluded that ADB's support for the road sector was successful, and suggested giving more attention to strengthening the road maintenance regime. Such recommendations are reflected in the forms of the proposed TA on addressing the need to improve road maintenance planning and budgeting. It is envisaged that future ADB support will build on the outputs of this TA to (i) monitor and appraise the effective use of the improved database, and (ii) help the Government to improve the three dimensions of the maintenance regime—planning, funding, and execution. The proposed TA is consistent with (i) Mongolia's development priorities for improving public asset inventory through promoting ICT as a tool to create more transparent government; and (ii) ADB's strategy which focuses on assistance to institutional strengthening, and efficient delivery of public services.<sup>3</sup>

### **III. THE TECHNICAL ASSISTANCE**

#### **A. Impact and Outcome**

9. The impact of the TA will be improved road maintenance management in Mongolia. The outcome of the TA will be an improved road asset management system.

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<sup>3</sup> ADB. 2009. Country Operations Business Plan: Mongolia 2009–2012. Manila (still under preparation).

## **B. Methodology and Key Activities**

10. The output of the TA will be (i) a GIS-based road database providing real-time information about road conditions to the Government and road users, (ii) a data center and web server, and (iii) a policy note and technical papers for strengthening the institutional capacity of the Department of Roads (DOR) for road asset management.

11. **Upgrading the Existing Road Database.** The TA will upgrade the existing database in four stages: (i) preparation stage (assess the quality of the current database, identify additional information, and identify entities between which data flows to determine the database format), (ii) field survey stage (collect additional data and information on about 11,200 km of national roads and road condition data on about 2,600 km of national paved roads); (iii) desk work stage (customize the software purchased under the TA to meet the database requirement, calibration of the survey outputs, and input the data into the database); and (iv) quality control (monitor operation of the database and take corrective actions as needed).

12. **Establishing a Data Center and Web Server.** Under the TA, hardware, software, and other equipment necessary for a data center/web server will be procured, and system architecture for a data center/web server to exchange data and information between the government agencies and the users will be developed. It is expected that the road data center/web server will be located in the Government Information Data Center and be maintained by the Government.

13. **Strengthening Institutional Capacity.** Under the TA, strengthening of the institutional capacity of the DOR for road asset management through (i) producing various technical papers on routine and periodic maintenance, (ii) introducing a road condition survey on a pilot basis, and (iii) preparing a medium-term plan on maintenance works for the national paved roads, will occur. Operating policies and procedures of the database and the data center and web server, as well as a policy note on deployment of intelligent transport systems in the country, will be developed under the TA. As broader and collective support is required from the stakeholders—State Property Committee (the owner of the road network); Ministry of Roads, Transport, Construction and Urban Development (MRTCUD); Ministry of Finance; DOR; ICTA; and communication service providers—for developing and maintaining a database and a data center/web server, a management structure and partnership arrangements to ensure sustainability will be formulated. Under the TA, focus group discussions, stakeholder meetings, need assessment workshop, and a training program on the asset management system and the use and maintaining of the database and the data center/web server will be conducted. It is expected that students of the Road Faculty of the Mongolian University of Science and Technology will be involved in undertaking pilot activities such as conducting the road condition survey, calibrating the survey outputs, inputting the data into the database, and preparing a medium-term maintenance plan for national paved roads.

## **C. Cost and Financing**

14. The TA is estimated to cost \$600,000, of which the Government has requested ADB financing of \$500,000 (Appendix 2), which will be financed on a grant basis by the Republic of Korea e-Asia and Knowledge Partnership Fund. The Government will finance the balance equivalent to \$100,000 in kind by providing counterpart staff, office facilities, and other support services required in implementing the TA.

#### D. Implementation Arrangements

15. The MRTCUD will be the executing agency, and the DOR will be the implementing agency. A project steering committee has been established under the MRTCUD. Its members include a project coordinator; government officials from the Ministry of Finance, MRTCUD, ICTA; and the Administration of Land Affairs, Geodetic and Cartography. It will discuss and resolve issues that arise during TA implementation and oversee progress. The DOR has appointed a project coordinator to (i) supervise day-to-day activities of the consultants, (ii) assist the consultants in undertaking their services by providing information and data, (iii) arrange meetings and workshops, (iv) liaise with the project steering committee and various government agencies and organizations, and (v) report activities to ADB and the Government.

16. The TA will require 42.5 person-months of consulting services (4.5 person-months international and 38 person-months national) to carry out the work as defined in the terms of reference in Appendix 3. ADB will engage a national consulting firm using biodata technical proposal procedures and the quality and cost-based selection method based on the standard quality–cost ratio of 80:20; and two individual international consultants using the individual consultant selection method in accordance with ADB's *Guidelines on the Use of Consultants* (2007, as amended from time to time). The international maintenance expert (3 person-months) will have expertise in GIS-based road database management and road asset management systems, and the international information technology expert (1.5 person-months) will have expertise in the development of system architecture and intelligent transport systems.

17. The international maintenance expert's services will be provided in two stages. In the beginning of the TA the expert will be fielded at least a month earlier than the national consultants to (i) design the road database system, (ii) develop specifications for hardware and software and road condition data acquisition equipment, (iii) help the national consultants in procuring equipment, (iv) procure database software, (v) prepare guidelines for carrying out field surveys and measuring road conditions, and (vi) outline institutional improvements for the road asset management system. In a later stage the expert will (i) help the national consultants in calibrating database software and the survey outputs, and inputting the data into the database; and (ii) monitor operation of the database and take corrective actions as needed. The international information technology expert's input is required for a continuous period of 1.5 months; the expert will also start his or her services ahead of the national consultants to undertake the tasks described in the terms of reference. At the end of their services the experts will produce short reports and organize workshops to discuss their findings and recommendations with the project steering committee. A national consulting firm will undertake field surveys, customize software, upgrade the database, and establish a data center and web server.

18. The TA will finance the procurement of road condition data acquisition equipment (about \$47,000), software for the database (about \$80,000), hardware for the data center and web server and other equipment (about \$17,000), and office equipment (about \$5,000). The equipment, except for the database software, is expected to be procured through the shopping procedure. As off-the-shelf software is readily available and obtainable from limited sources, and taking into consideration procurement efficacy and efficiency, it is anticipated that the GIS-based software for the database will be procured through the single source selection method. The consultants will procure hardware, software, and equipment in accordance with ADB's *Procurement Guidelines* (2007, as amended from time to time), and will turn them over to the DOR after completion of the TA.

19. The proposed TA will be implemented over a 14-month period, with expected commencement in mid-June 2009 and completion by August 2010. ADB approved advance contracting on 28 April 2009; this includes posting the consultant selection recruitment notice, short-listing, and requesting and evaluating proposals. The advance contracting will be undertaken in accordance with ADB's *Guidelines on the Use of Consultants*.

20. The proceeds of the TA will be disbursed in line with ADB's *Technical Assistance Disbursement Handbook*.<sup>4</sup>

21. As the TA will promote an innovative development initiative with the potential for future replication, it will be important to closely evaluate the performance of the project and gather useful lessons learned during implementation. In this regard, the expected outputs and outcome will be monitored by ADB review missions and reports to be produced during implementation. The technical papers for improving road asset management and policy note are expected to be disseminated through workshops, seminars, and ADB knowledge products.

22. As defined in the terms of reference, the international and national consultants will prepare reports on their activities and submit them to ADB and the Government. The international consultants will prepare short reports on their activities at the end of the services. The national consultants will submit an inception report within 1 month after the TA starts, monthly reports within 2 weeks of the following months, an interim report within 6 months after the TA starts, a draft final report within 13 months after the TA starts, and a final report within 14 months after the TA starts. The final report should attach all documents produced by both the international and national consultants under the TA: (i) the various technical papers for improving the road asset management system, (ii) a medium-term plan for maintenance of the national paved roads, (iii) a policy note for deploying an intelligent transport system, (iv) manuals and procedures for operating and maintaining of the database and the data center and web server, and (v) reports on the training and workshops organized during TA implementation including training programs, handouts, and lists of attendances.

#### **IV. THE PRESIDENT'S DECISION**

23. The President, acting under the authority delegated by the Board, has approved ADB administering technical assistance not exceeding the equivalent of \$500,000 to the Government of Mongolia to be financed on a grant basis by the Republic of Korea e-Asia and Knowledge Partnership Fund for the Road Database Development Using Geographic Information System, and hereby reports this action to the Board.

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<sup>4</sup> ADB 2008. *Technical Assistance Disbursement Handbook*. Manila.

## DESIGN AND MONITORING FRAMEWORK

Design Summary	Performance Targets and/or Indicators	Data Sources and/or Reporting Mechanisms	Assumptions and Risks
<p><b>Impact</b> Improved road maintenance management in Mongolia</p>	<p>Maintenance planning and budgeting is based on the database by 2011.</p>	<p>Government statistics</p>	<p><b>Assumption</b> The Government commits to using the GIS-based decision support tool.</p> <p>The Government decides to use a performance-based contract.</p>
<p><b>Outcome</b> Road asset management system is improved</p>	<p>A GIS-based database is fully functional by 2010.</p> <p>A system for prioritizing maintenance works, costing of interventions, and scheduling of works is operational by 2010.</p>	<p>MRTCUD annual report</p> <p>ADB missions</p>	<p><b>Assumption</b> The Government will continue to collect road condition data.</p>
<p><b>Outputs</b></p> <ol style="list-style-type: none"> <li>1. A GIS-based accurate and timely road database providing real-time information about road conditions to the Government and road users is established.</li> <li>2. Data center and web server are operational.</li> <li>3. A policy note and technical papers are developed.</li> </ol>	<p>Starting in 2010, annual report on roads and road conditions is submitted to MRTCUD.</p> <p>Information on road condition is put on the website by 2010, and updated daily.</p> <p>Beginning in 2011, the annual budget for updating database is allocated.</p> <p>By 2010 computers and software are operational.</p> <p>A policy note for deployment of ITS is submitted to ADB and the Government by September 2009.</p> <p>A policy note on deployment of ITS is prepared by September 2009.</p> <p>Guidance on institutional improvements for the road asset management system is developed by September 2009.</p>	<p>Final TA report</p> <p>Data center and web server annual performance report</p> <p>TA consultants' reports</p>	<p><b>Assumption</b> Government Information data center is connected with the Government agencies and ministries by 2010.</p> <p><b>Risk</b> Limited coverage of cellular network in some areas.</p>

Design Summary	Performance Targets and/or Indicators	Data Sources and/or Reporting Mechanisms	Assumptions and Risks
	<p>A rule-based manual for planning and budgeting of routine and periodic maintenance works is developed by August 2010.</p> <p>A medium-term plan on maintenance works for the national paved roads is prepared by August 2010.</p> <p>An operating policy and procedure of the database is developed by August 2010.</p> <p>A management structure and partnership arrangements among stakeholders for operation and maintenance of the data center and web server are developed by September 2009.</p> <p>Meetings to discuss the findings and the recommendations of the policy note and technical papers are held with PSC by September 2009 and August 2010.</p> <p>Workshops on carrying out survey, and calibrating the survey output by August 2009 and inputting the data into the database by February 2010.</p>		
<p><b>Activities with Milestones</b></p> <ol style="list-style-type: none"> <li>1.1 Assess the quality of the current database, identify additional information, and identify entities between which data flows within 2 months of starting the TA.</li> <li>1.2 Carry out stakeholder meetings to assess in-depth needs for the improved database within 2 months of starting the TA.</li> <li>1.3 Determine format of database within 3 months of starting the TA.</li> <li>1.4 Procure hardware, software, and road condition data acquisition equipment necessary for the database and field survey within 3 months of starting the TA.</li> <li>1.5 Customize the software to meet the database requirement within 8 months of starting the TA.</li> <li>1.6 Carry out surveys to collect road inventory data on about 11,000 km of national roads, and road condition data on about 2,600 km of national paved roads within 6 months of starting the TA.</li> <li>1.7 Calibrate the survey outputs and input the data into the database within 10 months of starting the TA.</li> <li>1.8 Monitor operation of the database and take corrective actions as needed during TA implementation.</li> </ol>			<p><b>Inputs</b></p> <p>ADB grant financed by Republic of Korea e-Asia and Knowledge Partnership Fund: \$500,000</p> <p>Government: \$100,000</p> <p>Software/hardware/equipment : \$149,000</p> <p>4.5 person-months of international consulting services</p> <p>38 person-months of</p>

Activities with Milestones	Inputs
<p>2.1 Carry out focus group discussions to identify requirements for establishing a data center and web server within 2 months of starting the TA.</p> <p>2.2 Procure hardware and other equipment necessary for the data center and web server within 3 months of starting the TA.</p> <p>2.3 Develop system architecture and establish a data center and web server within 10 months of starting the TA.</p> <p>3.1 Develop operating policy and procedure of the database within 14 months of starting the TA.</p> <p>3.2 Review current status of deployment and the future perspective of an ITS in Mongolia and prepare a policy note on deployment of an ITS within 3 months of starting the TA.</p> <p>3.3 Assess the efficiency of the current planning and budgeting processes of maintenance works and outline institutional improvements for the road asset management system, including a training program on maintenance management, within 3 months of starting the TA.</p> <p>3.4 Develop a rule-based manual for identification, costing, and prioritization of maintenance works; and prepare a medium-term plan on maintenance works for national paved roads within 14 months of starting the TA.</p> <p>3.5 Develop operating policy and procedure of the database within 14 months of starting the TA.</p> <p>3.6 Formulate management structure and partnership arrangements among stakeholders for operation and maintenance of the data center and web server within 3 months of starting the TA.</p> <p>3.7 Conduct workshops and seminar on carrying out survey, calibrating the survey output, inputting the data into the database, and use and maintaining of the database and the data center and web server during TA implementation.</p> <p>3.8 Conduct focus group discussion and stakeholder meeting to disseminate the results during TA implementation.</p>	<p>national consulting services</p> <p>Survey:\$51,000</p> <p>Training and workshops:\$4,000</p>

ADB = Asian Development Bank; GIS = geographic information system; ITS = intelligent transport system; km = kilometer; MRTCAD = Ministry of Roads, Transport, Construction and Urban Development; PSC = project steering committee; TA = technical assistance.

**COST ESTIMATES AND FINANCING PLAN**  
(\$'000)

Item	Total Cost
<b>A. Republic of Korea e-Asia and Knowledge Partnership Fund<sup>a</sup></b>	
1. International Consultants	
a. Remuneration and Per Diem	90.00
b. International and Local Travel	13.20
c. Others	
i. Reports	1.40
ii. Translation	7.00
iii. Communications	0.40
iv. Software for road database <sup>b</sup>	80.00
d. Training and/or Workshops	1.00
e. Miscellaneous Administration and Support Costs	2.00
f. Contingencies	4.00
2. National Consultants	
a. Remuneration and Per Diem	129.00
b. Local Travel	4.80
c. Others	
i. Reports	4.00
ii. Translation	8.30
iii. Communications	0.90
d. Equipment <sup>c</sup>	
i. Office	5.00
ii. Hardware/software for data center/web server	17.00
iii. Road condition data acquisition	47.00
e. Training and/or Workshops	3.00
f. Surveys	
i. Paved road condition survey	22.00
ii. Road inventory data survey	29.00
g. Miscellaneous Administration and Support Costs	9.00
h. Contingencies	17.00
3. Representatives for Contract Negotiations	5.00
<b>Subtotal (A)</b>	<b>500.00</b>
<b>B. Government Financing</b>	
1. Office Accommodation	60.00
2. Remuneration and Per Diem of Counterpart Staff	20.00
3. Contingencies	20.00
<b>Subtotal (B)</b>	<b>100.00</b>
<b>Total</b>	<b>600.00</b>

<sup>a</sup> Administered by the Asian Development Bank.

<sup>b</sup> Software (\$80,000) will be procured using single source selection method.

<sup>c</sup> Office computers, printer, and facsimile machine (\$5,000); equipment for data center/web server such as hardware and software, firewall, router, uninterruptible power supply, etc. (\$17,000); and road condition data acquisition equipment (\$47,000) will be procured using shopping procedure.

Source: Asian Development Bank estimates.

## OUTLINE TERMS OF REFERENCE FOR CONSULTANTS

1. The technical assistance (TA) will require about 42.5 person-months of consulting services (4.5 person-months international and 38 person-months national) spread over a period of 14 months, including fieldwork. The consultants will be engaged by the Asian Development Bank (ADB) in accordance with its *Guidelines on the Use of Consultants* (2007, as amended from time to time). The international consultants will be recruited through the individual consultant selection method. The national consulting firm will be selected using the biodata technical proposal procedures and quality and cost-based selection method based on the quality–cost ratio of 80:20.

### A. International Consultants (4.5 person-months)

2. The international consultants will be engineers with 15 years of experience. The international maintenance expert (3 person-months) will have expertise in geographic information system-based road database management and road asset management system. The international information and communication technology (ICT) expert (1.5 person-months) will have expertise in the development of system architecture and intelligent transport systems (ITSs). The international maintenance expert's services will be provided in two stages. In the beginning of the TA, the maintenance expert will be fielded at least a month earlier than the national consultants for a continuous period of 2 months to design the road database format; help the national consultants and the Government in procuring hardware, software, and equipment; prepare guidelines for carrying out field surveys; and outlines of institutional improvements for road asset management. In a later stage the expert will help the national consultants in customizing database software, calibrating the survey outputs, inputting the data into the database, and preparing a rule-based manual for planning and budgeting of routine and periodic maintenance works, a medium-term plan for maintenance of the national paved roads, and an operating policy and procedure for the database. The ICT expert will start the services a month ahead of the national consultants for a continuous period of 1.5 months to undertake the tasks described in section 2 below. At the end of their services the experts will produce short reports and organize workshops to discuss their findings and recommendations with the Ministry of Finance; Ministry of Roads, Transport, Construction, and Urban Development (MRTCUD); Department of Roads (DOR); Information and Communication Technology Agency; and Administration of Land Affairs, Geodetic and Cartography. The tasks to be carried out by the experts will include but not be limited to the following:

#### 1. Maintenance Specialist (3 person-months)

- (i) assess current planning and budgeting processes of maintenance works, and outline institutional improvements for the road asset management system including training program for MRTCUD and DOR staff on maintenance management;
- (ii) assess the quality of the current database, identify additional information, and identify entities between which data flows;
- (iii) carry out stakeholder meetings to assess in-depth needs for the improved database and provide guidance to the national consultants for design of database format, and ensure compatibility of the database with asset management system applications and processes;
- (iv) develop specifications for hardware and software and road condition data acquisition equipment;

- (v) help the national consultants in procuring equipment, and procure database software;
- (vi) prepare guidelines for carrying out field surveys and measuring road conditions including survey plans and field implementation manuals, and conduct training on the use of the guidelines and manuals;
- (vii) help the national consultants in customizing the database software to meet the database requirement;
- (viii) undertake quality control on calibration of the surveys outputs and inputting the data into the database;
- (ix) monitor operation of the database and take corrective actions as needed;
- (x) help the national consultants develop an operating policy and procedure for the database to ensure sustainable operation of the database;
- (xi) prepare a rule-based manual for identification, costing, and prioritizing maintenance works;
- (xii) help the national consultants in preparing a medium-term plan on maintenance works for national paved roads; and
- (xiii) conduct stakeholder meetings to discuss the findings and recommendations for improving the road asset management system.

**2. Information and Communication Technology Specialist (1.5 person-months)**

- (i) carry out focus group meetings to identify requirements for establishing a data center and web server;
- (ii) assist the maintenance specialist in developing specifications for hardware and software for the database and data center and web server;
- (iii) provide guidance to the national consultants for architecture design of the data center and web server;
- (iv) formulate a management structure and partnership arrangements among stakeholders to ensure sustainable operation and maintenance of the data center and web server;
- (v) review current status of deployment and the future perspective of deploying an ITS; identify key issues and problems in deploying an ITS (shortage of funds, lack of knowledge, lack of technology, and not enough trained people); and
- (vi) develop a policy note for deployment of an ITS including priority of deployment of ITS fields, such as traveler information, traffic management, demand management, road management, advanced driving assistance, electronic transactions, commercial vehicle management, public transport management, and incident and hazard response (standards need to be applied to meet interoperability requirements); and the approach to be used for deploying an ITS.

**B. National Consultants (38 person-months)**

3. A national consulting firm will undertake field surveys, customize software, upgrade the database, and establish a data center and web server. The national consultants must be highway, geodetic, and ICT engineers with 10 years of experience in road maintenance management, topographic surveying, software customization, and system architecture development. The tasks to be carried out by the consultants will include but not be limited to the following:

### 1. **Team Leader and Highway Engineer** (12 person-months)

4. The team leader will closely coordinate with ADB, MRTAUD, DOR, and the international consultants for undertaking the tasks to be carried out by the national consultants. The team leader will be responsible for (i) timely procurement of office equipment, road condition data acquisition equipment, and hardware and software for the data center and web server; (ii) timely commencement and completion of the field surveys and desk work; (iii) dissemination of the TA outputs; and (iv) timely reporting of TA implementation progress. The team leader will also (i) supervise and coordinate day-to-day TA activities, including monitoring progress, resolving problems, and liaising with the government agencies and communications service providers; (ii) together with the international maintenance specialist, monitor operation of the database and take corrective actions as needed; (iii) with the help of international and national maintenance specialists, prepare a medium-term plan on maintenance works for the national paved roads and an operating policy and procedure of the database to ensure sustainable operation of the database; and (iv) in consultation with the international consultants, organize and conduct focus group meetings, stakeholders discussions, and workshops to disseminate the TA results.

### 2. **Maintenance Specialists** (8 person-months)

5. The specialist will be responsible for (i) field survey to collect road inventory data on about 11,000 kilometers (km) of national roads using a geographic positioning system including road alignment, geometry, drainage structure, and roadside facilities; (ii) coordinating with the Road Faculty of the Mongolian University of Science and Technology for organizing and undertaking the road condition survey on about 2,600 km of national paved roads; (iii) calibrating the survey outputs; (iv) inputting the data; and (v) importing and inputting other required data, such as date of construction, traffic, maintenance cost, and dangerous locations, into the database. The specialist will ensure the surveys are carried out in accordance with the guidelines, the manuals, and the plans for conducting the field survey prepared by the international maintenance expert. Together with the highway engineer, the maintenance specialist will prepare a medium-term plan on maintenance works for the national paved roads, and help the international experts in developing an operating policy and procedure of the database.

### 3. **Geodetic Engineers** (two engineers, each 4 person-months)

6. The engineers will (i) organize and undertake field survey for collecting additional data and information on about 11,200 km of national roads; (ii) calibrate the survey outputs; and (iii) input the data into the database. The engineers will use the guidelines, the manuals, and the plans for conducting the field survey prepared by the international maintenance expert.

### 4. **Information and Communication Technology Specialists** (system architect, 1.5 person-months; senior ICT specialist, 1.5 person-months; and ICT specialist, 5 person-months)

7. The specialists will (i) provide input to the international consultants in identifying entities and interfaces between which data flows, (ii) identify database format, (iii) customize the software to meet the database requirement, (iv) develop system architecture for a data center and web server to exchange data and information between the government agencies and users, (v) create a user-friendly web application aggregating information on the roads and road conditions, and (vi) establish a data center and web server. The specialists will provide inputs to the international consultants for formulating a management structure and partnership

arrangements among stakeholders for operation and maintenance of the data center and web server.

#### **5. Computer-Aided Design Engineer (2 person-months)**

8. The engineer will (i) import the data from the existing database into the new database; and (ii) input other data such as traffic, maintenance cost, and black spot locations into the database.

#### **C. Reporting and Workshops**

9. The national consultants will submit the following reports to ADB: (i) inception report within 1 month after the TA starts, (ii) monthly reports within 2 weeks of the following months, (iii) interim report within 5 months after the TA starts, (iv) draft final report within 11 months after the TA starts, and (v) final report within 12 months after the TA. Four copies of each report in English and Mongolian are required for the Ministry of Finance, MRTAUD, DOR, and the Information Communication Technology Agency; and four CD-ROMs containing the final report. ADB requires two copies of each report in English and three CD-ROMs containing the final report. The final report should attach

- (i) a policy note for deployment of an ITS;
- (ii) guidance on institutional improvements for road asset management;
- (iii) a rule-based manual for identifying, costing, and prioritizing maintenance works;
- (iv) a management structure and partnership arrangement among stakeholders for operation and maintenance of the data center and web server developed by the international consultants;
- (v) a medium-term plan for maintenance of the national paved roads and an operating policy and procedure of the database jointly developed by the international and the national consultants; and
- (vi) reports on the training and workshops organized during TA implementation—including training programs, handouts, and lists of attendances—and the guidelines, manuals, and plans for conducting field surveys.