Government of Nepal

Ministry of Physical Infrastructure and Transport

Department of Transport Management

NEPAL INDIA REGIONAL TRADE AND TRANSPORT PROJECT (NIRTTP)

SUB-PROJECT OFFICE

Road Transport Safety and Axle Load Control Study in Nepal

Part A: Road Transport Safety

TASK-A6

ROAD ACCIDENT INFORMATION MANAGEMENT SYSTEM

Submitted by:

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in association with

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ACRONYMS AND DISAMBIGUATION

ALC	Axle Load Control
ALC-MIS	Axle Load Control – Management Information System
CDO	Chief District Officer
CIREN	Crash Injury Research and Engineering Network
CRRI	Central Road Research Institute
DB	Database
DDC	District Development Committee
DoLIDAR	Department of Local Infrastructure Development and Agricultural Roads
DoR	Department of Roads
DoTM	Department of Transport Management
DTPO	District Traffic Police Office
FARS	Fatality Analysis Reporting System
FIR	First Information Report
FNNTE	Nepal National Transport Entrepreneurs
FTTEN	Federation of Tipper and truck Entrepreneurs of Nepal
GDP	Gross Domestic Product
GEC	General Estimates System
GoN	Government of Nepal
ICT	Information and Communication Technology
IIT	Indian Institute of Technology
IRC	Indian Road Congress
ITPO	Ilaka Traffic Police Office
MoPIT	Ministry of Physical Infrastructure and Transport (Nepal)
MVTMA	Motor Vehicle and Transport Management Act-1993
MVTMR	Motor Vehicle and Transport Management Rule-1997
NASS	National Automotive Sampling System
NIRTTP	Nepal India Regional Trade and Transport Project
NRs.	Nepalese Rupees
PDO	Property Damage Only
PSU	Primary Sampling Unit
QALY	'Quality Adjusted Life Year
RTA	Road Traffic Accident
RTU	Road and Traffic Unit
SRN	Strategic Road Network
TESU	Traffic Engineering and Safety Unit
ToR	Terms of Reference
TPD	Traffic Police Directorate

TRL	Transport Research Laboratory
UK	United Kingdom
UN	United Nations
US	United States
USD	United States Dollar
VDC	Village Development Committee
VFTC	Vehicle Fitness Testing Center
VOC	Vehicle Operating Cost
VOSL	value of statistical life
WB	World Bank
WHO	World Health Organization
WTP	Willingness to Pay

EXECUTIVE SUMMARY

RTA is becoming global issue of public health. It has greater impact to the society, as well as on the GDP. Further, it is getting high priority issue of transport management. Global initiation for the prevention and reduction of RTA has also been initiated by UN WHO by the declaration of "Decade of Action for Road Safety". In this regard, GoN has recently approved the 'Road Safety Action Plan'. In this aspect of road safety, there are five pillars to address such as: Road Safety Management, Safer Roads and mobility, safer vehicles, Safer Road Users and Post-Crash Response.

Road accident reporting, and maintaining the database and application of this database are very essential for planning, designing and monitoring the road safety programs. The objective of the study is to identify an adequate road accident database management system. The specific objectives of the study are to:

- To review of the existing accident recording practices in Nepal and abroad;
- To develop the conceptual framework of an adequate road accident information management system;
- To prepare terms of reference for the consultancy services to establish the proposed road accident information management system;
- To initiate the conceptual recommendations on road accident cost, road accident investigation and compensation of victims;

The consultant conducted the multi-disciplinary approach for analysis as well as finalizing the recommendation on the scope of the Study. The Study outcomes are summarized as:

a. Existing Road Traffic Accident reporting and recording system by the Traffic Police needs to improve and must be implemented with the application ICT. The accident recording can be eased by the application of mobile devices which are connected to the central database system.
b. The initiation to establish the 'Road Accident Information Management System (RA-IMS)' should be taken by DoTM. This should include the capacity enhancement of Traffic Police and DoTM officials.

c. The Terms of References (ToR) for the procurement of qualified consultant and supply of equipments for establishing the system has been prepared and attached in the Appendix-1 and Appendix -2 of the report.

d. Accident costing approaches have been recommended based on the international practices and national characteristics.

e. Accident investigation is one of the major technical aspects to be conducted for finding the causes of road accident and proposing the countermeasures. The consultant team has recommended the approaches for the investigation of RTA.

f. Compensation of road accident victims is always troublesome for authorities due to the improper investigation system, and imperfect insurance provision in the legal framework.

मूख्य संक्षेप

सडक दुर्घटना आजको परिप्रेक्षमा जनस्वास्थमा पर्ने महत्वपूर्ण समस्याको रुपमा देखा परेको छ । यसले विश्वव्यापी रुपमा सामाजिक तथा आर्थिक पक्षलाई अधिकतम भार थपेको छ। साथै सडक दुर्घटना यातायात व्यवस्थाको महत्वपूर्ण रुपमा पनि रहेको छ। अन्तर्राष्ट्रिय रुपमा यस समस्याको समाधानका लागि प्रयासहरु जारी छन्- , जसमध्ये राष्ट्रसंघीय विश्व स्वास्थ्य संगठन अन्तरगत "Decade of Action for Road Safety" (सडक सुरक्षा दशक -२०११-२०२०) भन्ने अभियान शुरु गरेको छ। यस अभियानमा सडक सुरक्षालाई प्रमुख पाँच पक्षमा विभाजित गरी अध्ययन, विश्लेषण र कार्यक्रमहरुको योजना बनाई सडक सुरक्षाको स्थितीमा सुधार गर्नु पर्ने विषयमा जोड दिएको पाइन्छ।

सडक सुरक्षाका प्रमुख पाँच पक्षहरु :-

- सडक सुरक्षाको व्यवास्थापन
- सुरक्षित सडक र यातायात प्रवर्द्धन
- सुरक्षित सवारीसाधन
- सुरक्षित सडक प्रयोग कर्ता
- दुर्घटना प्रश्चातको व्यवस्थापन

सडक सुरक्षा कार्यक्रमहरुको योजना तर्जूमा गर्दा होस- वा अत्यधिक दुर्घटना हुने सडकमा दुर्घटनाको न्यूनीकरण गर्न पूर्व सडक दुर्घटनाको तथ्यांक वा अभिलेख अति महत्वपूर्ण हुनजान्छ। त्यसैले सडक दुर्घटनाको सूचना संकलन तथा सुचनाहरुको डेटावेस तयार गर्नु पर्ने अन्तरराष्ट्रिय प्रचलन अनुसार यसलाई सडक सुरक्षाको महत्वपूर्ण कदमका रुपमा लिइन्छ।

यस परिप्रेक्षमा, यातायात व्यवस्था विभागले सडक दुर्घटनाका तथ्यांक सम्बन्धी "सडक दुर्घटना सुचना व्यवस्थापन प्रणाली" स्थापना गर्नका लागि आवस्यक पर्ने पूर्व तयारीको प्रयास अनुरुप यो अध्ययन गराइएको छ।

सडक दुर्घटना सम्बन्धी सूचना वा तथ्यांक संकलन गर्नका लागि अत्याधिक रुपमा सूचना प्रविधीको प्रयोग गरि वैज्ञानिक आधारको डेटावेस तयार गर्नुपर्ने देखीएकोले यस अध्ययनका उद्देश्यहरु यस प्रकार राखीएका छन :

- नेपालमा प्रचलित सडक दुर्घटनाका तथ्याङ्कहरुको संकलन तथा व्यवस्थापन पद्धतिको पुनरावृत्ति गर्नु।
- नेपालमा लागि उपयुत्त हुने सूचना प्रविधीको प्रयोग गरि सडक दुर्घटनाका सूचना संकलन तथा व्यवस्थापन गर्न उपयुक्त डेटावेस स्थापनाको लागि शिफासि गर्ने।

- सो सडक दुर्घटना सम्बन्धी सूचना संकलन गर्ने डेटावेस तयार गर्नका लागि सफ्टवयर बनाउन परामार्शदाताको लागि कार्यसूची तयार गर्ने ।

यसै अध्ययनको कार्यसूचीमा उल्लेख भए अनुसार परमर्शदाताले सम्पूर्ण पक्षहरुको सर्वेक्षण, पूनरावृत्ति आदि सम्पन्न गरि निम्न कुराहरुमा सडक दुर्घटना सम्बन्धका विभिन्न पक्षहरुलाई निम्न अनुसार निष्कर्ष तथा सिफारिस पेश गरेको छ ।

क) सडक दुर्घटना सम्बन्धीको सूचना संकलन गर्न र यसलाई वैज्ञानिक रुपमा डेटावेस बनाउनका लागि हाल प्रचलित व्यवस्था (कागजी प्रकृया) लाई तुरुन्त सूचना प्रविधीमा आधारित सडक दुर्घटना सुचना व्यवस्थापन प्रणाली को स्थापना गर्नुपर्ने हुन्छ ।

ख) "सडक दुर्घटना सूचना व्यावस्थापन प्रणाली" को स्थापना गर्नका लागि यातायात व्यवस्था विभाग र ट्राफिक प्रहरी तथा अन्य सरोकारवाला संस्थाहरुसंग सहकार्य गरि उक्त प्रणालि स्थापना गर्नका लागि कार्ययोजना तयार गर्नुपर्ने देखिन्छ ।

ग) उक्त प्रणाली स्थापना गर्न परामर्शदाता छनोट गर्नका लागि तयार गर्नुपर्ने कार्यसूची यस प्रतिवेदनमा पेश गरिएकोछ ।

घ) सडक दुर्घटनाको आर्थिक क्षति आंकलन गर्नका लागि नेपालको परिप्रेक्षमा उपयुक्त हुने पद्धती यस प्रतिवेदनमा पेश गरिएको छ ।

ङ) सडक दुर्घटनाको अध्ययन अनुसन्धानका लागि वैज्ञानिक रुपमा गराउने प्रचलनको विकास गर्नका लागि सरोकारवाला संस्थाहरुको सहकार्यमा यसबारे निर्देशिका तयार गरि लागु गर्नुपर्ने देखिन्छ ।

च) सडक दुर्घटनाको क्षतिपुर्ति सम्बन्धी व्यवस्था औचित्यपूर्ण र वैज्ञानिक बनाउनका लागि विमा प्रणलीलाई प्रभाावकारी रुपमा लागु गर्नुपर्ने हुन्छ ।

CHAPTER 1 INTRODUCTION

1.1 BACKGROUND

Road Traffic Accident (RTA) is major public health problem and a leading cause of death and injury around the world. Poorly maintained road network and vehicle fleets, weak regulatory environment, and undefined roles and responsibilities of various stakeholders towards road transport safety are favorable circumstances for increasing trend in road accidents and fatalities in the developing countries. Each year nearly 1.3 million people die and millions more are injured or disabled as a result of road crashes, mostly in low and middle income countries. As well as creating enormous social costs for individuals, families and communities, road traffic injuries place a heavy burden on health services and economies. The cost to countries, many of which already struggle with economic development, may be as much as 1–2% of their gross national product. As motorization increases, preventing road traffic crashes and the injuries they inflict will become an increasing social and economic challenge, particularly in developing countries. If present trends continue, road traffic injuries will increase dramatically in most parts of the world over the next two decades, with the greatest impact falling on the most vulnerable citizens. Appropriate and targeted action is urgently needed.

The World report on road traffic injury prevention, launched jointly in 2004 by the World Health Organization and the World Bank, identified improvements in road safety management and specific actions that have led to dramatic decreases in road traffic deaths and injuries in industrialized countries active in road safety. The use of seat-belts, helmets and child restraints, the report showed, has saved thousands of lives. The introduction of speed limits, the creation of safer infrastructure, the enforcement of limits on blood alcohol concentration while driving, and improvements in vehicle safety are all interventions that have been tested and repeatedly shown to be effective. The World report on road traffic injury prevention also identified the importance of collecting accurate, reliable data on the magnitude of the road traffic injury problem: it highlighted the need for data systems to be put in place to collect the information needed to allow countries to develop evidence-driven road safety policies. The international community must now take the lead to encourage good practice in road safety. To this effect, the United Nations General Assembly adopted a resolution on 14 April 2004 urging that greater attention and resources be directed towards the global road safety crisis. Resolution 58/289 on 'Improving Global Road Safety' stressed the importance of international collaboration in the field of road safety. Two further resolutions (A/58/L.60 and A/62/244), adopted in 2005 and 2008 respectively, reaffirmed the United Nations' commitment to this issue, encouraging member countries to implement the recommendations of the World report on road traffic injury prevention. In November 2009, ministers and heads of delegations to the First Global Ministerial Conference on Road Safety echoed these calls with the adoption of the Moscow Declaration,

resolving to take a number of actions to improve road safety, including improvements to national data collection systems and international comparability of data

Motor Vehicle and Transport Management Act-1993 (MVTMA-1993) states that the road transport safety is prime concern of Department of Transport Management (DoTM). DoOTM has to play key role of regulator and responsible for overall management of the road transport service sector. DoTM needs to manage and facilitate safe, effective and reliable road transport services by managing and controlling the vehicle fleet, driver's licensing, route permit, fare fixation, axle load control and minimize the road traffic accidents and making adequate provision of compensation of road accident including regulating the insurance for road traffic accidents.

Considering the road safety to be multi sectorial issue and to be addressed by different stakeholders a road safety action plan has been prepared and approved by the Government, recently. It has been formulated on the basis of UN Decade of Actions for Road Safety (2011-2020) and five main pillars are highlighted as follows:

- **Pillar 1:** Road Safety Management
- **Pillar 2:** Safer Roads and Mobility
- **Pillar 3:** Safer Vehicles
- **Pillar 4:** Safer Road Users and
- **Pillar 5:** Post-crash Response

The agreed actions have been assigned to various stakeholders like Department of Roads, Education, Health, Police, and DoTM depending upon specific roles and responsibility of each stakeholder. DoTM is mainly responsible for the road transport safety management, safer vehicle and safe road users.

1.2 RATIONALE

Most of the goods needed for everyday life are transported by road and the current generation has far greater opportunities for motorized travel in the course of work and leisure than their forefathers. Their advantages have been achieved, however, at a large cost as a result of various levels of injuries as a result of road crashes. The experience of many countries has shown that it is perfectly possible to introduce measures that greatly reduce this important economic and human cost but that reliable data are needed to quantify the scale of the problem and to identify the most effective solutions.

As road accidents and fatalities are rising continuously in Nepal, it is necessary to develop counter measures suited to local conditions. A sound scientific approach to accident recording and analysis is essential for effective road safety plans, research and countermeasures. Accident location information is essential for planning engineering improvements. The timing and type of road users involved in road accidents can provide information for effective enforcement and

educational strategies. Uniform, complete and accurate reports, subject to rapid retrieval and analysis and compatibility with record systems at national level can tell us not only how many accidents there are but what kind of accidents they are, where and when they occur, the physical circumstances and the people, injuries, death and damage they involve, what emergency services and educational strategies are required.

Collecting road accident data is not "bureaucratic form filling", because it provides the essential information that each country needs to tackle one of the most widespread and serious problems that it faces. It is essential that decision-makers in the country should recognize the seriousness of the problem of road accidents, in terms of the human and economic consequences. They should also recognize the essential role of collecting high-quality data on road accidents and on exposure in order to measure the scale of the problem and to devise effective countermeasures. This recognition should extend from the national authorities to local authorities, the police officers and all those who, in all countries, carry the principal responsibility for recording details of road accidents.

Further, accident recording and reporting are performed manually in the country. Only the summary tables are entered into the computer database. Furthermore, accident casualties after having serious injuries which has been hospitalized are not dealt with the records of traffic police. The hospital records of the road accident and their follow up have not been systematized to include into the national records of the traffic accident.

Collecting good quality data on exposure can be expensive, but these data are essential in order to calculate accident risks reliably and then to develop optimal policies for reducing those risks. Better policies based on more reliable information will lead to fewer casualties, so the cost of data collection will be amply justified by the benefits of the resultant casualty reduction. In the context of wide application of Information and Communication Technology (ICT) DoTM has planned to move into the smart card system for the vehicle registration and driving licensing. Similarly, it has developed the conceptual model for the development of ICT based accident recording, reporting and storing.

The accident costing is another issues to be interpreted while performing any economic analysis and justification of the project funding. Therefore, the road accident costing approaches for the Nepalese context is important aspect to be developed.

Road accident investigation methods for the finding of road accident causes are another vital aspect of related to the road safety. There are not any dedicated organizational units for the investigation of road accidents within Traffic Police, DoTM and DoR. Therefore, institutional arrangement funding approaches, responsibilities for the investigation shall be well defined. It will be helpful for the justified compensation of victims and development of remedial measures for the road safety improvement. An adequate methodology for the accident investigation is one of the task for this study.

After having an road accident, compensation issue becomes a major concern between victims and offender. Therefore, the compensation methods and their legal aspects are needed to be formulated. This study after having the brief review of existing provisions has recommended some fundamental approaches for the compensations of victims.

DoTM, as the main regulator of the transport service in the country, has a series of responsibilities to perform in this aspect of road safety. DoTM acts as the prime stakeholder for three Safety Pillars i.e. Safety Management, Safer Vehicles and Safer Road users. Therefore, this study and tasks components would be the pioneering steps towards the implementation of 'Road Safety Action Plan' in the country.

1.3 OBJECTIVE OF THE STUDY

The broad objective of the study is to identify an adequate road accident database management system. The specific objectives of the study are to:

- To review of the existing accident recording practices in Nepal and abroad;
- To develop the conceptual framework of an adequate road accident information management system;
- To prepare terms of reference for the consultancy services to establish the proposed road accident information management system;
- To initiate the conceptual recommendations on road accident cost, road accident investigation and compensation of victims;

1.4 SCOPE OF THE STUDY

The scope of the service is to achieve the objectives of the study which covers various essential aspects needed to justify for establishing a technically sound, sustainable and adequate road accident database system in the context of Nepal. In this regard, the scope of the study includes the following sub-tasks.

i. Review of existing practices on accident reporting and recording;
ii. On the basis of practical experiences and lessons learned from the past, develop a conceptual model for road accident information management system (web based) including an efficient and effective mechanism to collect the road accident data including the roles and responsibilities for each stakeholders;
iii. Preparation of draft Terms of Reference for consulting services to developing the necessary software and establish the computerized road accident database including the trainings for the related stakeholders,
iv. Preparation of adequate procedures for recording road accidents including investigating the cause of accident;
v. Recommendation of an adequate procedure for calculating the road accident costs;
vi. Review and recommend the process of compensation to the victims of the accidents.

1.5 DEFINITIONS

Motor Vehicle: A vehicle fitted with an engine providing its sole means of propulsion, which is normally used for carrying persons or goods, or for drawing (on the road), vehicles used for the carriage of persons or goods.

Road Traffic: Any movement of a road vehicle on a given road network. Pedestrian movement is also considered as the road traffic.

Road Transport: Any movements of goods and/or passengers using a road vehicle on a given road network.

Road traffic Crash: A collision or incident involving at least one road vehicle in motion, on a public road or private road to which the public has right of access. Included are: collisions between road vehicles; between road vehicles and pedestrians; between road vehicles and animals or fixed obstacles and with one road vehicle alone. Multi-vehicle collisions are counted as only one crash provided that any successive collisions happen within a very short time period.

Injury: Physical damage that results when a human body is suddenly or briefly subjected to intolerable levels of energy. It can be a bodily lesion resulting from acute exposure to excessive energy or impairment of function resulting from lack of vital elements.

Road User: A person using any part of the road system as a non-motorized or motorized transport user.

Road Traffic Fatality: Any person killed immediately or dying within the period of 30 days as a result of an injury crash. The definition is applicable for the purpose of accident database management.

Cause(s): Actions, omissions, events or conditions, or a combination thereof, which led to the accident or incident.

Emergency Services: The services which can be accessed by dialing the emergency number including Police, Fire and Rescue, Ambulance service.

Fatal Accident: Injury accident in which at least one road user sustains a fatal injury.

Injury Accident: Road vehicle accident in which at least one road user sustains an injury.

Major Accident: Accident that has to be considered as particularly serious because of the number of killed or injured victims, or because of the damage caused to the environment or property.

Multidisciplinary Investigation: If the investigators represent two or more fields of knowledge (E.g. "road environment", "vehicle", "human behavior" etc.) the accident investigation is considered to be "multidisciplinary".

Road Accident Report (RAR): The standard form filled by the traffic police at the site of the accident.

Raw Data: Accident investigation data as it is collected and not yet processed or stored in a database.

Road User: Person on the road. Road user includes Vehicle occupant as well as pedestrian.

Road Vehicle Accident: Unintended event that involves at least one road vehicle in motion and leads to personal injury or property damage, or both.

Routine Accident: an injury (including fatal) accident that is not considered as Major accident.

Stakeholder: The groups and individuals who are in a position to take action, through policy or practice, to improve road safety or who gather manage or hold accident related information, useful to road safety.

1.6 STRUCTURE OF THE REPORT

The report on the task review of accident data recording system in Nepal and recommendation of the adequate web based (application of ICT) accident information management system consists of the following headings:

Chapter 1: Introduction

Chapter 2: Road Accident Reporting System

Chapter 3: Road Accident Information Management System

Chapter 4: Implementation of RA-IMS

Chapter 5: Investigation of Road Accidents

Chapter 6: Road Accident Cost

Chapter 7: Compensation of Road Accident Victims

Appendix -1: Terms s of Reference for the Preparation of Road Accident Information Management System

Appendix -2: Terms of Reference for the Procurement of Equipment Needed for the Central Server

CHAPTER 2 ROAD ACCIDENT REPORTING SYSTEM

2.1 ROAD ACCIDENT REPORTING SYSTEM IN NEPAL

2.1.1 Road Accident in Nepal

Road Traffic Accident (RTA) is one of the serious issues for the concerned authorities and decision makers in Nepal. The rate of accidents with respect to the road network size, vehicle population and overall population is higher in the country. The total registered vehicles in the country are about the 1.7 millions and dominated by the motorcycle which comprised of more than seventy percent in number. Major cause of road accidents as per the data from Traffic Police Directorate is the drivers' negligence. Similarly, motor cycles are most like to be involved in road accidents in Nepal. The major and sever casualties resulting more than ten persons killed at once are related to the single vehicle accident which is due to the run-off roadway type of the accident.

Statistical records of Traffic Police show that the slight increase in the number of persons killed in the road accident is presented in **Figure 2-1**. There may be some cases of under reporting on the data. There is not clearly defined mechanism of data recording system when a injured person is admitted to the hospital for treatment and dies after some days i.e. within thirty days after having the accident.

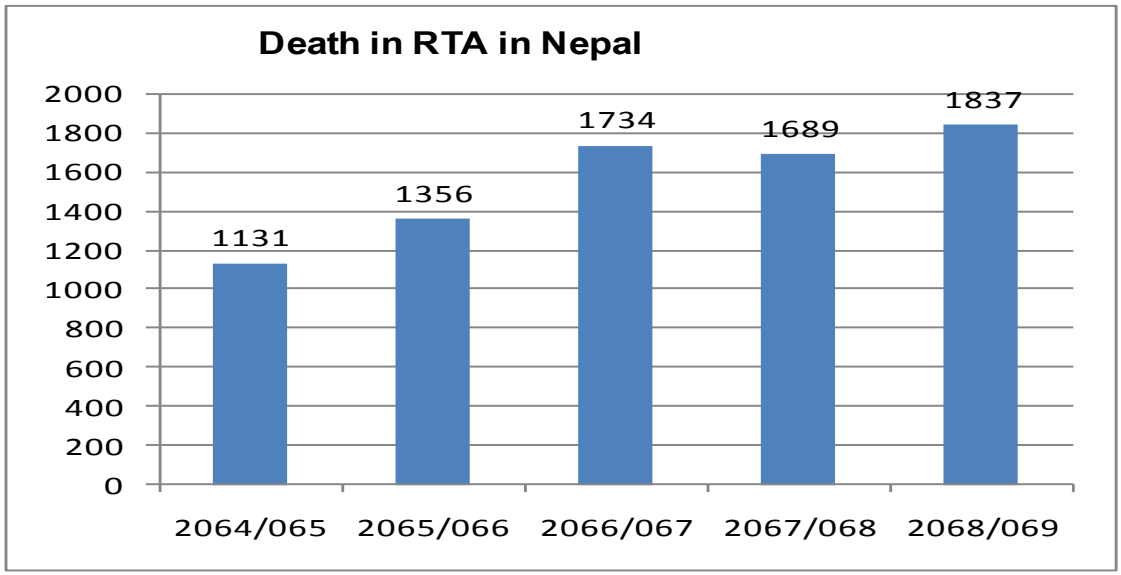


Figure 2-1 Death in RTA in Nepal

In RTA statistics, injuries are categorized into two levels. The seriously injured persons are referred as the persons having disabilities after the accident. Similarly, the persons wounded without the disabilities are considered as the injured only and they are fully recovered after the treatments. The data recording system of injured persons is not reliable and they are under reported. Many injuries are not report to the traffic police and treated without police reports.

Most of the cases of accidents with injuries are not recorded and the victims are compensated by the second party of the accident. The relative numbers of the injured and deaths are given in **Figure 2-2**.

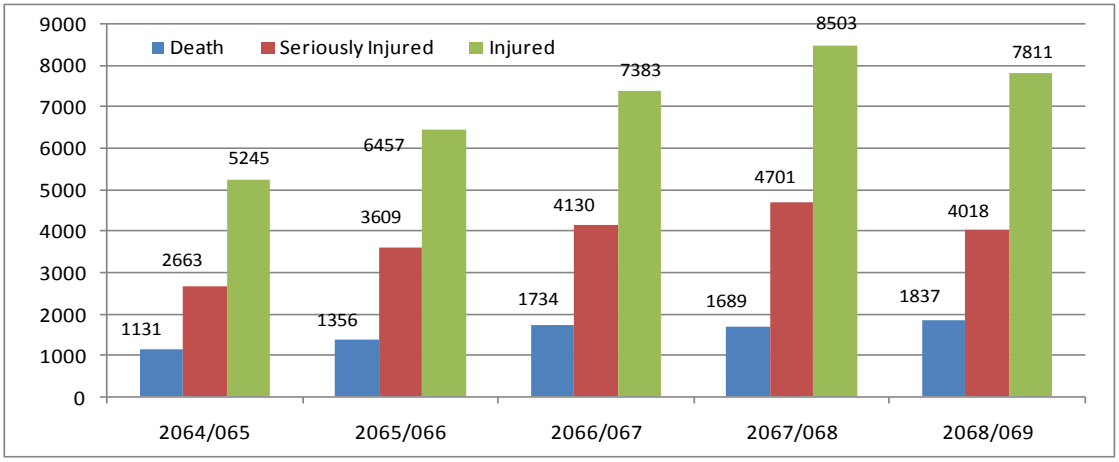


Figure 2-2 Numbers of Deaths and Injured Persons in RTA

The vehicle involvement in road accident is another important statistical part of the RTA. The most frequently involving mode of the road transport is found as Motorcycle in the Road accident in Nepal. This statistics is supported by the total percentage of the Motorcycles in the entire vehicle fleet in Nepal. In the second position after the Motorcycle is cars and they are most accident occurring type of vehicle in Nepal. The percentage of the vehicles involved in the RTA is shown in **Figure 2-3**.

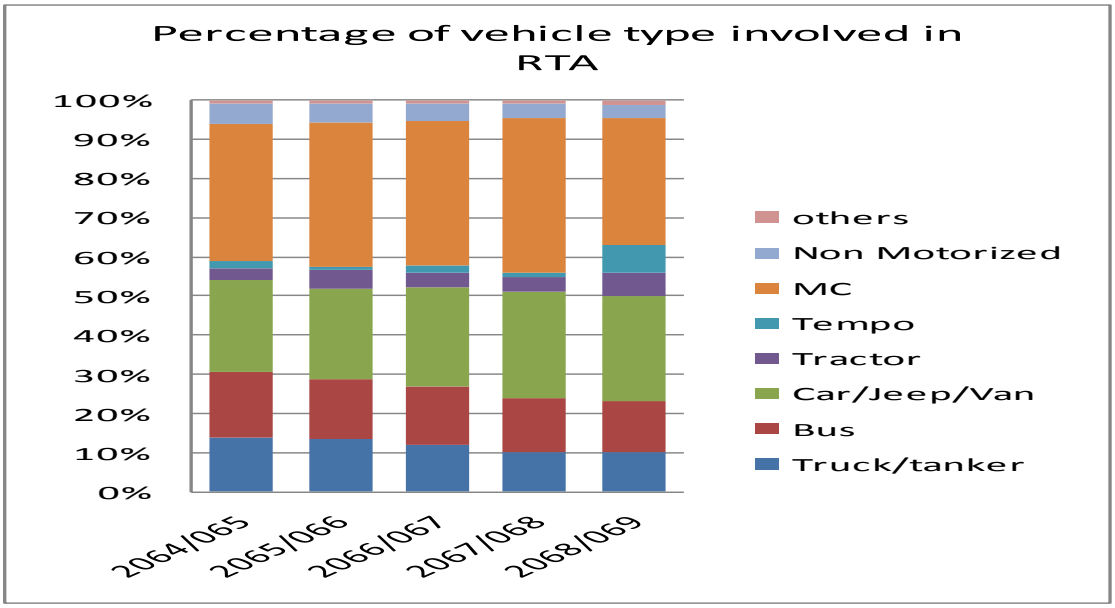


Figure 2-3 Percentage of Vehicle-type Involvement in RTA

2.1.2 Accident Reporting in Nepal

Traffic Police collects and compiles all data pertaining to road-accidents in Nepal through their network of local, district and regional offices. In urban and strategic locations, Traffic Police personnel record all details at the site of the road-accidents, while in rural and remote areas; in the absence of traffic police, this responsibility is usually assigned to general police as well. However, investigations of the accident-sites, including measurements, are performed by Traffic Police. They are trained to the minimum level of the description of the road accident and making a diagram of the accident site with the indication of dimensions. The general form of recording write-up and sketch is shown in **Figure 2-4**.

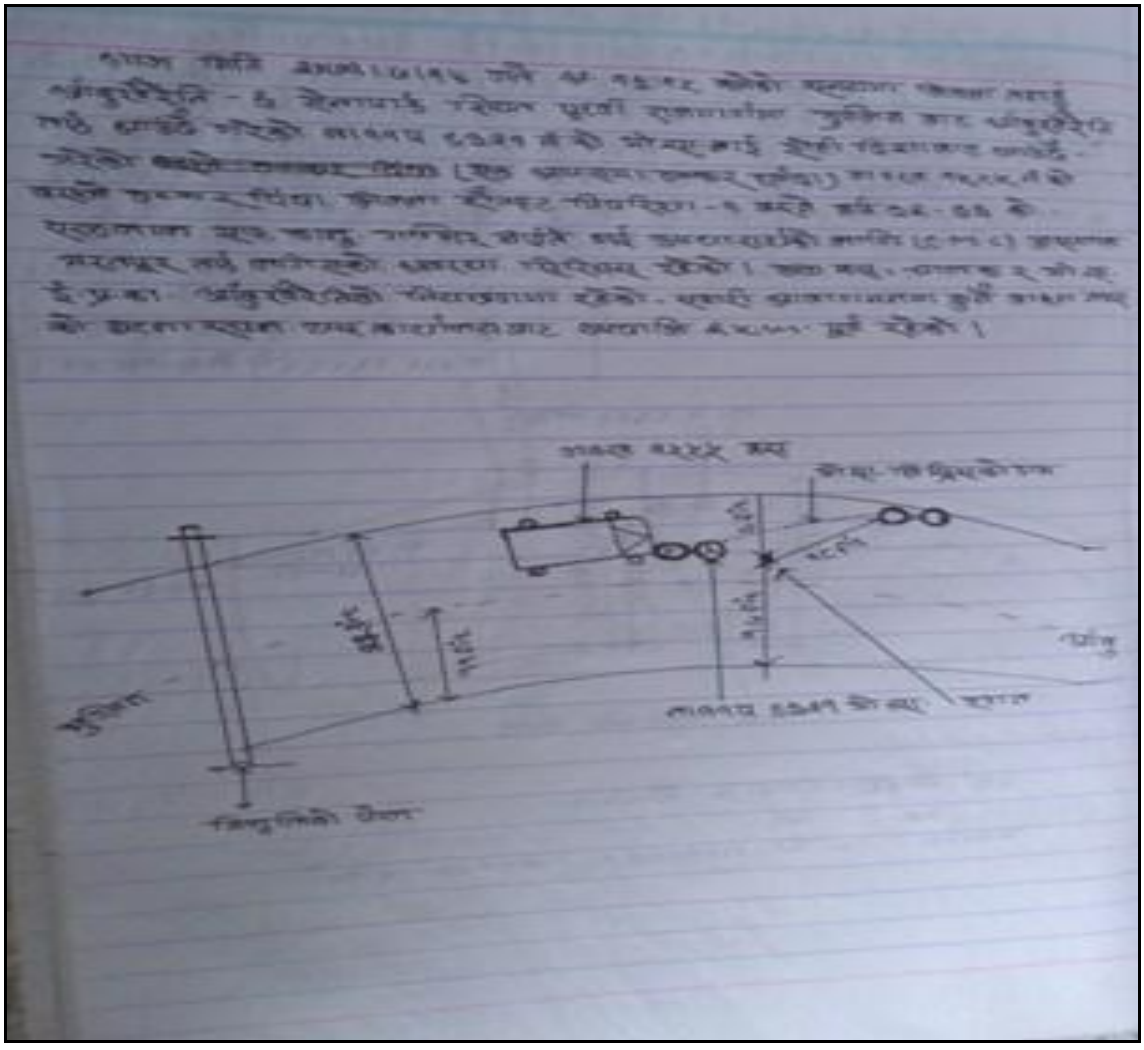


Figure 2-4 Typical Page of the Accident Recording Register

The information recorded in the above page of the accident register are typical for all cases of the incident. The information recorded in the above figure are as:

i. Date and time of the accident site
ii. District and VDC name with ward number
iii. Place name along the highway/road

iv. Vehicle types involved in the accident
v. Origin and destination places of the vehicle involved in the accident
vi. Name of the injured/victims
vii. Name of the hospital where the victim was send for treatment
viii. Health condition of the injured person
ix. Driver has detained at the Police post
x. Accident does not disturbance to the traffic movement
xi. The place of the accident is located at the distance of 25 m form the traffic police station

This comprehensive record of the accident does not have adequate information which may be applicable for planning, designing and monitoring the road safety initiatives or other actions for preventive actions.

This type of recoding even would not be sufficient for the legal procedure in case of fatality and other property damages. Traffic Police on the basis of the accident register (as shown in the **Figure 2-4**) prepares (fills) the full form of the Accident Report as shown in **Figure 2-5**. After filling the Accident Report, traffic send it to the higher authority with the cover letter to the higher authority for necessary actions for the victims as shown in **Figure 2-6**.

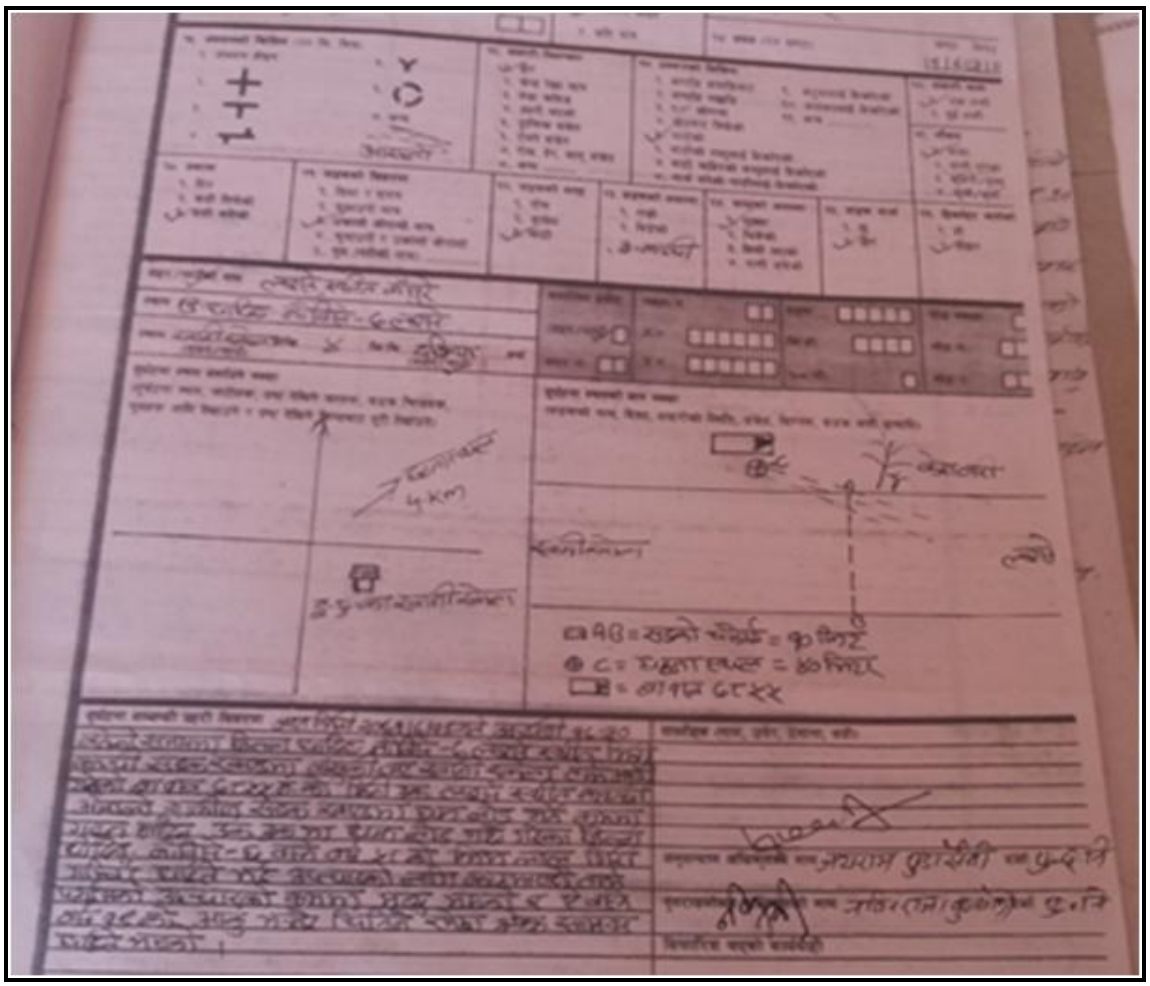


Figure 2-5 Road Accident Report form Filled by Traffic Police

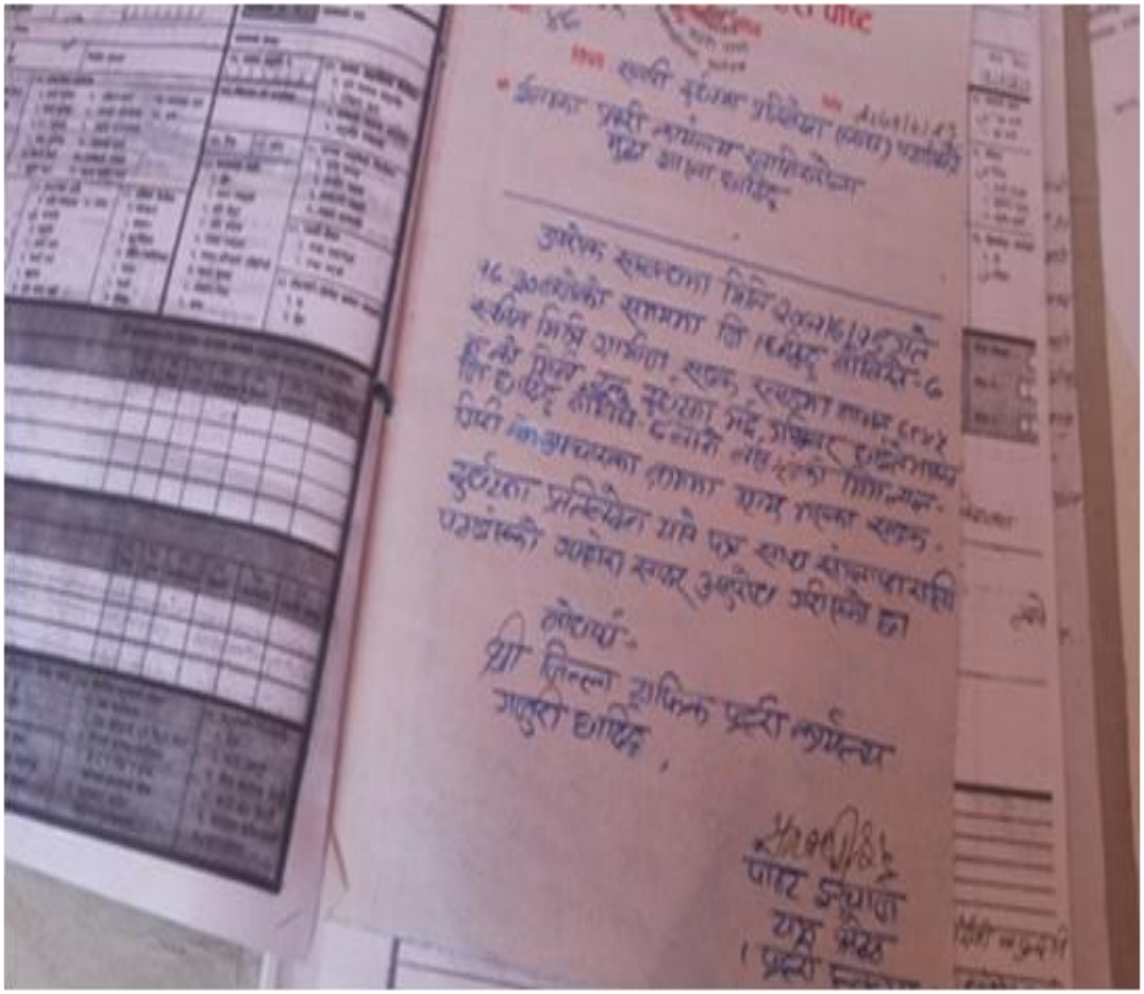


Figure 2-6 Sample Copy of Road Accident Report with the Cover Letter

In general cases of the accident recording, traffic police keeps the record on the Accident register. At the end of each month and at the end of FY respective Traffic Police station/post prepares the summary sheet for the all accidents recorded during that period. After then these records on the accident are sent to the higher authority i.e. ILAKA Traffic Police Office (ITPO). Similarly, TPO keeps the records and the reports from the stations within its jurisdiction and sends it to the District Traffic Police Office (DTPO). DTPO maintains all the records of the accidents within the Districts and at the last of each month these records are sent to the Regional Traffic Police Office (RTPO). The RTPO is responsible to convey all the regional records to the Traffic Police Directorate at the Nepal Police Head Quarters. The process of accident recording mechanism is shown in **Figure 2-7**.

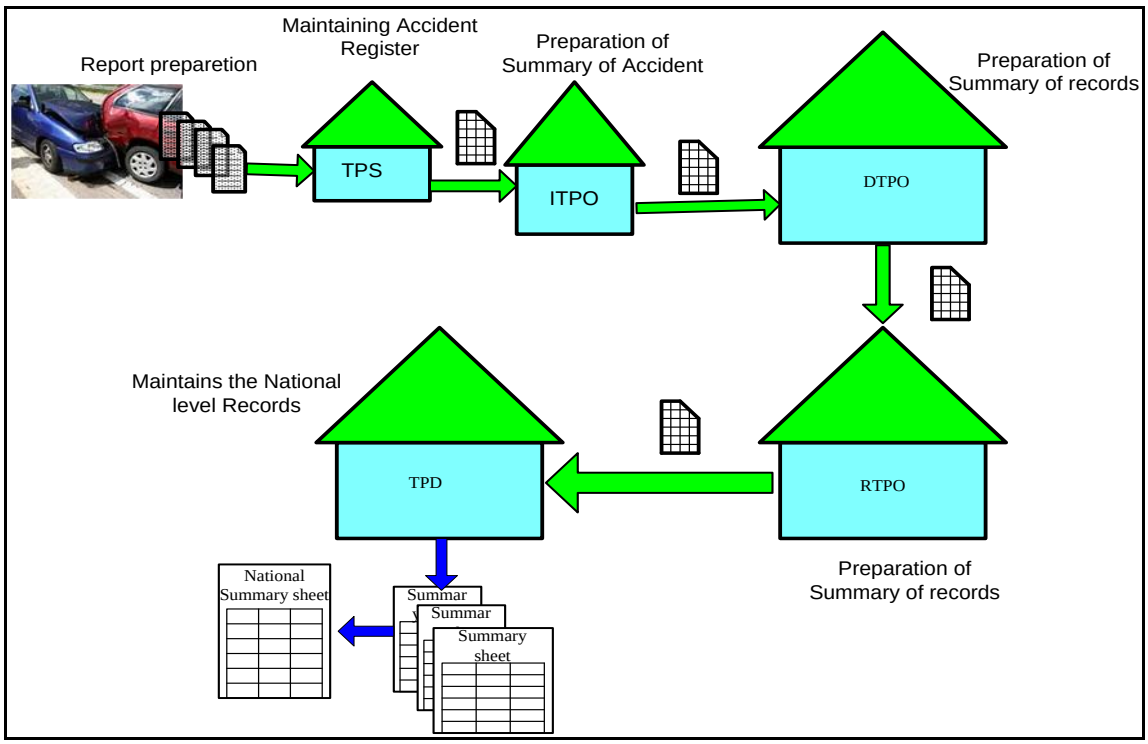


Figure 2-7 Accident Reporting System in Nepal

The Traffic Directorate at Nepal Police Headquarters maintains consolidated statistics of road-accidents in Nepal segregated by five development regions in Nepal and includes statistics such as age, gender, vehicle involved, and severity of injury. However, as consolidated data, those do not provide data in detail necessary for comprehensive analysis of road accidents.

The Road Accident Report Form, which was designed for further use in accident analyses using computer software, contains all the essential elements of accident information discussed previously. These elements are "Where, When, Who, What (consequence of Accident), What (Environmental conditions), Why, or how of the accident". As these Accident Forms are observed to be, invariably, used by all units of Traffic Police throughout the Country and was developed during the nineties by UK TRL following extensive discussions with both DOR and Traffic Police, it is felt that there is no need for changing the format or designing it afresh. What is required is to make its use for all types of accidents and to complete these forms fully.

To review the current state of documentation of road accidents, the Consultant collected samples of the filled accident forms from various offices of Traffic Police during field visits by the consultant'.

The result of the review of the sample of filled accident forms that were available is shown in **Table 2-1**. While the Form requires all the basic information pertaining to road traffic accident (RTA) to be inputted, not all the details were filled up. This could be attributed partly due to lack of orientation and training to personnel of Traffic Police filing FIR regarding the details they

should record at all costs. Distribution of a checklist of all the essential data are filled to the field personnel filing FIR, would be beneficial in such cases.

Parameter	Coverage of the issue	Whether Adequately Covered in Completed Forms by police
Where accidents occur: location by map coordinates, road name, class	Yes	No. The location of accidents as conceived in format in form of X, Y co-ordinates not filled.
When accidents occur: year, month, day of week, time	Yes	Mostly filled. Sometimes the exact time of the accident not available
Who was involved: people, vehicles, animals, roadside objects	Yes	Not completely filled or available in completed forms
What was result of collision: worst severity of injury or property damage	Yes	Not completely filled or available in completed forms
What environmental conditions existed: Poor light, weather, road surface condition.	Yes	Traffic control conditions invariably not filled
Why or how did collision occur: collision type, driver fault	Yes	Collision Diagrams and anecdotal notes generally included

Table 2-1 Review of the RTA Report Used by Traffic Police

Table 2-2 further elaborates the review of the filled accident forms. This review shows percentage of details pertaining to a particular aspect (e.g. driver, vehicle, casualties, etc.) that was filled in the corresponding space of the Form. In interpreting **Table 2-2**, the percentage indicates the extent of the details reflecting a particular aspect that was filled in their corresponding space of the Form, irrespective of whether this information was referred to in either the anecdotal note or depicted in the collision diagram.

Table 2-2 Detail Review of Filled Accident Forms by Nepal Traffic Police

S/N	Type of Collision	Type of Information	% Detail Filled in the Form	Average % Details Filled in the Form*
1	All types	Basic information[2]	80%	63%
2		Road & environment	87%	
3		Collision diagram	86%	
4		Subjective note	93%	
5		Driver involved	39%	
6		Vehicle involved	44%	
7		Casualties -Passengers	49%	

[2]Includes total casualties, accident-type, location, date, time, collision diagrams, anecdotal note

S/N	Type of Collision	Type of Information	% Detail Filled in the Form	Average % Details Filled in the Form*
8		Casualties- Pedestrians	29%	
9	Single vehicle related	Driver involved	60%	75% % hit-and-run= 0%
10		Vehicle involved	65%	
11		Road & environment	84%	
12		Casualties -Passengers	94%	
13		Accident severity	71%	
14		Nature of Collision	86%	
15		Junction type	71%	
17	Vehicle-vehicle collision	Driver involved	23%	58% % hit-and-run= 25%
18		Vehicle involved	25%	
19.		Road & environment	84%	
20.		Casualties -Passengers	13%	
21.		Accident severity	82%	
22.		Nature of Collision	91%	
23.		Junction type	91%	
25.	Pedestrian related	Driver involved	60%	79% % hit-and-run= 33%
26.		Vehicle involved	69%	
27.		Road & environment	93%	
28.		Casualties -Pedestrians	33%	
29.		Accident severity	100%	
23.		Nature of Collision	100%	
24.		Junction type	100%	
31.	Multiple collisions	Driver involved	40%	79% % hit-and-run= 50%
32.		Vehicle involved	38%	
33.		Road & environment	94%	
34.		Accident severity	100%	
35.		Nature of Collision	100%	
36.		Junction type	100%	
38.	Hit and run (not involving pedestrians)	Driver involved	43%	70%
39.		Vehicle involved	51%	
40.		Road & environment	94%	
41.		Casualties -Passengers	20%	
42.		Casualties- Pedestrians	51%	
43.		Accident severity	100%	
44.		Collision type	100%	

S/N	Type of Collision	Type of Information	% Detail Filled in the Form	Average % Details Filled in the Form*
45.		Junction type	100%	
46.	Vehicle damage only	Driver involved	Nil	65% % hit-and-run= 0%
47.		Vehicle involved	Nil	
48.		Road & environment	89%	
49.		Accident severity	100%	
50.		Nature of Collision	100%	
51.		Junction type	100%	

NA: not applicable or not available

Table 2-2 shows that overall 80% of the details pertaining to basic information (total casualties, accident type, location, date, time, etc.) were filled up. It is interesting to note that the details pertaining to basic information filled in was less than that depicting the road and its surrounding environment (87%). The details pertaining to other aspects relating to driver, vehicle involved, causalities, was even worse with only 29 to 49 % of the details filled up despite the fact that most of the same forms had the collision diagram and anecdotal notes filled up. As Traffic Police fill up the Accident Form in their office from the anecdotal description filed at the site, the above finding show that there is general laxity in correctly or completely entering all data at the office. The details pertaining to pedestrian casualties was most lacking in general with only 29% of the details filled up.

Some of the other details that were generally deficient or lacking in the filled Police Records were as follows:

- Name of the road or highway where accident occurred was not explicitly shown in the Collision Diagrams. However, direction and place location was indicated in all these diagrams.
- The reference to particular Form (Report No.) was not given in any of the samples. The absence of reference to computer no. is understandable as currently Traffic Police do not have computerized RTA data at their local offices.
- The laxity towards correct and complete data entry in the Accident Forms, as discussed above, clearly underscore the need for proper training, orientation to police personnel in data entry on a continual basis..
- The fact that none of the samples of the Forms were reviewed by superior officers responsible, underscores the need for mandatory cross checking to rectify the errors, omissions during data entry.
- As discussed previously, numerous data entered in the respective spaces of the forms did not tally with either their anecdotal notes and/or collision diagrams. For example, 93% of the sample reviewed had reference to basic information in their anecdotal notes.

- Details regarding use of safety-features such as seat-belts and helmets were not usually filled up in most cases. For four wheeled vehicles, this can be attributed partly to the fact that Traffic Police stopped the strict enforcement of the traffic rule mandating use of seat-belt in the recent past.
- Much additional information that was relevant in framing up appropriate road-safety policy was not filled up. For example, almost all the samples reviewed, the question regarding third party insurance of the vehicle involved was not filled in. Though, this can be attributed to fact that Traffic Police do not see the significance of this question, given the low number of insured vehicles in Nepal, this information is still necessary for policy planning relating to road-safety, accident costing and analysis.

The review of the sample of the filled accident forms was further segregated according to the nature of accident that was involved (e.g. single vehicle loss of control, vehicle and vehicle collision, etc.). This analysis provides more insight about the extent of the data gaps based on the nature of the accident involved. The following were some finding of this analysis:

- Details in accidents for hit-and-run cases were most lacking compared to other types of collisions. For these cases, details pertaining to passenger casualties was most lacking (20%), followed by those pertaining to driver and vehicle involved with only 43% and 51% of these information, respectively, filled up. This is understandable, based on the fact that Traffic Police lack the logistics and incentive to nab absconding vehicles in hit-and-run cases except in exceptional cases.
- Driver and vehicle related data was absent in all accidents that only involved vehicle damage despite none of these accidents being hit-and-run cases. As most of the sample forms reviewed is predominantly from Kathmandu Valley where traffic congestion is prevalent during peak hours at major roads, this implies that either Traffic Police do not give due seriousness to record details of these type of accidents as the severity is minor compared to those involving casualties or that the parties involved exert undue pressure on them not to report the accident due to its implications on vehicle insurance premiums (e.g. penalty) or other reasons. However, lack of vehicle-damage-only data hinders the accurate assessment of road-accident costs as it represents a substantial portion of all road-accidents.
- It was interesting to note that only 33% of details pertaining to pedestrian casualties were filled up in pedestrian-related accidents, less than the corresponding figure for hit-and-run cases (50%). This fact shows that Traffic Police are generally lax in entering details of pedestrian data.
- Not more than 40% of the RTAs involving multiple collisions included details pertaining to driver and vehicle involved and could be due to fact that half of these accidents involved hit-and-run cases.
- In conclusion, the system of entering data in the accident forms needs to be substantially improved and upgraded. Traffic Police should accord this responsibility with high priority.

2.1.3 DoR and Traffic Police Coordination

DOR, as the concerned agency for planning and management of road network in Nepal, is ultimately responsible for analyzing road traffic accidents and implementing countermeasures at accident blackspots and hazardous locations. This is the general practice in place globally for effective accident mitigation and treatment. Therefore, DOR should compile all accident data maintained at Traffic Police for comprehensive accident analysis while the latter authority should confine itself to enforcement and collection of accident data at the sites.

Currently, there is no permanent network arrangement between DOR and Traffic Police to collect the accident data from the latter agency for comprehensive accident analysis. However, during the late nineties, DoR Traffic Engineering & Safety Unit or TESU (now renamed the Road & Traffic Unit, RTU) had collaborated with the Traffic Police to collect accident data under the UK-assisted Road Maintenance Project (RMP). RMP had also installed TRL MAAP-five Accident Software at DoR TESU and Valley Traffic Police Office, VTPO (now the Metropolitan Traffic Police Office, MTPO). The MAAP-five software was later upgraded to MAAP for Windows under RMP. During this period, DoR TESU also assisted VTPO in data-entry in MAAP five but, unfortunately, this collaborative arrangement stopped after RMP completion and collection, maintenance of accident data was again confined to Traffic Police. In addition, all the digital accident data from 1995 to 2000 maintained in MAAP for windows and the software itself at DoR TESU was lost due to virus problems. Currently, this Project is also assisting DoR to indigenously develop software for accident data management to improve accident analysis but this subject is being dealt with separately.

The system of accident database management has not improved since DoR ceased compiling and analyzing accident data. While Traffic Police do some analysis on accident data and identify accident blackspot based on their observations, they lack technical expertise to develop appropriate countermeasures to mitigate or reduce road accidents at these locations. In their recent annual report, Traffic Police recommended that DoR should identify and implement means to maintain up to date accident data and countermeasures for accident reduction/prevention. Based on these premises and as per global practice, DoR should again start a system of compiling and analyzing police data for both prevention and reduction of road accidents in Nepal. Therefore, there should invariably be a permanent arrangement between DoR RTU and Traffic Police to transfer the latter's filled accident forms to DoR to enable the latter to conduct a comprehensive analysis. To establish such a collaborative partnership, there should first be a formal understanding between DoR RTU and the Traffic Police Directorate (TPD) in the form of a memorandum of understanding or other form which legally binds the Directorate to transfer RTA data to DoR.

Ultimately, it is absolutely necessary to enter the RTA data on computer for easy retrieval and comprehensive analysis. DoR RTU should initiate a system of disseminating its findings to the Traffic Police when required and develop a system of collaborative approach between them,

stakeholders and private organizations in establishing countermeasures at the blackspots and hazardous locations.

2.2 INTERNATIONAL PRACTICES

2.2.1 Accident Database Practice in India

In India, like Nepal, the source of accident data is largely from the First Information Reports (FIRs) written by police. The accidents are reported just like any other crime to the untrained and non-scientific personnel. These are kept in the general police records and accident records are sorted from there and the Traffic Police Departments of various States transfer this information to their own devised forms and prepare annual accident statistics. Generally, only one or two persons in the Department are allotted this work and it is considered to be a very low priority area work. Officially, the Ministry of Road Transport & Highways has a Road Safety Cell and Transport Research Wing, which has the responsibility of publishing national data on road accidents and injuries. Also the accident data is published by National Crime Bureau and different state governments for their respective jurisdictions. The ministry asks all the states to fill in the accident statistics in A-I and A4 forms designed by the Indian Roads Congress.

(1) Accident Recording Forms

The need for keeping reliable and comprehensive road traffic crash records has been recognized in India for over half a century. However, despite many efforts towards standardizing the accident recording and reporting systems in India, the existing database of road accidents continues to be poor. Officially, the police, or specifically the traffic police, if they exist as a separate entity in urban areas, have been given the responsibility for recording crash related information on all classified roads in the urban and rural areas. The standard AI and A4 forms have been recommended for recording the relevant information. The traffic police are also required to prepare annual summaries of accidents in each state which are the basis of the Indian national road accident statistics.

Despite these procedures, the data base maintained by traffic police has been found to be grossly inadequate from the point of view of recommended accident preventive measures. The form recommended by the IRC is not being used by most police departments, as it is too lengthy and cumbersome to fill. One of the reasons for poor response to improved forms could be that police organizations have not been actively involved in the whole process. The new accident recording form will be accepted only when they fully own it.

To gain an understanding of why the previously designed forms and procedures were not being used, Indian Institute of Technology (IIT), Delhi[3], 1991 reviewed the traffic accident recording

[3]Tiwari Geetam and Dinesh Mohan, "Road Traffic Accidents and Recording Procedures in India", International Conference on Traffic Safety, organized by IIT, Delhi 27-30 January, 1991.

and reporting procedures in different urban and rural areas in a project sponsored by Ministry of Surface, Transport, Government of India.

The Study found that accident recording procedures did not vary according to the city size or type of city. The similarity could be attributed to the fact that everywhere the interest of police departments was mainly to record information which determine who was at 'fault'. Regular police departments do not have much incentive on the training to fill complicated forms and gather information that did not interest them directly. It is understandable when one considers that it is the general police and not the traffic police that have been entrusted with the task of recording and investigating road accidents.

The Study Team observed that the information relating to vehicle accidents on road is at present collected through the police departments in the states / union territories. Under the existing system these data are supposed to be collected in Form A-I suggested by IRC which is very comprehensive and in which information on each individual road accident, whether serious or minor, reported at the primary level, namely the police post. However, it was observed that by and large the information on major accidents, on which penal action is required to be taken, are alone recorded on this Form or various police authorities have devised their own forms for the purpose. These data are, thereafter, reported to district and state police headquarters as part of the crime statistics.

The primary data on road accidents collected by the police posts are required to be consolidated at the state level in the office of the Inspector General or Commissioner of Police on an annual basis in Form A-4 of IRC. This Form is quite elaborated having 19 blocks which are common for all types of accidents namely fatal, major injury, minor injury and even non-injury. These consolidated statements were, inter-alia, required to be forwarded to the Ministry of Surface Transport. It was observed that the flow of this annual data from the State Governments was quite tardy which could perhaps be due to too many details being asked for about the accidents. This resulted in a total time lag of over three years in the availability of accident data.

In view of the slow flow of data and the problem of non-response from the state Governments/Union Territory Administrations, the Ministry devised simpler forms in order to procure the basic minimum data like total number of road accidents as classified according to fatal, grievous injury, number of persons killed and the number of persons injured for use in Parliament Questions and in Ministry's Annual Statistical Publication on Motor Transport Statistics.

(2) Data Gaps in the First Information Reports (FIRs) in India

In India, there is no standardized accident recording system that is followed. In many states, there is no accident recording form available and whatever accident statistics are available, they are through the First Information Records called FIRs. Although these records are useful in the absence of any other accident recording system, there are certain drawbacks in using them and there are some data gaps.

For this study[4] by CRRI, India, in all 1446 FIRs were studied. Some of the major gaps in the accident recording system by these FIRs are listed below:

- The accident reporting is generally based on the statements of the persons reporting the case. The report by any police official after a proper site investigation is rare. There are signs that data from such reporting cannot be fully reliable and extreme care should be taken to arrive at reliable statements. Since these FIRs are reported mostly by the victims, these suffer from biases.
- On-site investigation of accident causes is not available through these FIRs. The reports contain whatever is being reported to the police official by the victim or the witnesses of the accident or as instructed by the senior police official which may not always be correct.
- These FIRs are written keeping in view the administrative and legal requirements more than to probe traffic safety points. The victim, who reports the accident or the munshi or police official who prepares the FIR, does so with a view to fix responsibility for the accident in question. Thus, liability rather than reasons for accident causation is the prime objective of such an accident reporting system.
- Through these FIRs, it is not usually possible to know the exact location of the accident. Such information, thus, does not exactly tell where the accident took place or road geometric features of that place or to identify the black spots to take some traffic safety remedial measures.
- These FIRs have data gaps as they do not contain full information about the accident. The information is given by the victim and written by the munshies who are generally not aware of as to what accident parameters are necessary to be recorded for accident analysis and adopting safety measures.
- In the FIRs the type of injury is not stated properly. Generally, it is reported that the victim was injured seriously and had multiple injuries but not as which part of the body was injured.
- In the FIRs it is not stated whether the victim got the medical aid immediately after the accident or not and whether he died due to lack of immediate medical aid.

[4] Characteristics of Road Accidents and Recording System in India – A Case Study of Haryana, CRRI, February, 1992. Report, Central Road Research Institute (CRRI), New Delhi, India

- In the FIRs generally, no sketch is drawn for the accident location point.
- In the FIRs the exact cause of accidents is not reported correctly; in almost 75 to 80% cases, high speeding and for rash driving and negligence was reported to be the major cause of road accidents. Causes like mechanical defects, bad weather, and poor road conditions could not be obtained from FIRs, as they were not reported by the affected parties.
- The information regarding the socio-economic background of the road users such as their age, income, education, occupation etc. could not be known from the FIRs.

(3) Road Accident Database Management System

India has one of the highest rates of road accidents in the world with about 500,000 accidents a year. Some 130,000 people lose their lives each year, and another 500,000 or so are injured. In fact, more lives are lost in road accidents in India than in epidemics, natural calamities or wars put together. In 2009, an easy-to-use software known as the Road Accident Data Management System (RADMS) was developed in India. It has been implemented by the financial assistance of the World Bank. The RADMS was used in Tamilnadu and Himalchal Pradesh.

In April 2007, Tamil Nadu became the first state in the country to announce a Road Safety Policy. This was followed, in 2009, by a Road Safety Action Plan. As part of the Action Plan, an easy-to-use bilingual software package - known as the Road Accident Data Management System (RADMS) - was developed, with the help of an international consultant, under the World Bank-supported Tamil Nadu Road Sector Project. The GIS-based RADMS software geographically maps all road accidents that take place on Tamil Nadu's national and state highways, as well as on urban and district roads. The system identifies the most accident-prone spots and displays crash trends and other information at the click of a mouse. The RADMS software, developed after detailed consultations between the police, transport and highways departments, has been helping the authorities analyze the 'how', 'where' and 'why' of road accidents, and enabling them to plan and implement remedial measures. In the two years since the system has been operational, nearly 3000 accident-prone spots have been identified. The implementation of road safety measures based on this analytical data has brought down the number of accident fatalities in Tamil Nadu from 13.39 for every 10,000 vehicles in 2006 to 10.09 in 2010, exceeding the targets set by the state.

The RADMS software, developed at a cost of Rs. 2.20 crores (about $500,000), has been deployed at all the state's 1,400 police stations and personnel at each station have been trained in its use. While similar software was first used in Kerala, Tamil Nadu is the first state to deploy it extensively. The software is constantly being improved. It is planned to provide each police station with a hand-held GPS device to enable personnel to enter the details at the accident site itself. It is also planned to link the system with medical facilities across the state for quick attention to accident victims. The creation of a national road accident database along these lines can help to markedly improve road safety across the country.

RADMS is supported by a powerful analysis engine that enables the authorities to identify high-density accident locations and generate automatic vehicle collision diagrams. This is designed to assist road safety engineers in improving the safety of roads and intersections. RADMS has the facility of analyzing the following elements:

Kilometer Analysis analyses accidents along a selected stretch of road.

Grid Analysis looks at the frequency of accidents in a specified area and identifies accident hotspots.

Cluster Analysis provides an analysis of the density and severity of accidents in selected areas.

Monitor Sites Analysis provides a visual comparison of the severity of accidents on selected sites. It also generates reports and graphs showing the effect of remediation measures.

Collision Diagram Analysis analyses the general pattern of accidents in select locations, usually junctions.

Corridor Analysis locates high-crash concentrations within a corridor. It allows routes to be linked together so that an analyst can assess the overall safety of a transportation corridor.

Link Node Analysis analyses accidents occurring between any two nodes in the road network and is used when no maps are available to enter accident details.

Safety Benefit Evaluations study the effectiveness of remedial measures to reduce accidents.

Stick Analysis gives a pictorial representation of accidents along a number of parameters.

Monitor Sites Analysis is used to analyse the accident density in a defined region. This analysis helps the accident investigator to 'monitor' and compare an area of high crash density before and after implementing interventions

Figure 2-8 Homepage of RADMS in Tamil Nadu

Registered user can search and view the accident spots and can analyze the severity and trend of the road accidents.

Similar system was deployed in Himachal Pradesh in 2014. The RADMS has arranged the stakeholder and their responsibility as:

- Himachal Pradesh PWD: Procurement agency and sponsor
- Himlachal Pradesh Police: Implementing agency
- Transport Department: Key Stakeholder
- Department of health: Key Stakeholder
- State Department of IT: Key Stakeholder

RADMS was taken as an easy to use computer based accident data collection and recording system. The main feature can be noted as:

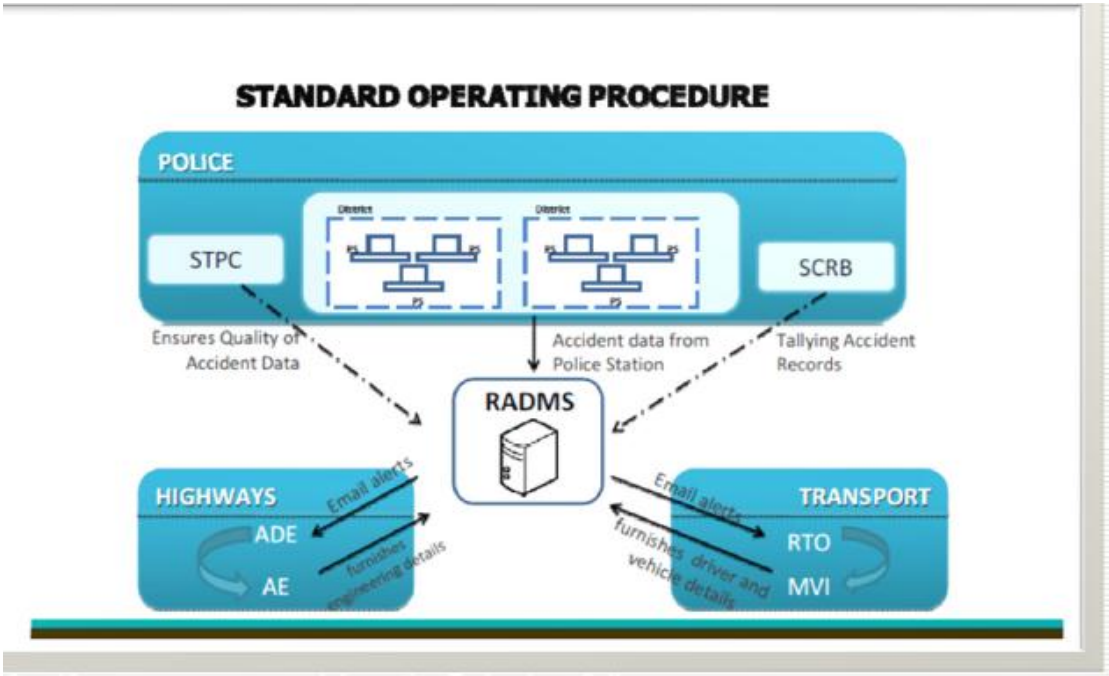


Figure 2-9 RADMS Standard Operating Procedure

- Customized accident report form
- Exhaustive analysis features
- Very detailed reporting module
- Query builder
- Dash-board for quick view of data
- Automated E-mails upon accident reporting

RADMS is popular and other States are on the way to establish the system in India. The use of IT in the road accident database management is becoming one of the key program for the "Road Safety Action Plan" in India.

2.2.2 Accident Database Practices in USA

A coordinated safety network approach offers the best means to gain maximum value out of each separate system and to make use of synergies based on links between the general database and other more specialized databases. Such an approach exists within the US National Automotive Sampling System (NASS), where there are different levels of data collected on a national basis with each providing a unique input into the policy-making agenda. At a general level, data are collected as part of the General Estimates System (GES). This federal system of data collection began operation in 1988. Providing data about all types of crashes involving all types of vehicles, the GES is used to identify highway safety problem areas, provide a basis for regulatory and consumer information initiatives and form the basis for cost and benefit analysis of highway safety initiatives. The GES obtains its data from a nationally representative probability sample selected from the estimated 6.4 million police-reported crashes that occur annually.

The Fatality Analysis Reporting System (FARS) provides a comprehensive census of all fatal crashes in the U.S. States based arrangements supply data based on police reports and related sources. It is federally funded and one of the two primary crash analysis resources used in the U.S. Its strengths come from the wide ranging but systematic nature of the data recorded and its derivation from the conventional approaches used as part of the standard policy direction on many aspects of road and vehicle safety. Its rigorous sampling basis gives strength that result in many opportunities for precise statistical analysis.

Table 2-3 Accident Recording in U.S.A.

1.	General Estimates System (GES)	• Was started in 1988 • Provides data about all types of crashes • Is used to identify highway safety problem areas, provide as basis for regulatory and consumer information initiatives and forms the basis for C.B.A. of highway safety initiatives • Obtains data from a nationally representative probability sample selected from the police reported crashes that occur annually
2.	Fatality Analysis Reporting System (FARS)	• Provides a comprehensive census of all fatal crashes in the US supplied by States • Is federally funded • Has systematic nature of the data recorded • About 5000 crashes are studied annually by trained crash investigators who make on-site investigations, interview crash victims and review medical records to collect crash worthiness data
3.	The Crash Injury Research and Engineering Network (CIREN)	Network of medial and engineering researchers working on safety at leading trauma centers • Funded jointly by Federal Govt. and the automotive industry • 10 CIREN centers collect, analyze and share crash data

At an intermediate level, the Crash Worthiness Data System, data are collected. Federal field research teams located at Primary Sampling Units (PSUs) across the country study about 5,000 crashes a year involving passenger cars, light trucks, vans and utility vehicle. Trained crash investigators obtain data from crash sites, studying evidence such as skid marks, fluid spills, broken and bent guardrails. They locate the vehicles involved. These researchers follow up their on-site investigators, by interviewing crash victims and reviewing medical records to determine the nature and severity of injuries.

A third level of data collection are those that are obtained as part of the Crash Injury Research and Engineering Network (CIREN) study. This study is a network of medical and engineering researchers working on safety at leading trauma centers. It is funded as a joint activity between the Federal Govt. and the automotive industry. There are 10 CIREN centers in the US which have been organized into a Network for collection, analysis and sharing of crash injury data. At a general level, the data systems act in a complementary fashion to one another. In addition, the data collection protocols are the same in each of the states and this offers significant advantage in terms of data analysis, purpose, interpretation and dissemination.

2.2.3 Accident Recording and Reporting in UK

All injury accidents that are reported to the police have their details recorded, such as the weather; the time and date; where the accident occurred; details of the people and vehicles involves; including maneuvers, injuries and damage.

When the present STATS19 system for collecting information about road accidents was established in 1949, such data were originally collected along with other more objective data. After ten years, however, doubts were cast over the reliability of these 'contributory factors' and collection of such data then ceased to be a national requirement. Efforts are on to further improve this National System taking into account the experience of police personnel and highway engineers over the years.

Certain counties in UK use software called the Traffic Accident System (TARS2), which consists of a database linked with geographical information software. Every month an updated copy of the TARS2 database is sent to the Road Safety Section of the City Council. Anyone can request information about accident and, using the TARS2 software, it is possible to produce maps showing locations of accidents as well as summaries and reports giving details of the accidents.

All recently introduced road safety-engineering schemes are monitored on a yearly basis to see how well they are performing. To do this data is compared from the accidents for the 3 years prior to the scheme against the available data for the 3 years after the scheme was introduced. In addition to this, continuous monitoring is done to see how the accident numbers are changing across the city. The role of the Accident Investigation team is to interrogate the database either through Access or using Map Info (a geographical Information System) to search for patterns in the number and type of accident occurring in the city.

CHAPTER 3 ROAD ACCIDENT INFORMATION MANAGEMENT SYSTEM

An efficient system of crash database including easy retrieval will provide useful tools for analysis of crash locations (at blackspots), collect information on the road safety trend in general and also offer useful guidance to develop interventions to reduce crashes and casualties. Since road safety is effectively managed through interventions in all the five pillars (safety management, safer roads, safer road-users, post-crash response), they are related to stakeholders such as DoR, DoTM, traffic police, health institutions and professionals. The multi-stakeholder approach to the road accident reduction and prevention is the essential step for the achievement of national goals on road safety. Furthermore, the efficient road accident information is vital data for the policy development, policy deliver, monitoring and evaluations of the efforts regarding road safety drive in the country. The application of an adequate road accident information management system application is shown in **Figure 3-1**.

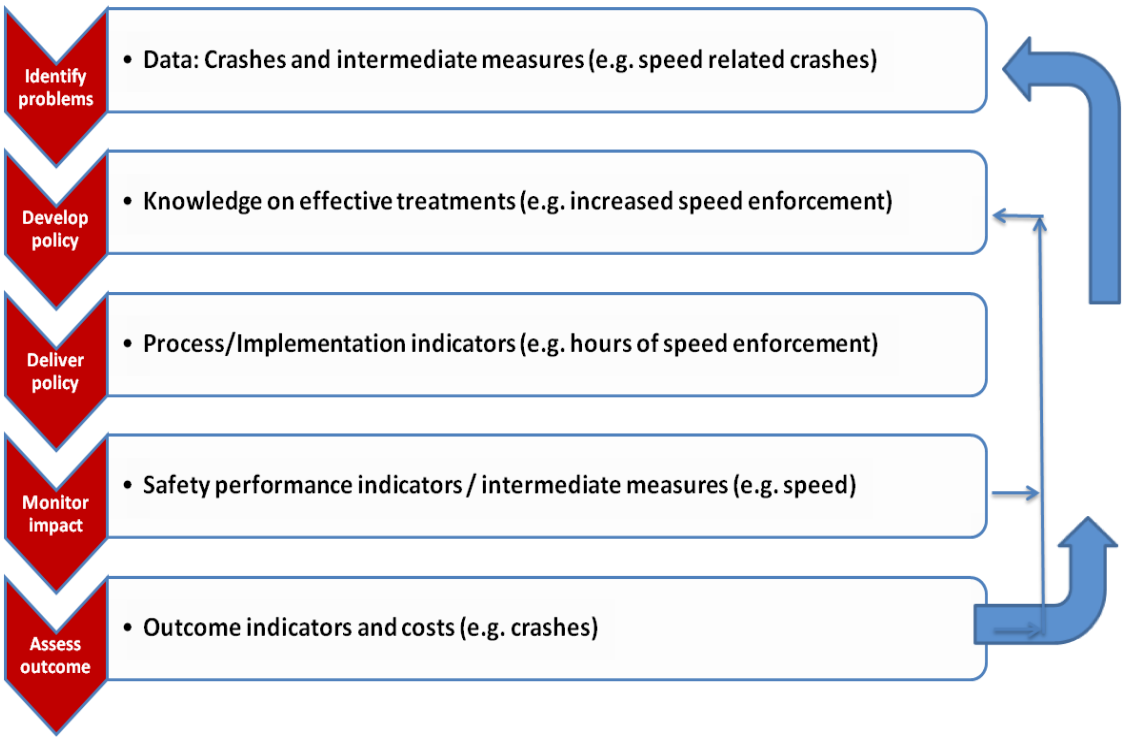


Figure 3-1 Use of an Efficient Road Accident Information System

The collection and analysis of the road accident records are core activities of the transport management system. Further, the national level road safety strategy formulation and implementation part is very much depends on the reliable road accident database system. The relationship among the component s of the road safety strategy and the accident database is presented in **Figure 3-2**.

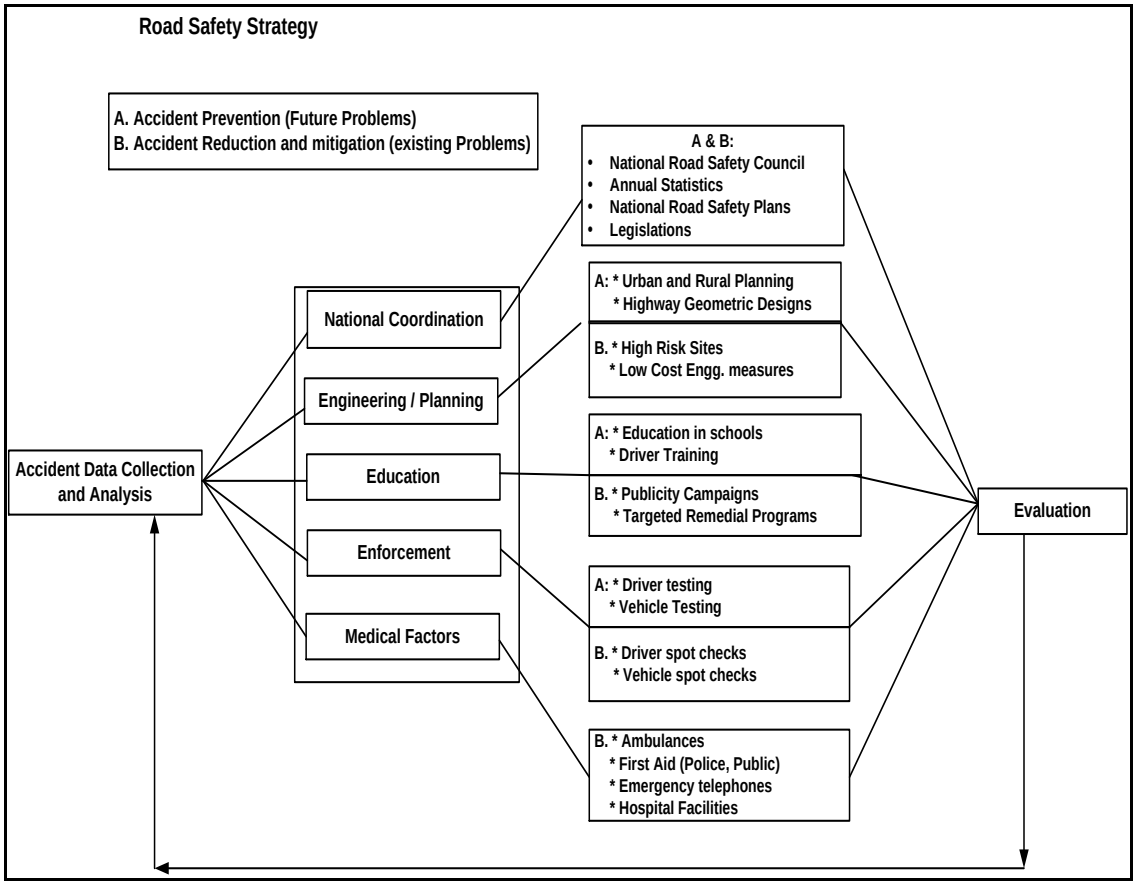


Figure 3-2 Road Safety Strategy and Accident Information System

The road accident data and their application are vital for the road transport management component. The road accident information management system components are: accident data reporting, recording (storage), utilization and dissemination. All these phase of the database system should be easy to handle and user friendly. These aspects of the road accident database are very relevant by the application of Information and Communication Technology (ICT). Application of ICT has been realized as an relevant in transport management sector and DoTM is implementing the project for application of smart-card for driving license and vehicle registration system. In this context, web-based data reporting, storage and analysis of road accident database system with the application of ICT has been discussed among the stakeholders and accepted the conceptual model for the development of the same.

The conceptual model for the establishment of Road Accident Information Management System (RA-IMS) is presented in the **Figure 3-3**. The steps for the model are described below.

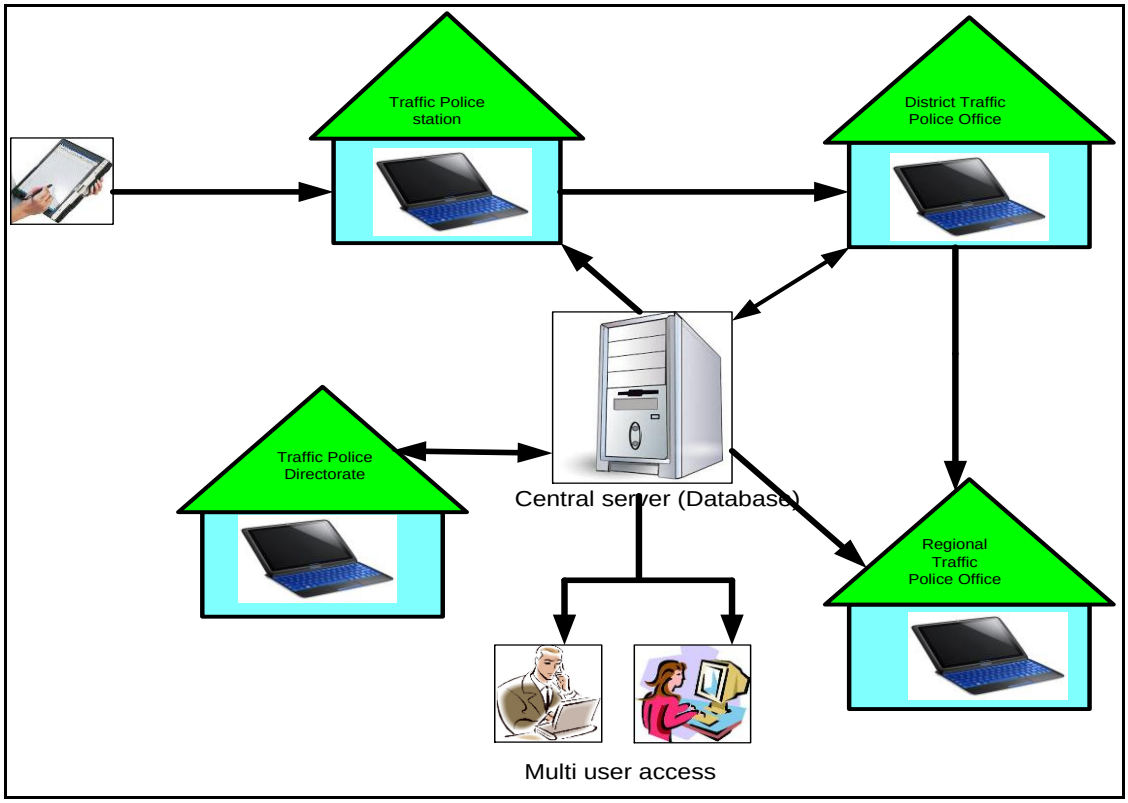


Figure 3-3 Conceptual Model of RA-IMS

a) **Accident Data Collection**: Traffic police with the use of mobile devices with the inbuilt software will record all the aspects of the accident information as shown in the Accident Report Form. At this stage of the field inspection, all activities are recorded offline. This is based on the site observation and measurement of site conditions. Main responsibility for this task will be given to the Traffic Police.

b) **Approval of the Site Information and Uploading It to the Central Server**: After the first hand information collected at the incident site, is brought to the traffic police station/offices and this information will be approved by the higher rank of the police personnel. Then it will be uploaded to the central server.

c) **Storage of Accident Records at Central Server**: The uploaded information on the particular accident will be stored on the central server i.e. will be maintained the central database on the road accident.

d) **User Applications and Analysis**: Concerned stakeholders will be provided by the user ID for the extract of relevant information on road safety and its analysis. This very simple process and reliable database will have tremendous advantage for the betterment of road transport management system.

CHAPTER 4 IMPLEMENTATION OF RA-IMS

4.1 INTRODUCTION

DoTM as the regulatory body in the transport management is responsible for the prevention and reduction of road accident. It has mandate to develop the road accident database system in coordination with Traffic Police and DoR. Road Safety Action Plan - 2012 has given the task to DoTM to establish a central crash database system. In this context, NIRTTP sub-project office at DoTM has taken initiations to establish the RA-IMS from the Kathmandu Valley as the pilot project. In this regard, DoTM has already conducted stakeholders' workshop for the identification of sustainability approach to establish the system. Ministry of Physical Infrastructure and Transport has taken the proposal of the implementation of the database system. Furthermore, MoPIT has agreed upon to allocate for maintaining the system in the future.

In this context, allocation of regular budget on the road accident data collection, reporting and maintaining the system will help to take initiation to establish the system by the NIRTTP sub-project office. RA-IMS implementation project is recommended to undertake by the DoTM by the assistance of NIRTTP sub-project office. The steps for establishment are as below:

a) Procurement of consulting services for software development, training of personnel at Traffic Police and DoTM,

b) Procurement of equipment's related to the data collection, storage and internet connection;

c) Installation of the server and distribution of the mobile devices to the traffic police stations;

d) Procurement of internet connection and technical services for at least one year.

The detailed ToRs for the procurement consulting services for software development and training of the personnel and supply of hardware required for the system are given in the Appendix -1 and Appendix -2 of this report.

4.2 DOTM INITIATION

DoTM has disseminated the idea regarding the Road Accident Information Management System with the major stakeholders. Department of Roads, Traffic Police, Ministry of Physical Infrastructure and Transport (MoPIT) has appreciated the concept in the workshop conducted on 6 Jan 2015.

The broad objective of the workshop was to disseminate the project concept on "Road Accident Information Management System (RA-IMS). The workshop participants acknowledged the concept and the representative from major stakeholders committed to assist to establish RA-IMS by the respective contributions.

Traffic Police has assured to adopt the RA-IMS system. However, the issue of the training of traffic police and infrastructure development was raised by Traffic Police in the workshop. Similarly, MoPIT has informally assured the flow of budget for the maintenance of the system in future. Other concern agencies have been widely consulted in the workshop. The workshop photograph is shown in **Figure 4-1**.

Figure 4-1 Workshop Photograph (6 January, 2015)

4.3 INSTITUTIONAL ARRAGEMENT

A Coordination Committee for RA-MIS is necessary to establish. It would be the governing body for the establishment, operation and maintenance of RA-IMS. The Committee will be headed by the DG of the DoTM and members from the other concerned institutions. It would play key role in the planning, and monitoring as well as time to time upgrading of the system.

4.3.1 Department of Transport Management

The day-to day operations will be the responsibility of IT Section at DoTM. The Director General would delegate its responsibility to the Technical Director. Technical Director would administer the IT section of the Department. Major responsibilities of DoTM may include:

- Coordination with other stakeholders for the operation, maintenance of the system.
- Planning and budgeting of the system and its approval from the MoPIT
- Monitoring the whole system and issuing the additional user ID.
- Coordination with the Ministry of Health for the status review and update related data in the system.
- Coordinate with the DoR and DoLIDAR for the purpose of sharing data and upgrading the road network system which is needed for the RA-IMS.
- Coordinate with the Road Safety Council for the planning, and budgeting for the road safety programs related to the DoTM responsibility mentioned in the Road Safety Action Plan.
- Coordinate with Government Integrated Data Center (GIDC) for the establishment of reliable database system.

4.3.2 Traffic Police Directorate

Traffic Police is the main actor for the collection of primary data for the system. Traffic Police Directorate (TPD) would have a dedicated unit for handling the accident data. TPD would take initiations for the establishment of system. It would organize the training of traffic police personnel for the operation of the system. The required infrastructure for the establishment and operation of the system at the traffic police stations would be prepared by the TDP. TPD will represent all the underlying traffic police offices for concerned issues of RA-IMS.

Traffic Police Directorate would formulate policy to train their personnel for the operation of RA-IMS. At the initial stage of the establishment of this system, TPD would have develop some kind of motivational scheme to train its staff and make them familiar for the application of IT in their day-to day job.

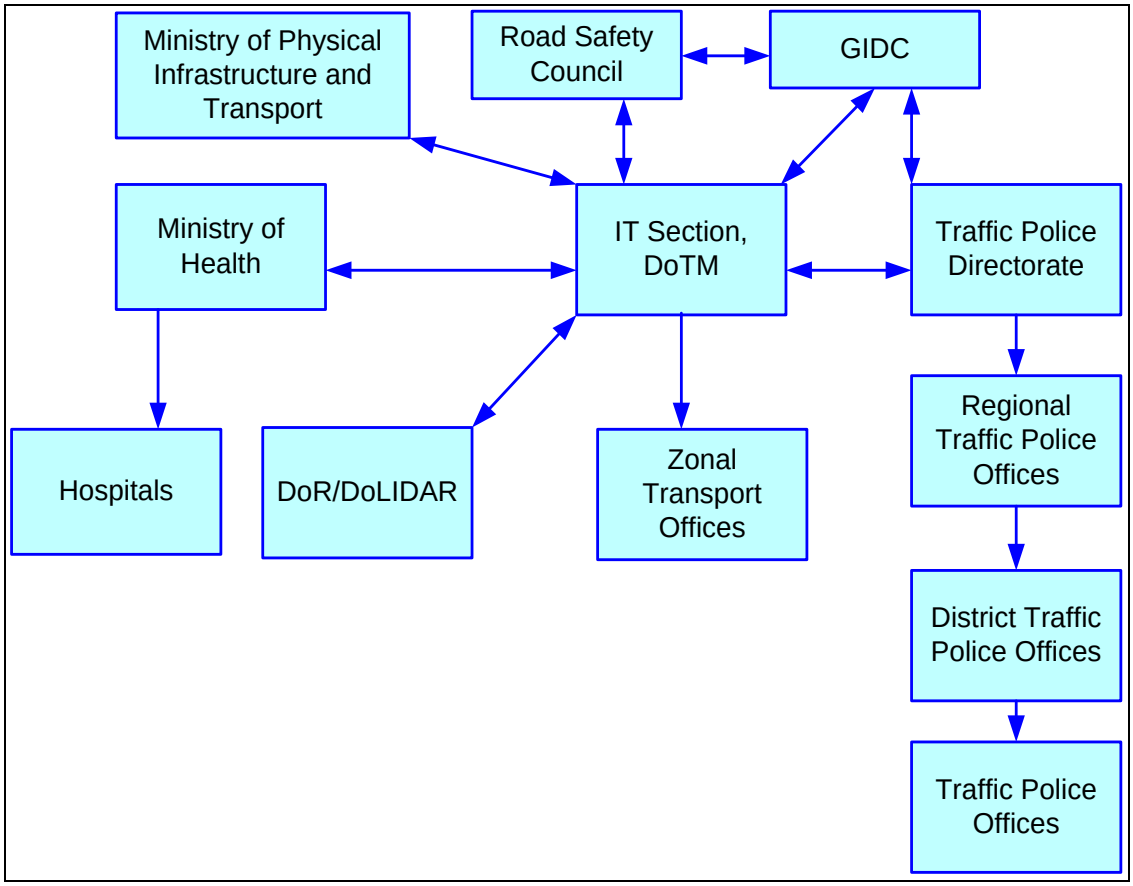


Figure 4-2 Institutional Arrangement for the Operation of RA-IMS

4.4 FUNDING APPROACH FOR RA-IMS

The Government of Nepal under the Ministry of Physical Infrastructure and Transport would responsible for providing the regular budget for the operations and maintenance of the RA-IMS. The system establishment at the pilot phase will be established by the NIRTTP project for Kathmandu Valley. Further, this system will be gradually extended to the other road corridor.

CHAPTER 5 INVESTIGATION OF ROAD ACCIDENTS

5.1 INTRODUCTION

Road accidents are complex phenomena which are occurred due to the several causes. The causes of the accidents and its consequences are very difficult to determine. The technical, human, environmental as well as social parts of the accident are always related to each other. The most common problem of the investigation of the accident is to identify the causes, the nature and the location of the incident. Similarly, investigation sometimes is related to quantifying the losses due to the accident.

The objective of the study is to develop an adequate method of investigation of accident for finding the causes of the accident and the mitigation. The proposed method of investigation is based on the international practices as well as the national level of practices and issues.

A safety oriented road accident investigation aims to identify accident causes and contributing factors; injuries, injury mechanisms and injury outcomes; and how the accident and injuries could have been prevented. The investigation therefore needs to adopt a holistic view of accident analysis. In order to get a holistic picture of an accident the investigation adopts a broader perspective than investigations aimed to gather data for the judiciary system.

Traffic Police with the responsibility of recording the primary accident information at the accident site adopts the standard type of accident record. However, the Road Accident Report (RAR) form filled is not sufficient to identify the causes of accident. The RAR is only the primary form of investigation. It does not have adequate technical methods to fill the form. The enhancement of road safety must be the only the purpose of the investigation activity. In this context, road accidents are needed to conduct investigation.

Safety oriented road accident investigation is the acquisition of all relevant information and the identification of one or several of the following:

- the cause or causes of the accident;
- injuries, injury mechanisms and injury outcomes;
- how the accident and injuries could have been prevented;
- is conducted by one or several investigators with specialized knowledge in accident investigation
- and other fields of knowledge, relevant for the purposes of the investigation;
- is aimed at preventing future accidents and injuries through the development of countermeasures;
- does not contribute to any judicial enquiry or take a stand on responsibilities.

5.2 RATIONALE

Most serious public transport accidents are investigated to a greater or lesser extent but, with some conspicuous exceptions, particularly with aviation, only a few are done with the aim of improving safety. Many have been investigated with the aim of apportioning blame or liability and although safety recommendations are often made, they frequently fail to identify some of the underlying causes of whatever went wrong.

An accident is rarely the result of a single event. More often, it is caused by a combination of unrelated events coming together. In many modes, the human element in this causal chain can be significant. People rarely make mistakes deliberately, but will often do things that have serious consequences. When an accident occurs, it is normally the result of one or more shortcomings in the existing transport system and new challenges to the man-machine interface are being introduced by new technologies in all transport modes.

In Nepal, recently MoPIT, has started to conduct accident investigations for major road accidents. The investigation must focus on improving the safety of the system and aim to answer five questions as:

- What happened?
- How did it happen?
- Why did it happen?
- What can be done to prevent a reoccurrence?
- What can be done to minimize accident consequences?

There are great benefits to be had from the proper investigation of both accidents and near accidents, sometimes referred to as incidents. An investigation will endeavor to establish not only the primary or initiating cause but also those that underlie the event. It is the desire to probe deeply into all the reasons for an accident that is the essence of a safety-oriented investigation. If mistakes have been made it is essential to find out why, to make recommendations to ensure they cannot be made again and to make public the lessons so that others may learn from them.

A key issue in any accident investigation is the status and impartiality of the body carrying out the inquiry. Any organization with an actual, or perceived, vested interest in the result is rarely able to act with total impartiality. Therefore, the investigation committee should be formed as independent body of experts. Further, the investigating body should not have to submit its report to any higher authority for approval before it is published. Without these criteria, there will always be the suspicion of a ‘cover up’ or a failure to take a robust stand with the regulatory authority of the state concerned and thus a lack of public acceptability.

5.3 LEVELAND TYPES OF ACCIDENT INVESTIGATION

Road accident investigations are carried out mainly for the major accidents. However, investigations should be carried out for the purpose of project planning, development,

implementing and monitoring of road safety programmes in the country. The investigation level can be distinguished as in **Table 5-1** below:

Table 5-1 Level of the Road Accident Investigations and Definitions

Level of investigation	Definition	Examples
Statistical data collection	Collection of anonymous accident data elements that are used mainly for monitoring trends and priority identification	National Statistics of traffic accidents
Intermediate level investigations	Medium-level investigations between the statistical and the in-depth, suitable for black-spot management	Qualified police reports − Insurance reports
In-depth investigations (independent as well as non-independent)	Detailed multidisciplinary investigation with a high number of variables, The aim is to prevent the reoccurrence of serious accidents by discovering structural failures and proposing corrective measures	In-depth Accident Study
Special accident investigations	Multidisciplinary investigations with case tailored methodologies. The aim is to prevent similar serious accidents by discovering structural failures and proposing corrective measures	Investigations having more numbers of accidents (as defined by the concerned authority)

5.4 INVESTIGATION TEAM

Good quality data can only be obtained by the qualified team of experts. This requires investigators to have undertaken training of experiences on the relevant field to ensure that they gain both specialist knowledge of conducting safety oriented road accident investigations and adequate experience. This can be achieved in established teams by novice investigators working alongside experienced investigators.

In the past, Government or MoPIT had formed investigation team with the members from the concerned agencies such as MoPIT, DoTM, Traffic Police, and Zonal Transport Management Offices. Such investigation team was formed for investigating a particular accident. Recently, MoPIT has issued a provision to investigate major road accidents within each development regions by the investigation team lead by the Regional Director of Regional Road Directorate. This investigation team comprises of technical staff from DoTM or its Zonal Offices, Traffic Police, engineer from Division Road Offices.

5.5 RECOMMENDTAION FOR ROAD SAFETY ORIENTED INVESTIGATION

The objective of the road safety oriented accident investigation is to establish transparent and independent causes and thereafter countermeasures for safety improvement. This can be formed

at central level or can be site specific or project led. In the latter form, investigation of blackspot locations can be conducted by a group or an individual road safety expert. This group can seek assistance or collaborate with traffic police, DoTM, for the site inspection and investigation. The recommendations specifically address the safety oriented investigation of a statistical sample of accidents, which aims ultimately to feed evidence based policy making. Safety oriented road accident investigations should be carried out on the regular basis to monitor the situations along the specific problematic areas or highway corridor. Different policy aims require different types of data, for example, developing vehicle safety systems, improving driver education or for the setting of targets for the reduction of fatal accidents. The following sections discuss on the important aspect related to road safety oriented investigation.

5.5.1 Establishment of Central Investigation Committee

It is recommended that MoPIT (Road Safety Council) should work out and approve instructional directives for the formation of Road Accident Investigation Committee. The committee members, terms of references and the duration of the committee should be clearly mentioned in the directives. The methodological guidelines for the committee should also be outlines in the directives.

The Road Safety Council would lead to the formation of Investigation Committee. The investigation committee would be assigned to study only for the severe accidents for the certain period. The independent experts in the related field would be nominated for the Investigation Committee.

The composition of the team may comprise;

(i) Joint Secretary (Technical), MoPIT

(ii) Road Safety Expert

(iii) Representative of DoR, Highway Engineer

(iv) Representative of DoTM, Mechanical Engineer

(v) Representative of Traffic Police

5.5.2 Procedure of the Investigation

The investigation of accident is recommended to carry out by the following methods:

- **Desk-study of the Accident related Documents**: The committee members will study on the nature of the road corridor (geometry, alignment, settlement etc.), traffic flow pattern, and other specific documents on the accident site and accident type. The expert team should review the existing norms and standards on the vehicle speed, geometric characteristics, vehicle parameter (such as require stopping sight distances etc.), etc.

- **Site Inspection and Field Mobilization of the Team**: The committee will detail sketch out the accident site including the before and after scenarios related to the road and road side conditions, vehicle damage and other sign of accidents.
- **Vehicle Examination**: The vehicle/vehicles involved in the accident should be examined in detail by the respective expert.
- **Interaction**: Interaction with the stakeholders, drivers involved in the accident, passengers, pedestrians, and other road side dwellers.
- **Report Preparation**: After the collection of all relevant information the committee will prepare the report.

5.6 VERIFICATION OF ACCIDENT DATA FROM OTHER SOURCES

In general accident data is underreported in many country. The causes for the underreporting may be the lengthy and slow administrative process for the formal dispute resolution after the accident. If the accident compensation issue is resolved at the local level such accidents are not recorded by the traffic police.

Major issue of underreporting is related to the injury cases. Minor injuries are generally not recorded due to the absence Traffic Police. Similarly, accidents with the minute property damage are also not recorded. These cases are resolved by the negotiation at the accident spot. Accidents with the serious injuries are transferred to the hospitals for the treatment. The hospital records could be useful to verify the accident data. Further collection of published news in the National Daily Newspaper could also be the sources of verification to the accident data maintained by the traffic police.

5.7 TYPICAL ROAD ACCIDENT INVESTIGATION REPORT

The typical road accident investigation report shall contain the following chapters and sub-topics.

Acronyms and Definitions

Executive summary

1. Introduction
    1.1. Background
    1.2. Accident site description
    1.3. Scope, Purpose, conduct and Methodology
2. Accident facts and analysis
    2.1. Accident description and chronology
        2.1.1. Background and accident description
        2.1.2. Chronology of Events
            2.1.2.1. Pre-Crash Events Description
            2.1.2.2. Crash Events Description
            2.1.2.3. Post-Crash Events Description
    2.2. Accident Response
    2.3. Accident Notifications and Team Formation
    2.4. Ancillary Issues
3. Analysis
    3.1. Events and Causal Events
    3.2. Barrier Analysis
    3.3. Safe Start Program Analysis
    3.4. Speed and Stopping Distance Analysis
    3.5. Casual Factors
4. Conclusions and Judgments of Need
5. Committee Signature and support staff
6. Annexure of on the specific study will be based on the general

5.8 CAUSES OF ACCIDEN

Various causes of accidents are grouped into three components as:

- Drivers' fault
- Road and road-side conditions
- Vehicle conditions

5.8.1 Unsafe Act of Driver

Drivers are main actors in any road accidents. Therefore, their acts should be defined in the way that they would not be blamed by any other failure of the system. The unsafe actions of the drivers are very favorable for any accidents. These unsafe actions are mentioned as:

- Failure to observe clearance
- Failure to signal intentions

- Failure to yield right of way
- Speed too fast for conditions
- Following too close for conditions
- Improper backing
- Improper parking
- Improper passing
- Improper turning
- Operating equipment without authority
- Unsafe acts of others
- Driving while under the influence of alcohol or drugs
- Insufficient visibility
- Operating beyond vehicle capacity – overweight
- Operating defective equipment
- Operating for excess hours of service – fatigue
- Operating without proper equipment
- Operating without proper license – driver
- Reckless driving
- Other

5.8.2 Unsafe Conditions of Vehicle/Road

Road and vehicle conditions are equally important for safe driving. These aspects are very prominent to be considered while investigation of accidents. These unsafe actions are mentioned as:

- Carbon Monoxide hazard
- Defective brakes
- Defective personal protection
- Defective turning signals
- Defective tires
- Inoperative lights
- Road conditions
- Road illumination
- Vehicle loaded improperly
- Excessive load
- Unauthorized or illegal cargo
- Others

5.8.3 Unsafe Contributing Factors for Driver

Road accidents are very much related to the drivers' conditions. These conditions should be taken into consideration during the accident investigation. These unsafe actions are mentioned as:

- Personal impairment -- Alcohol/Drug Abuse
- Distraction
- Personal impairment -- Emotional/Mental state
- Equipment modified
- Personal Impairment – Fatigue
- Inadequate maintenance
- Interior hazard inside vehicle
- Lack of knowledge/skill/training
- Personal Impairment - Physical capabilities
- Procedure improvised or not followed
- Unsafe act of others
- Other/none

5.8.4 Basic Causes/ Contributory Factors

During the accident investigation contributory factors may be considered as:

- Inadequate correction of known vehicle hazards
- Inadequate design/mechanism
- Inadequate enforcement of operators' rules
- Inadequate hazard identification system
- Inadequate vehicle inspection program
- Inadequate maintenance
- Inadequate personal protection
- Inadequate pre-job planning
- Inadequate purchasing standards
- Inadequate company rules
- Inadequate employee selection or hiring
- Inadequate training or orientation
- Inadequate or failure to warn driver of hazards
- Other/none

CHAPTER 6 ROAD ACCIDENT COST

6.1 INTRODUCTION

Road transportation in Nepal has been a major factor for development by increasing mobility which has fostered trade, access to markets, education and health care. But, the increase in transportation has not been without a set of negative side effects particularly in the form of road traffic accidents. Poor quality of the roads; old and not maintained motor vehicles; immature and undisciplined drivers of both public and private vehicles; non-functioning driving laws; and weak police force to monitor transport and road safety are some top causes that have resulted increased road traffic accidents in Nepal. However, neither investigation of causes of accident is carried out after an accident nor any prevention method is applied.

Accident database is maintained by the Traffic Police. However, these figures do not give the real picture of number of road traffic accidents because a large number of them are not reported. These accidents bear an enormous impact on society in terms of human loss, pain and suffering, and cost to the economy and the individual. Hence, it has become essential to estimate the cost of road traffic accidents to highlight the socio-economic burden from the accidents.

Being able to calculate the cost of an accident means that the potential benefit of solutions that would reduce the number of accidents can be calculated. This provides a way to compare the benefits of proposed accident solutions with the costs of implementing them in order to provide the maximum benefit for the money available for investment.

First effort to estimate costs of road traffic accidents in Nepal was done by Department of Roads (DoR) with grant from ODA in 1996 and a report, "The Road Accident Costs, Department of Roads, June 1997" was prepared in 1997. Second effort was done by (DoR) itself during the implementation of Road Connectivity Sector I Project and a report: "Cost of Road Traffic Accidents in Nepal, 2008" was prepared. Since then no effort has been done yet to estimate cost of vehicle accidents in Nepal.

6.2 CLASSIFICATION OF ACCIDENTS

In order to estimate costs of road traffic accidents it is important that a country has a consistent classification of the accidents. Accidents either involve personal injury to a person together with vehicle damage or not and vehicle damage only. Personal injury accidents are classified as being either fatal or serious or slight. Accidents are usually subdivided into the following categories (definitions used by most Western European countries, as well as by the WHO/UNRSC Data Manual, UNECE and IRTAD):

a) A fatal accident is one in which one or more persons are killed as a result of the accident provided death occurs within 30 days.

b) A serious accident is one in which there is no death but one or more persons are seriously injured. A serious injury is either one when a person is detained in hospital as an "in patient", or if any one of the following injuries are sustained whether or not he or she is detained in a hospital:
   - Fractures,
   - Concussion,
   - Internal injuries,
   - Crushing,
   - Severe cuts, and
   - Lacerations or severe general shock requiring medical treatment.

c) A slight accident is an accident in which there is no death or serious injuries but a person is slightly injured. This can be an injury of a minor character such as a cut, sprain or bruise.

d) A damage only accident is one when no one is inured but damage to vehicles and or property is sustained.

It should be noted that accident severity is defined by the most serious casualty class of any of the victims of the incident. The "cost of an accident" is therefore not the same as the "cost of casualties" resulting from that accident, at a more disaggregated level.

6.3 OVERVIEW OF ROAD TRAFFIC ACCIDENT COST VALUATION APPROACHES

The cost of road traffic accident includes costs associated with injuries such as costs to victims, families, government, insurers, and taxpayers and costs of property damages. Costs associated with a vehicle accident can be either prevalence based or incidence based. Prevalence based costs measure all injury related expenses during one year regardless of when the injury occurred. Incidence based costs sum the lifetime costs that are expected to result from injuries that occur during a single year. Incidence based costs are computed by multiplying the number of injury victims times lifetime cost per victim. It measures the savings that prevention can yield.

The papers by Hills and Jones-Lee (1981, 1983) have presented six different approaches for estimating cost of road traffic accidents. Similarly, International Road Assessment Program (iRAP) has also proposed a very simple approach for estimating road traffic accident costs in developing countries. All of the approaches are applicable to nonfatal as well as to fatal accidents. However, several criteria should be taken into consideration when selecting which accident valuation method to use, namely the objective of the evaluation as well as the ease of application in terms of data availability and validity of assumptions. The approaches are explained in below.

6.3.1 The "Gross Output"(or Human Capital) Approach

The 'Gross Output' approach or the Human Capital approach usually considers both direct (i.e., medical, damage to vehicles, administrative costs including insurance, police, court, etc.) and indirect (lost productivity) costs. Information is therefore required on: average wage rates,

adjustments may have to be made for self-employed agricultural workers and "unpaid" workers such as housewives; length of absence from work as a result of the accident (by casualty severity); in-patient hospital costs including average length of stay in hospital and average cost of treatment (by casualty type), out-patient costs including the number of out-patient visits and average costs of such a visit, average costs of general practitioners and the ambulance service.

Usually average wage rates (gross of tax) are considers for the year in which death occurred and then for future years. Costs in future years that the casualty might have lived is discounted back to give present day values. This is not done separately for every individual killed or injured in a road accident. Estimates are based on average (i.e. national) output or earnings data together with appropriately estimated damage, medical, insurance and police costs.

The human costs of pain, grief and suffering cannot be estimated from an analysis of observed data using the Gross Output method. TRL Overseas Road Note 10 has recommended the values for pain, grief and suffering to be used in the absence of more localized data. The note recommends adding 38% of the total cost for a fatal accident, 100% for a serious injury and 8% for a minor injury to the cost. In developed countries, another study suggests the sums added should be equal to 20% for a fatal accident, 50% for a serious accident, 30% for a major accident and 1% for a minor accident. It should be noted that the values represented by these percentages are essentially arbitrary.

Most researchers and organizations (TRL, ADB, iRAP, etc.) suggest using the "Gross Output" method to estimate the cost of road accidents in developing countries.

This approach has clear disadvantages, as it focuses only on the economic effects of the loss of life and does not account for the value and enjoyment of life forgone. This grossly underestimates the true value of prevention of road accidents and produces lower values than the estimate based on willingness to pay.

6.3.2 The "Net Output" Approach

The Net Output approach subtracts the amount of the discounted value of the victim's future consumption from the gross output value. However, it is difficult to derive an estimate what a person "consumes" (in terms of food, fuel etc.) throughout his or her remaining lifetime. When this method was used in the UK to cost road accidents (being replaced in the early 1970's by the gross output approach), the 'total consumer expenditure and the public authorities' current expenditure on goods and services" was divided by the total population. A crude estimate of "consumption per head" was thus obtained. In this approach, the difference between an individual's gross output and future consumption may be regarded as a measure of the rest of society's economic interest in his continued survival.

6.3.3 The "Life Insurance" Approach

The life insurance approach treats the cost of an accident is the amount for which a typical individual is willing to insure his own life. However, the amount of insurance cover may be he or she values his or her life to the dependents. It does not consider the value of life to the insured person himself or herself. Thus a bachelor with no dependents may insure for little sum, whereas a person with several children may insure his or her life for a much greater sum. Another problem with this approach is that the level of life insurance cover may be well below what it `ought' to be if the intention is to provide income on which his or her dependents are to survive. Further, to base any analysis on the basis of insured population alone is almost certainly to choose a biased sample. This approach is of particularly limited value in developing countries where relatively few people carry life insurance.

6.3.4 The "Court Award" Approach

The court award approach considers the amounts awarded by the court to the surviving dependents of those killed as indicative of the cost of fatalities. This method estimates the value of life or injury by averaging the sums awarded by courts, which result from a crime or a negligence, to the surviving dependents or the injured person.

The cost only includes private costs, i.e. not necessarily hospital costs met by the state. In addition, any sum awarded by the court will have all taxes removed. From these it can be assumed that use of court awards as implied values for the loss of life or limb in a road accident is an imperfect estimate. This approach is of limited interest because the sums awarded by courts depend greatly on the degree of responsibility of the culprit.

6.3.5 The "Implicit Public Sector Valuation" Approach

The Implicit Public sector valuation approach derives cost of an accident from implicit sums placed on accident prevention legislation or decisions that affect road safety.

The main problem with this approach is that public policies attribute very different values to life depending on the sector. In UK, studies have shown that using this approach the value of life could range from 50 to 20 million Pounds (about the range of 75 to 30 million US $).

6.3.6 The "Value of Risk-Change" or "Willingness to Pay" Approach

The Willingness To Pay (WTP) approach attempts to account for the shortcomings of the human capital approach by considering more than just the workplace output of an individual. This approach determines the value of life based on a person’s willingness to pay for small reductions in the probability of dying. WTP values are determined using contingent valuation or stated preference surveys or by analysis of revealed preference data.

Contingent valuation method is a survey-based economic technique for the valuation of avoiding the death of an unidentified person. Questions in contingent valuation surveys tries to determine

how much people value hypothetical reductions in risk and these valuations are then aggregated across the population to determine the value of a statistical life. This method has been much more widely used to determine Value of Statistical Life (VOSL) estimates in a greater number of countries and situations.

Revealed preference surveys obtain values of WTP through questionnaires designed to gather information on a person's investments in purchasing risk reduction devices such as airbags, helmets, etc.

The stated preference survey method involves a series of scenarios requiring people to choose between two routes with different levels of safety, travel time, and other characteristics. Statistical analysis is then used to derive the VOSL.

The WTP approach generally estimates the value of life higher than that estimated using the human capital method. This is a direct result of the willingness method's greatest advantage i.e. measurement of total value of life rather than just job market value. The higher value estimated using willingness includes the value of forgone earnings as well as the value from leisure and simply life itself.

This method has been used more and more in developed countries but due to the difficulty of obtaining reliable empirical estimates, this approach is hard to apply in developing countries. Furthermore, questionnaires could only be administered to adults and there would be an important bias considering that the proportion of children killed or injured in traffic crashes in developing countries is double the one in developed countries. Surveys have also shown that respondents are relatively insensitive to small variations in risk.

6.3.7 The Rule of Thumb Approach

An alternative approach for estimating cost of road accident was investigated by International Road Assessment Program (iRAP) during the study of "Valuing Life and the Cost of a Serious Injury". The study explored the practicality of deriving a relatively simple "rule of thumb" drawing on available data and results from both Willingness-To-Pay and Human Capital studies from a range of countries. This started from the hypothesis that the level of income in a country is a primary determinate of the Value of Statistical Life (VOSL).

In developed countries, the study found ratio of the VOSL to the per capita GDP varies between 42 and 86 with a mean and median of 63. In developing countries the ratio of VOSL to per capita GDP ranges between 14 and 62 with a mean of 42 and a median of 40.

When the ratios between developed countries and developing countries were compared, it was clear that the developed countries' ratios tend to be higher particularly when they were based on a Willingness-to-pay approach. Although the ratios for developing countries were more variable, overall the range of ratios was narrower than might have been expected. Based on the findings the iRAP study has suggested to use the ratio of VSL to GDP per capita for obtaining workable

estimates of the Value of Statistical Life for developing countries. **Table 6-1** shows the suggested values.

Table 6-1 Values for Fatal and Serious Injuries

Values	Lower	Central	Upper
Value of Fatality	60*GDP/Capita	70*GDP/Capita	80*GDP/Capita
Value of Serious Injury	12*GDP/Capita	17*GDP/Capita	24*GDP/Capita

Source: "Valuing Life and the Cost of a Serious Injury", International Road Assessment Program (iRAP), 2008)

Table 6-2 Values for Developing Countries

Country	VSL	Per Capita GDP	VSL/per capita GDP	Year	Currency	Method
Cambodia	18,864	317	60	2002	$	HC
Philippines	41,330	982	42	2003	$	HC
Thailand	2,741,064	85,890	32	2002	B	HC
Vietnam	162,620,000	7,582,788	21	2003	D	HC
Lao	4,617	336	14	2003	$	HC
Indonesia	255,733,113	8,645,085	30	2002	Rp	HC
Malaysia	1,200,000	15,811	76	2003	RM	WTP
India	1,311,000	23,578	56	2004	Rs	WTP
Myanmar	4,806,909	144,967	33	2003	MK	HC
Bangladesh	889,528	16,169	55	2002	Tk	HC
Latvia	276,327	4,807	57	2006	LVL	HC
Poland	1,056,376	27,585	38	2006	PLM	HC
Lithuania	1,018,269	16,405	62	2003	LTL	HC

Source: "Valuing Life and the Cost of a Serious Injury", International Road Assessment Program (iRAP), 2008)

6.4 APPROACHES FOLLOWED IN DIFFERENT COUNTRIES

There is no international consensus about how to estimate road accident costs and its longer term consequences. The least controversial item is the direct cost of crashes including medical costs, non-medical costs (e.g. criminal prosecutions), vehicle costs (e.g. repairs and towing) and general costs (e.g. police and emergency services). The most controversial issue is that the indirect cost such as loss of productivity and health related quality of life. Earlier studies in the 1950s and 1960s calculated indirect human cost using the human capital or lost production approach without including a value for loss of quality of life. In the period from 1970s until the late 1980s, a number of countries added an arbitrary value entitled 'pain, grief and suffering' to the value of lost production as a means of capturing the lost quality of life as a consequence of a road crash.

Most of the countries currently include following five cost components in their estimate of the costs of road accidents:

- Human costs: immaterial costs through suffering, pain, sorrow and loss of quality of life;
- Production loss: loss of production and income resulting from the temporary or permanent disability of the injured, and the complete loss of production of fatalities;
- Property damage: damage to vehicles, freights, roads and fixed roadside objects;
- Medical costs: costs resulting from the treatment of casualties, e.g. costs of hospital stay, rehabilitation, medicines and adaptations for the handicapped; and
- Administrative costs: in this category costs of police, fire brigade, law courts and administrative costs of insurers are taken into account.

6.4.1 Human Costs

In most High Income Countries (HICs), human costs are derived based on WTP. Australia and Germany estimate the human costs on the basis of compensation payments as determined in law courts or statutory values. Singapore and all Low and Medium Income Countries (LMICs) use a rule of thumb as proposed in a guideline for cost studies in developing countries, meaning that human costs are estimated as fixed percentages of the total costs per fatality, serious injury and slight injury respectively.

Almost all countries also estimate the human costs of (all) injuries. In US, the values of injuries are based on 'Quality Adjusted Life Years' (QALYs). For five injury categories, based on the Maximum Abbreviated Injury Scale (MAIS), the number of QALYs is estimated and the human losses are calculated using a value per QALY. Australia and Germany use compensation payments as an indicator for the human costs of injuries, and in the Asian countries the rule of thumb method. Other countries use the ratio between the human costs of a (serious or slight) injury and the VOSL that is found in other countries or recommended in European studies. These ratios are based on studies into the human costs of road injuries in the UK.

6.4.2 Production Loss

To estimate production loss 'human capital' method is used in LMICs and WTP method is used in HICs. Both approaches in their estimate of the costs of road accidents include a component of consumption loss, which means a correction is needed to avoid double counting. In most countries consumption loss is deducted from the VOSL, resulting in human losses. Consumption loss is then included in production loss (known as 'gross production loss'). Exceptions are Belgium and Switzerland that include consumption loss in the human costs. These two countries calculate the net production loss (gross production loss minus consumption loss).

6.4.3 Property Damage

In most countries this is done by deriving the average property damage per accident (in most cases for different accident severities) from insurance data, and estimating the number of accidents on the basis of police registrations, insurance data, and assumptions. A problem with

this approach is that the estimate of the number of accidents, particularly property damage only accidents, is uncertain due to incomplete registration.

The estimates of non-claimed damage range from 22% (Austria) to about 50% (Netherlands) of total property damage. The UK is the only country where a study into the non-claimed damage has been carried out using questionnaires.

6.4.4 Accident Costing in Japan

The benefit from traffic safety is measured in terms of human damage (casualties and injuries), material damage, public loss arising from emergency reduces or accident management, and loss due to traffic congestion by an accident. An occurrence rate of rate of a traffic accident varies with factors such as road type, roadside type, road structure and characteristics of road traffic. Therefore, the damage cost is specified with the types of these factors. The characteristics of a traffic accident occurrence (frequency and severity) differ with the road type, national freeway, access controlled roads and ordinary roads. The damage cost of human injuries, occurrence rate of human injury and loss per accident are then to be calculated with the formula defined for each category.

The total loss by traffic accident in a road network is the sum of the loss at each link, calculated according to road type, roadside type and the road structure. The total traffic safety benefit is the change in total damage cost. The practice used in Japan is explained from "Guidelines for the evaluation of Road Investment Projects".

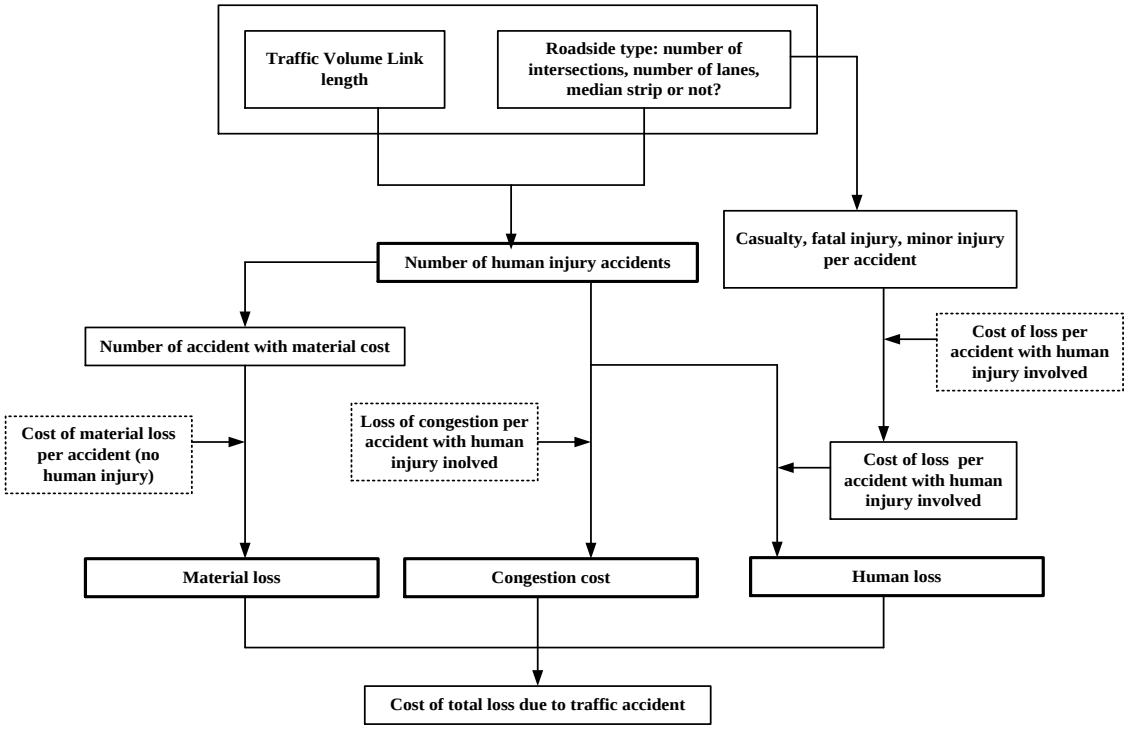


Figure 6-1 Structure of Traffic Accident Loss Calculation in Japan

The average cost of human accident has been calculated as follows:

Average damage cost of human accident = human loss due to human accident
+ material loss due to mterial cost
+ loss due to traffic congestion caused by accident

6.5 RECOMMENDATION OF METHOD FOR COSTING ROAD TRAFFIC ACCIDENT

The above mentioned seven approaches substantially differ in approach and the resultant cost estimates vary to a great extent. While the life insurance and court award approaches provide slightly higher estimates. Similarly, implicit public sector valuation provides quite low accident cost. Since, the net output approach requires subtracting amount of discounted value of the victim's future consumption from the gross output value which is also difficult to estimate.

The Willingness-To-Pay approach is conceptually appealing but has practical problems in being applied in Nepal as the methodological approach required to produce estimates is costly and requires sophisticated survey techniques.

Although the output approach generally provides moderate cost of accident, it is used in many developing countries. It requires lot of data collections and takes long time for analysis of data and estimate costs.

Considering all methodologies of costing road traffic accidents and difficulties to implement those following steps are recommended for costing road traffic accidents:

6.5.1 Estimation of Value of Statistical Life (VOSL)

It is recommended to use following relations to estimate VOSL of a person:

i. Value of VOSL for Fatal Accident = 60*GDP per capita of Nepal
ii. Value of VOSL for Serious Injuries = 12*GDP per capita of Nepal

The estimated values of human capital of Nepal were calculated in 1996 and 2007. Methods used during the studies were Gross Output method (human capital approach). The estimated human costs were Rs.204632 and Rs.228019 respectively. These values were 17 and 11 times per capita of 1996 and 2007 respectively. The calculated values were very conservative and do not represent actual values as they were calculated based on very limited data. Hence, it is thought consider values obtained from above calculations.

6.5.2 Estimation of Property Damage Costs

Vehicle damage cost data are advised to collect from following four sources:

i. Transport operators
ii. Repair workshops
iii. Insurance companies, and
iv. Families of dead and injured persons

Transport operators such as Federation of Nepal National Transport Entrepreneurs (FNNTE), Federation of Tipper and truck Entrepreneurs of Nepal (FTTEN), SajhaYatayat, Nepal Yatayat, SanyuktaYatayat, etc and others can be good sources of costs of vehicle damage during road accidents excluding damages during riots. Data on vehicles damaged by category of vehicle and by type of accidents such as fatal, severe, minor and Property Damage Only (PDO) should be collected. A suitable questionnaire should be first designed to obtain cost related data.

There are many auto workshops in Kathmandu with highly-skilled and semi-skilled mechanics. These workshops can be good sources of costs of vehicle damage during road accidents excluding those of damaged vehicles during riots. Data on vehicles damaged by category of vehicles and by type of accidents such as fatal, severe, minor and PDO should be collected. Suitable questionnaires should be first designed to obtain cost related data.

Currently, as per government rule all commercial and private vehicles need to be insured. Similarly, all banks have made it mandatory to insure vehicles for loan payments. Due to this obtaining data of value of claims for vehicle damages should not be difficult. As for operators and workshops suitable questionnaires should be first designed to obtain data on claims related to vehicle damage during road accidents. Data on vehicles damaged by category of vehicle and by type of accidents such as fatal, severe, minor and PDO should be collected.

Families of dead and injured persons could be best source of obtaining vehicle damage costs. Addresses of these families can be obtained from hospital and police records and vehicle registration number.

The average repair costs obtained from above sources need to be adjusted to calculate the total net vehicle related costs incurred in road accidents. This includes the following calculation:

Cost of vehicle Damage =
= The Average Vehicle Repair Cost
- Customs of duties and tax on spare parts and any salvage estimate
+ insurance excess (insured vehicle only) + survey fee (insured vehcile only
+ lost business (commercial vehciles only)

According to the TRL's Costing Road Accidents in Developing Counties (1995), an adjustment factor is needed to compensate for lack of reasonable information on vehicle repairs according to accident injury severities. The adjustment factors are as follows:

i. Fatal Accident 1.55 times average repair cost
ii. Serious Injury Accident 1.40 times average repair cost
iii. Minor Injury Accident 1.25 times average repair cost
iv. PDO Accident 0.85 times average repair cost

If the obtained data from different sources seem underestimated it is recommended to apply above factors for reasonable estimate of property damage costs.

6.5.3 Medical Costs

Medical costs are often the first and most tangible economic burden experienced by victims' families, even though medical costs account only for a small percentage of total road accident cost. Basic sources of data on medical costs include hospital medical records and nursing homes, insurance payments and families of victims.

Estimates of hospital costs such as costs of beds, X-rays, pathology tests and other hospital related costs can be obtained from the records of hospitals and nursing homes. Currently, most of them have computerized data system.

General estimates of medical costs can also be obtained from insurance companies. The most reliable source of estimate of medical costs can be the bill payments by families of victims to hospitals, clinics, doctors, etc. Addresses of these families can be obtained from hospital and police records and vehicle registration number.

To the medical cost estimated from above sources it is also advisable to add average funeral costs for fatal accidents.

6.5.4 Administration Cost

The administration costs are low compared to other cost components. Hence, it is advised not to spend much time and effort in producing detailed estimates of these costs because of the sector's complexity. Alternatively, TRL has advised to use following values for administration costing in developing countries after their analysis from previous international case studies:

Value for Administrative Cost =

i. 0.2% of total resource cost for Fatal Accident,
ii. 4.0% of total resource cost for Serious Injury Accident,
iii. 14 % of total resource cost for Minor Injury Accident, and
iv. 10 % of total resource cost for PDO Accident

Whereas,

$$\mathbf{Totalresourcecost} = (\mathbf{VSL} + \mathbf{medicalcost} + \mathbf{Costofpropertydamage})$$

Above factors are suggested to estimate administration cost of road traffic accidents in Nepal also.

6.5.5 Human Costs

Apart from cost elements that directly and indirectly affect accident victims and the economy, accidents have other effects such as Pain, Grief, and Suffering (PGS) that adversely affect quality of life. These human costs are therefore added to the overall estimate of road accident cost.

The following values for PGS are suggested by Transport Research Laboratory suitable to use in developing countries:

i. 28% of the total cost of a fatal accident,
ii. 50% of the total cost of a serious injury accident,
iii. 8% of the total cost of a slight injury accident, and
iv. 0% of the total cost of a damage only accident.

During the study of "The Road Accident Costs, Department of Roads, June 1997" the cost of PGS was estimated as 20% of the total cost of each type of accident. This value is suggested to use as value of PGS while estimating road traffic accident cost.

6.5.6 Computation of National Road Accident Costs

National costs of road accidents should be calculated by multiplying the estimated individual road accident costs by the estimated number of road accidents.

Table 6-3 Steps of Estimating Traffic Accident Cost

SN	Heading	Methodology
1	**Estimation of Value of Statistical Life (VOSL)**	1. VOSL for Fatal Accident = 60*GDP per capita 2. VOSL for Serious Injuries = 12*GDP per capita
2	**Estimation of Property Damage Costs**	Cost of net vehicle damage = [the average vehicle repair cost - (custom duties and sales tax on spare parts and any salvage estimate)+insurance excess (insured vehicles only)+ survey fee (insured vehicles only)+ lost business (commercial vehicles only)].
3	**Medical Costs**	1. Includes hospital costs such as costs of beds, X rays, pathology tests and other hospital or nursing home related costs. 2. Sources are records of hospitals and nursing homes, insurance payments and families of victims.
4	**Administration Cost**	Value for Administrative Cost = i. 0.2% of total resource cost for Fatal Accident, ii. 4.0% of total resource cost for Serious Injury Accident, iii. 14 % of total resource cost for Minor Injury Accident, and iv. 10 % of total resource cost for PDO Accident
5	**Human Costs**	20% of the total cost of each type of accident.
6.	**Total Accident Cost**	Total of 1+2+3+4+5
6	**National Road Accident Costs**	6*total number of accidents in a year

CHAPTER 7 COMPENSATION OF ACCIDENT VICTIMS

7.1 INTRODUCTION

Road Accidents are inevitable events for our society. The components of the road accident occurrence and its sequential consequences are very painful to the particular victim of the accident. Road accident preventive actions are very much highlighted by the government agencies in many aspects. Investments on the infrastructure improvement, regulatory provisions as well as educational measures are in the forefront in this regard. However, post-crash responses have not been well worked out in comparison to the earlier statement. The post-crash responses regarding rescue and medical treatment are easily talked in the society. But the detail scenarios of post-crash are very painful to the victims and their relatives as well as the society. It has very huge intangible aspects of the victims' compensations.

Compensation of road accident victims are understood as the provision of third party insurance claim after having bodily damage after having an accident. However, the issues are not such simple in the various context of the society. The compensation to the victims may arise due to the following reasons:

7.1.1 Road Accident

An occurrence in which bodily damage is caused to a person as a result of the use of a motor vehicle, for purpose of transportation; an event caused as a result of an explosion or catching fire of the vehicle, caused by an element of the vehicle or by a material essential for the vehicles ability to operate, even if resulting from a cause outside the vehicle, will be deemed as a road accident; as will an event caused due to an impact with a vehicle parked in a forbidden place, or an event caused by use of the mechanical power of the vehicle, provided that the said use did not change the original purpose of the vehicle; however, an event, resulting from an intentional act designed to cause damage to a person or property of the same person, and the damage caused as a result of the action itself and not by the effects of the action on the uses of the motor vehicle, will not be deemed as a road accident.

7.1.2 Bodily Damage

Death, illness, injury or a physical, mental or intellectual defect, including harm caused to a device required for the operation of one of the body parts, which was attached to the injured persons' body at the time of the road accident.

7.1.3 Use of a Motor Vehicle

Driving a motor vehicle, entering or exiting thereof, parking, pushing or towing thereof, roadside treatment or roadside repair of the car, performed by the user or by another person not in the course of his occupation, including the rolling down or turning over of the motor vehicle, disengagement or falling of a part of the motor vehicle or its cargo while in transit, as well as

disengagement or falling of, as mentioned, from a standstill or parked motor vehicle, while not in maintenance of a person in the line of his business, and excluding the uploading or downloading of cargo while the motor vehicle is standing still.

7.1.4 The Insurance Provision

The Motor Vehicle Insurance provision (Third-Party Insurance) as mentioned in Chapter 8 of the MVTMA-1993 and respective laws in the MVTMR-1997.

7.2 INSURANCE FOR COMPENSATION OF VICTIMS

MVTMA-1993 and MVTMR-1997 has mentioned the insurance provision for the compensation of accident victims. The compensation provision of the victims is managed by the compulsory of third party insurance system. In the absence of third party insurance, victims are compensated by the transport service operators. The main provisions can be outlines as below:

- Compulsory insurance system: As per the MVTMA the owner or manager of a motor vehicle shall procure such insurance of each motor vehicle as may be prescribed. However, it has been maintained only for public transportation, but the private vehicles are not following the compulsory third party insurance.
- Insurance of transport employees: Insurance of drivers and other employee has been maintained for public transport vehicles. This has not been maintained for private and other corporate vehicles.
- Insurance of passenger: Passengers for prescribed route and seat capacity is insured by the operator of the transport service. However, passengers more than seat capacity and unpermitted route are not paid by the insurance company. The compensation of the victim is the responsibility of the operator of the transport service.

The insurance provision for the victim is the one of the regulating measures. However, there may create other cases not considered by the insurance provision in the Act and Regulations. Then it becomes the serious problem faced by the transport authorities as well as transport service operators.

7.3 COMPANSATION OF ACCIDENTS VITIMS IN NEPAL

After having the road an accident in Nepal, traffic police is informed and it reaches to the accident site from the nearest traffic police station. Depending upon the severity of bodily damage and the scale of the property damage, further actions are preceded. In the presence of traffic police, most of the property damage and injuries are negotiated and case is settled down. The negotiation finalizes the amount of compensation on the minor injuries and property damage. It may be settled at the spot or at the police station. In the case of hospital treatment for the long period, traffic police makes an arrangement for the payment of hospital bills by the liable person or by the insurance company. However, in the case of fatal incident, it is preceded

for the litigation and compensation as per the MVTMA and MVTMR. The general model of compensation of victims in Nepal is shown in the **Figure 7-1**.

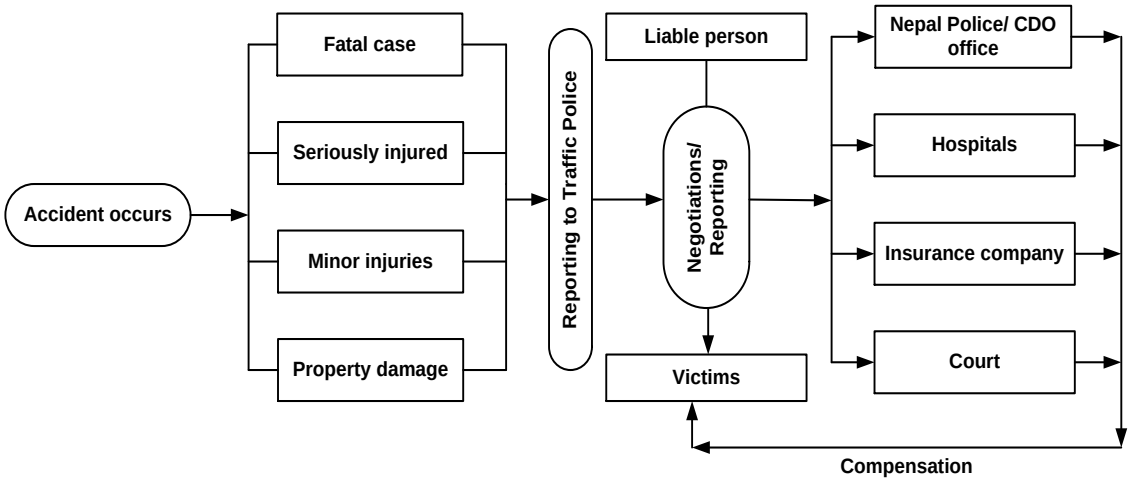


Figure 7-1 Road Accident and Compensation of Victims

7.4 ROAD ACCIDENT COMPENSATION ISSUES

Road accidents are unwanted and problematic situations for the road transport service. In the case of improper insurance systems, undefined and long administrative and legal processes, and poor level of public awareness accidents are always followed by the street chaos and strikes for the compensation of victims. In such cases, administrative office (such as Chief District Officer) with help of police officers plays the mediator and negotiator for settling down the case. There are some typical cases to handle hard for the compensation case. Some typical cases of post accident compensation are given in the **Figure 7-2**. These cases are mentioned as below:

a) Liable person having the third party insurance: The case becomes relatively easy to compensate the accident victims if the liable person is evidently identified during the accident. Otherwise, there may raise the question on the guilty or responsible person of the accident. It makes the compensation process more complicated. Insurance company compensates on the submission of the documents by the liable person.

b) Liable driver or operator is not insurer (not having insurance): In such cases of accident, there is always conflict to find out the responsible person for the accident. After defining the liable person of the accident, the compensation process is done in the evidence of traffic police.

c) Hit and Run Case: The case of having unidentified the second party of the accident, the incident is reported to the Nepal Police via Traffic Police report. The case is registered as the criminal case of hit-and –run. In such cases, victims of the incident do not get any compensation, and then people related to the victims held strikes and close the roadway for getting compensation from the government authority. After having negations with the concerned party, government authority is compelled to compensate the victims to end the strike or roadway closure.

d) Improper use of motor vehicle: The case is very frequent, when trucks carry peoples. In such cases the responsible is considered as the owner/operator of the transport company. However, the compensation depends on the negotiation among the liable and victims.

e) School students: The insurance provision in MVTMA and MVTMR does not speak on the insurance of students travelling on the school bus. This case may raise serious issue on the compensation. It is recommended to for the compulsory insurance on the number of student traveling on the school buses.

f) Public transport carrying more passenger than its capacity: In such case, transport operator/owner is liable to compensate the victim of the accident.

g) Public transport without route permit: Such cases may arise when buses serve along the newly constructed roads before the approval of route to operate the transport service by the Transport Management Committee or DoTM. In such cases the compensation becomes complicated but the service provider is liable to pay the compensation to the victims.

h) Liable vehicle/ person is the non-motorized mode of transport: MVTMA and MVTMR are related to only the motorized means of transport. However, road accident may happen by the non-motorized means as well. Such as bicycle or rickshaw. The owner/operator of such modes is liable to the compensation.

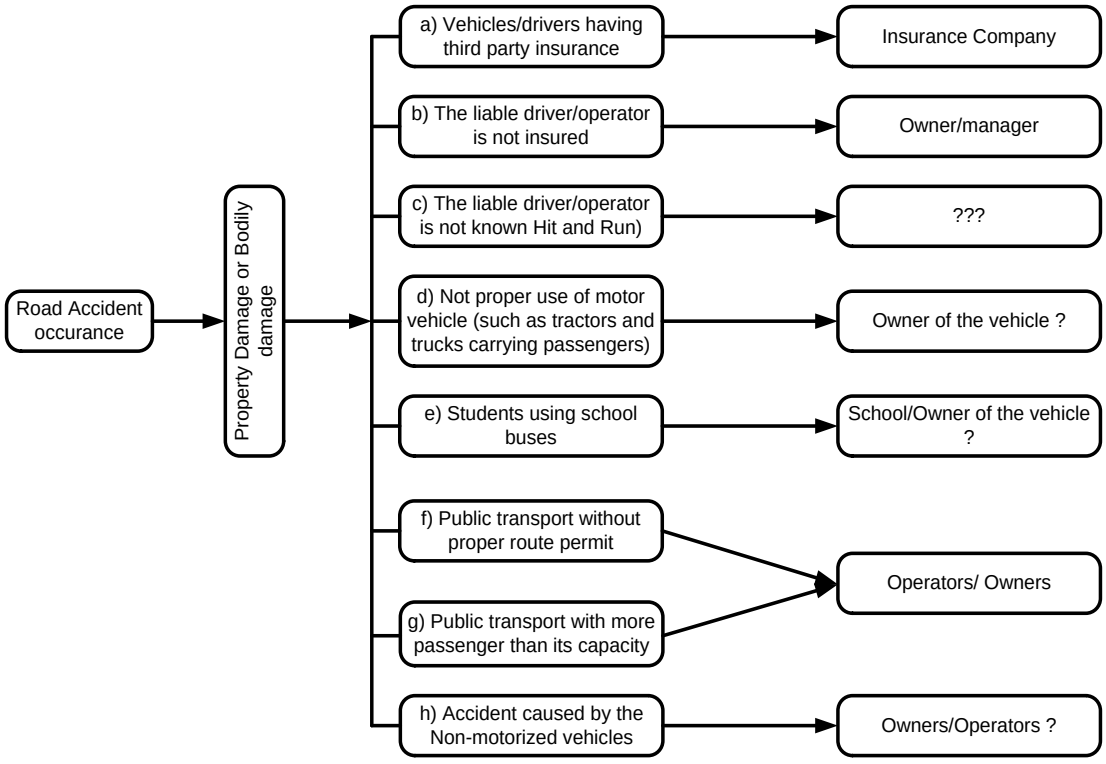


Figure 7-2 Typical Cases of Accident Compensation in Nepal

7.5 RECOMMENDATION FOR VICTIMS COMPENSATION

The study on the compensation of victim of the road accident concludes and recommends the following measures for the perfection of the compensation process.

- The complications of compensation cases are due to the imperfection of the insurance system. Therefore, third-party insurance should be made compulsory for each mode of motorized transport and strictly implemented.
- The evaluation of property damage and identification guilty person during the accident should be well defined. Traffic police should be trained on the accident analysis and reporting system.
- Government or MoPIT should carry study on the requirement of 'Compensation Fund' which would resolve the problem in the complicated cases of the accident such as 'Hit-and –Run' type of accident and others.

APPENDIX 1: TOR FOR SOFTWARE DEVELOPMENT

Government of Nepal
Ministry of Infrastructure and Transport
Department of Transport Management
NEPAL INDIA REGIONAL TRADE AND TRANSPORT PROJECT
SUB-PROJECT OFFICE

Terms of Reference (ToR)

Software Development

For

Road Accident Information Management System

(RA-IMS)

TABLE OF CONTENTS

Terms of Reference

Road Accident Database Information Management System

1. BACKGROUND

Department of Transport Management was established in 2041BS for the smooth management of transport. The purpose of this department and its affiliation, as per Vehicle and Transport Management Act 2049 and Vehicle and Transport Management Rules 2054, is to provide safe, reliable and easy transportation service to the public and goods carrier.

With more vehicles on the streets and little demarcation of lanes for those travelling at different speeds, road accidents in the country are rising. This is compounded by poor road conditions, drivers' fault, vehicle conditions, pedestrians and poor enforcement of traffic rules. To improve road safety, data is needed on the most frequent causes of accidents and the most accident-prone locations.

Currently, the information on road accident is carried out manually, and no effective network arrangements are established between Department of Transport Management (DoTM), Department of Roads (DoR) and Traffic Police to collect the accident data for comprehensive accident analysis. The existing paper-based recording process seems not effective as it lacked important information, is cumbersome, and generates a heavy back log of work at traffic police stations. In addition, coordination between the key institutions involved in road traffic management such as Traffic Police, DoR and DoTM also found not coordinated, resulting in piecemeal efforts to improve road safety. Similarly, the institutions like Municipalities, Hospitals, Insurance companies, etc. also do not have easy access to accident data.

A reliable accident database system is the first step towards scientific road safety management for effectively improving the hazardous locations and road safety interventions. The present paper based accident records maintained by the Traffic Police are found difficult in retrieving information/reports for analysis and decision-making required by safety stakeholders. The location of the accident is often reported and recorded in a vague manner and this makes it difficult to identify accident black spots and to design result-oriented, accountable road safety interventions.

Therefore, to establish a reliable, well managed and effective implementation of Road Accident Database System, DoTM under the support of Nepal India Regional Trade And Transport Project (NIRTTP) intends to develop and establish Web Based Road Accident Information Management System (RA-IMS). The System shall be hosted in the server housed within the premises of Government Integrated Data Center (GIDC) located at Singha Durbar. This will improve data collection process and establish reliable safety information database.

1.1 Accident Data Recording Practices in Nepal

Traffic Police in Nepal collects all crash data from the crash sites and compiles them at the local units and these are transmitted back to the concerned district and regional offices. The crash data are ultimately transmitted back to the Traffic Directorate at Nepal Police Headquarter in Kathmandu for entry into the crash database. However, the data in the filled Accident Forms are not transferred to a

computer database and the hard copy of the filled crash record forms are kept in the local traffic police units or general police concerned. The crash data at the Directorate at the center are aggregated to generate national crash statistics but segregated according to the five development regions in Nepal and includes statistics such as age, gender, vehicle involved, and severity of injury. However, as consolidated data, those do not provide data in detailed necessary for comprehensive analysis of road accidents.

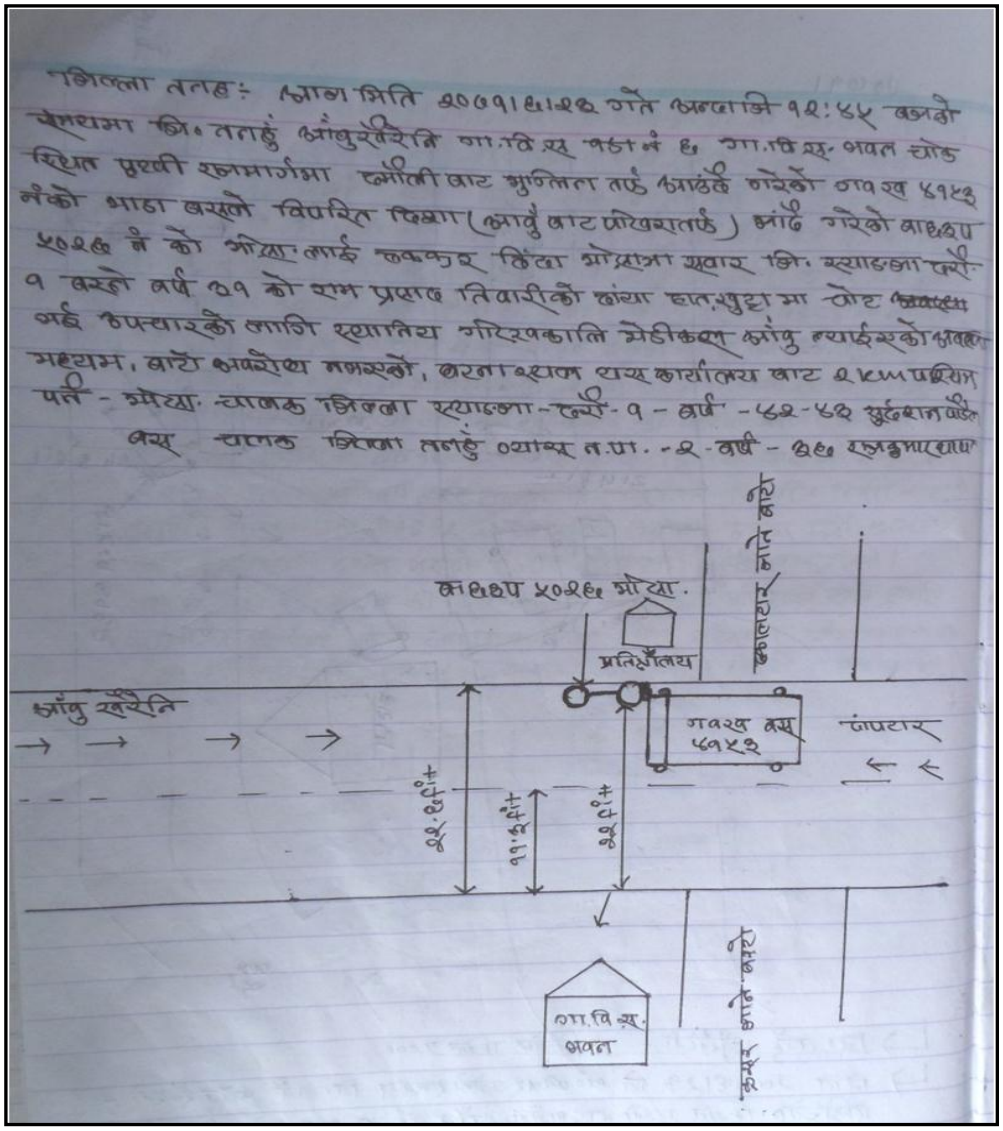


Figure 1First Page of Traffic Police Accident Recording Register

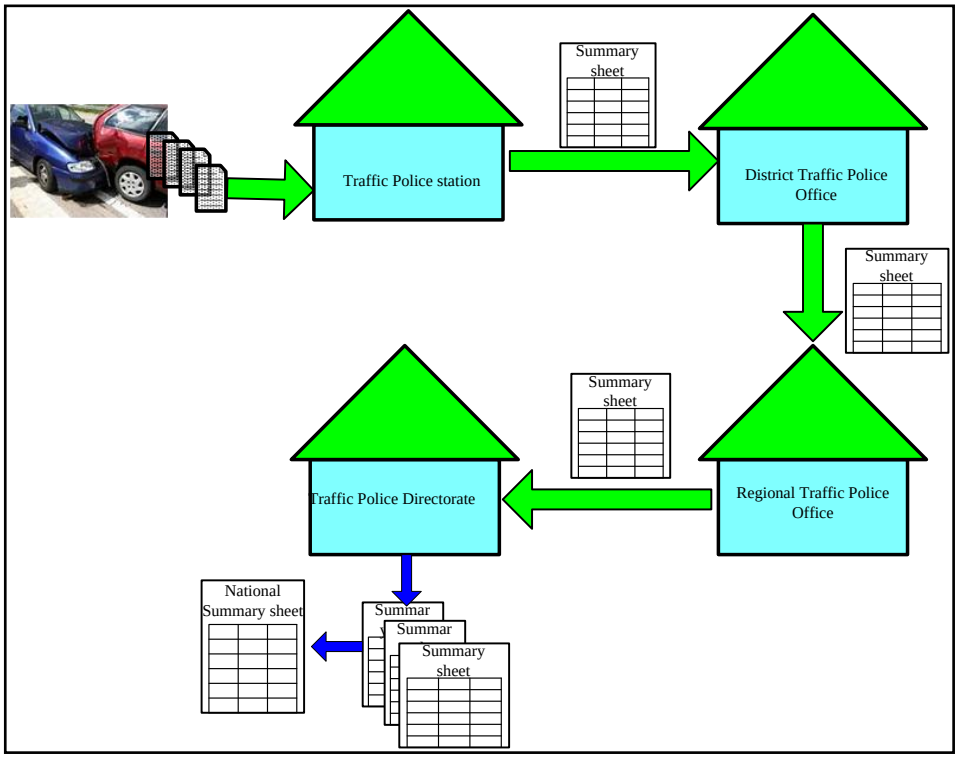
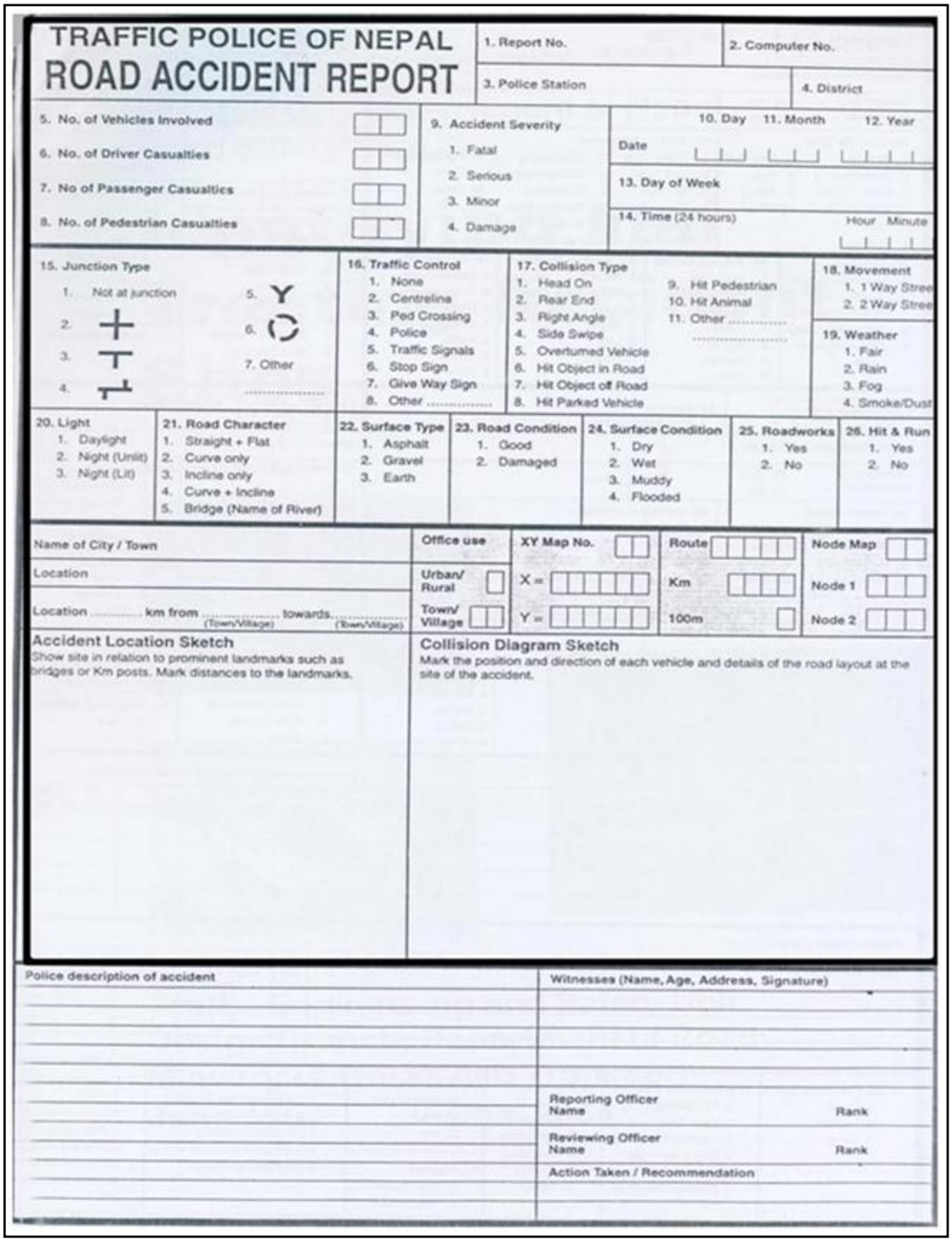


Figure 2 Accident Data Management System

In the urban areas and strategic locations, the traffic police personnel having the jurisdiction over the crash site in question record all details required but in the rural and remote areas where thereis no local traffic police unit, collection of all the crash details is delegated to the general police.

In the other hand, Traffic Police are practicing to apply the full format of "Road Accident Report" in case of the judiciary process. In the case of serious accidents after which Traffic Police should be submitted to the court for their legal treatment, they fill the report form at office. These forms have legal status and considered at the court for their decision of court verdict. These forms include most of the aspects related to the road accident. These forms are shown in the **Figure 2** and **Figure 3**.



TRAFFIC POLICE OF NEPAL

ROAD ACCIDENT REPORT

1. Report No.
2. Computer No.
3. Police Station
4. District

5. No. of Vehicles Involved
6. No. of Driver Casualties
7. No of Passenger Casualtics
8. No. of Pedestrian Casualties

9. Accident Severity
1. Fatal
2. Serious
3. Minor
4. Damage

10. Day 11. Month 12. Year
Date
13. Day of Week
14. Time (24 hours) Hour Minute

15. Junction Type
1. Not at junction
2. +
3. T
4. ⊥
5. Y
6. ○
7. Other .....

16. Traffic Control
1. None
2. Centreline
3. Ped Crossing
4. Police
5. Traffic Signals
6. Stop Sign
7. Give Way Sign
8. Other .....

17. Collision Type
1. Head On
2. Rear End
3. Right Angle
4. Side Swipe
5. Overturned Vehicle
6. Hit Object in Road
7. Hit Object off Road
8. Hit Parked Vehicle
9. Hit Pedestrian
10. Hit Animal
11. Other .....

18. Movement
1. 1 Way Stree
2. 2 Way Stree

19. Weather
1. Fair
2. Rain
3. Fog
4. Smoke/Dust

20. Light
1. Daylight
2. Night (Unlit)
3. Night (Lit)

21. Road Character
1. Straight + Flat
2. Curve only
3. Incline only
4. Curve + Incline
5. Bridge (Name of River)

22. Surface Type
1. Asphalt
2. Gravel
3. Earth

23. Road Condition
1. Good
2. Damaged

24. Surface Condition
1. Dry
2. Wet
3. Muddy
4. Flooded

25. Roadworks
1. Yes
2. No

26. Hit & Run
1. Yes
2. No

Name of City / Town
Location
Location ..... km from ..... towards.....
(Town/Village) (Town/Village)

Office use
Urban/ Rural
Town/ Village

XY Map No.
X =
Y =

Route
Km
100m

Node Map
Node 1
Node 2

Accident Location Sketch
Show site in relation to prominent landmarks such as bridges or Km posts. Mark distances to the landmarks.

Collision Diagram Sketch
Mark the position and direction of each vehicle and details of the road layout at the site of the accident.

Police description of accident

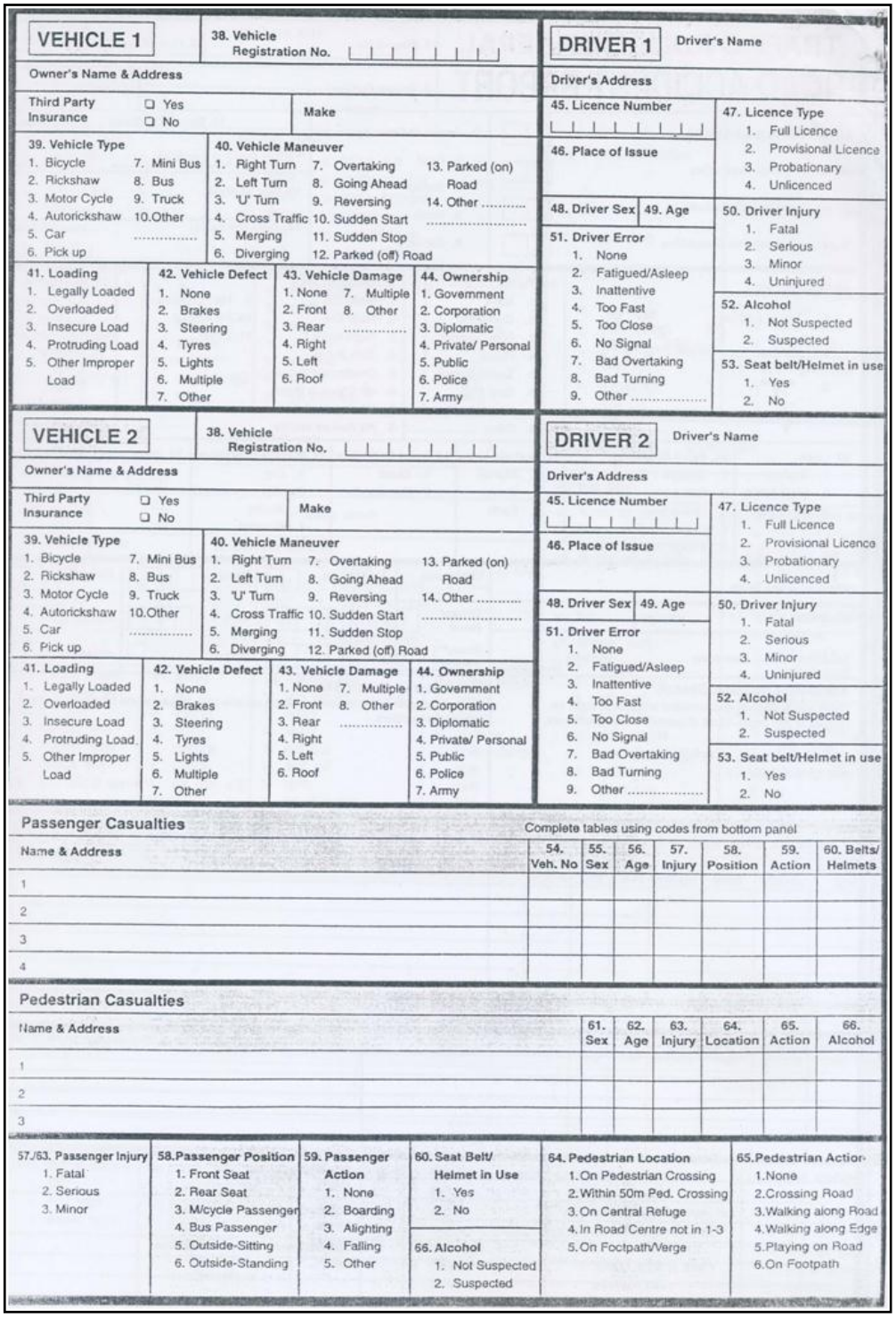
Witnesses (Name, Age, Address, Signature)

Reporting Officer
Name Rank

Reviewing Officer
Name Rank

Action Taken / Recommendation

Figure 3Nepal Police Road Accident Report (page 1)



VEHICLE 1

38. Vehicle Registration No.

Owner's Name & Address

Third Party Insurance ❑ Yes ❑ No

Make

39. Vehicle Type
1. Bicycle 7. Mini Bus
2. Rickshaw 8. Bus
3. Motor Cycle 9. Truck
4. Autorickshaw 10.Other
5. Car .....
6. Pick up

40. Vehicle Maneuver
1. Right Turn 7. Overtaking 13. Parked (on) Road
2. Left Turn 8. Going Ahead 14. Other .....
3. 'U' Turn 9. Reversing .....
4. Cross Traffic 10. Sudden Start
5. Merging 11. Sudden Stop
6. Diverging 12. Parked (off) Road

41. Loading
1. Legally Loaded
2. Overloaded
3. Insecure Load
4. Protruding Load
5. Other Improper Load

42. Vehicle Defect
1. None
2. Brakes
3. Steering
4. Tyres
5. Lights
6. Multiple
7. Other

43. Vehicle Damage
1. None 7. Multiple
2. Front 8. Other
3. Rear .....
4. Right
5. Left
6. Roof

44. Ownership
1. Government
2. Corporation
3. Diplomatic
4. Private/ Personal
5. Public
6. Police
7. Army

DRIVER 1

Driver's Name

Driver's Address

45. Licence Number

46. Place of Issue

47. Licence Type
1. Full Licence
2. Provisional Licence
3. Probationary
4. Unlicenced

48. Driver Sex 49. Age

50. Driver Injury
1. Fatal
2. Serious
3. Minor
4. Uninjured

51. Driver Error
1. None
2. Fatigued/Asleep
3. Inattentive
4. Too Fast
5. Too Close
6. No Signal
7. Bad Overtaking
8. Bad Turning
9. Other .....

52. Alcohol
1. Not Suspected
2. Suspected

53. Seat belt/Helmet in use
1. Yes
2. No

VEHICLE 2

38. Vehicle Registration No.

Owner's Name & Address

Third Party Insurance ❑ Yes ❑ No

Make

39. Vehicle Type
1. Bicycle 7. Mini Bus
2. Rickshaw 8. Bus
3. Motor Cycle 9. Truck
4. Autorickshaw 10.Other
5. Car .....
6. Pick up

40. Vehicle Maneuver
1. Right Turn 7. Overtaking 13. Parked (on) Road
2. Left Turn 8. Going Ahead 14. Other .....
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2. Brakes
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6. Multiple
7. Other

43. Vehicle Damage
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2. Front 8. Other
3. Rear .....
4. Right
5. Left
6. Roof

44. Ownership
1. Government
2. Corporation
3. Diplomatic
4. Private/ Personal
5. Public
6. Police
7. Army

DRIVER 2

Driver's Name

Driver's Address

45. Licence Number

46. Place of Issue

47. Licence Type
1. Full Licence
2. Provisional Licence
3. Probationary
4. Unlicenced

48. Driver Sex 49. Age

50. Driver Injury
1. Fatal
2. Serious
3. Minor
4. Uninjured

51. Driver Error
1. None
2. Fatigued/Asleep
3. Inattentive
4. Too Fast
5. Too Close
6. No Signal
7. Bad Overtaking
8. Bad Turning
9. Other .....

52. Alcohol
1. Not Suspected
2. Suspected

53. Seat belt/Helmet in use
1. Yes
2. No

Passenger Casualties

Complete tables using codes from bottom panel

Name & Address	54. Veh. No	55. Sex	56. Age	57. Injury	58. Position	59. Action	60. Belts/ Helmets
1							
2							
3							
4							

Pedestrian Casualties

Name & Address	61. Sex	62. Age	63. Injury	64. Location	65. Action	66. Alcohol
1						
2						
3						

57./63. Passenger Injury
1. Fatal
2. Serious
3. Minor

58. Passenger Position
1. Front Seat
2. Rear Seat
3. M/cycle Passenger
4. Bus Passenger
5. Outside-Sitting
6. Outside-Standing

59. Passenger Action
1. None
2. Boarding
3. Alighting
4. Falling
5. Other

60. Seat Belt/ Helmet in Use
1. Yes
2. No

66. Alcohol
1. Not Suspected
2. Suspected

64. Pedestrian Location
1. On Pedestrian Crossing
2. Within 50m Ped. Crossing
3. On Central Refuge
4. In Road Centre not in 1-3
5. On Footpath/Verge

65. Pedestrian Action
1. None
2. Crossing Road
3. Walking along Road
4. Walking along Edge
5. Playing on Road
6. On Footpath

Figure 4 Nepal Police Road Accident Report (page 2)

1.2 Objective

The main objective of this assignment is to develop Web Based Road Accident Information Management System (RA-IMS) and Capacity Building around an accident data systemthat facilitates real time data collection and statistics available for timely decision making, policy formulation, monitoring and program implementation for improvement of Road Safety.

2. PROPOSED DESIGN

The proposed design of Web Based Road Accident Information Management System (RA-IMS) is presented in the **Figure 1**.

The web based RA-IMS shall be designed and developed on the basis of Road Accident Form (Figure 2 and Figure 3) and shall be hosted in the server established at the Government Integrated Data Center (GIDC) located at the Singhadurbar, Kathmandu. Apart from the fields mentioned in Figure 2 and Figure 3, the database might require additional data fields for RA-IMS database for cross analysis of accident information. The RA-IMS shall be accessible to all the stakeholders having provided User Login authorizations for different level access according to the requirements. DoTM, as an Executing Agency (EA) of the RA-IMS, shall have full control (Read and Write) over the system and shall be responsible for providing user level access to stakeholders.

The RA-IMS shall be integrated with the mobile application for recording accident data using mobile devices in offline mode by traffic police at local level. After verification of data by the authorized person-in-charge at local Traffic Police Stations, every local Traffic Police Stations using their own login access provided by the DoTM shall upload verified accident data in the centralized server through the internet connection. Every addition of accident record shall be notified to the DoTM and Traffic Police Directorate by the system itself.

Once the accident data is uploaded, the data could be accessed by the users of any locations having internet connections.

The RA-MIS shall be developed in such a way that it plays a key role in decision-making process.Therefore, it shall generate the following standard reports but not limited and it shall have provision of intelligent report generator for additional reports wherever necessary on the basis of data recorded in the database.

Some of the Standard Reports, but not limited to the following, are:

1. Number of Accidents Vs Time of accident & Accident Severity
2. Number of Accidents Vs Accident Severity & Collision Type
3. Number of Accidents Vs Accident Cause & Vehicle Type
4. Accident Statistics
5. Identify Safer/Bad Driver according to the License Number

Additionally, the database of RA-IMS shall be powerful and scalable for future expansion of database and integration with other related applications like Vehicle Registration, Citizenship, License Registration, Municipalities, Applications of Insurance Companies, Hospitals, etc.

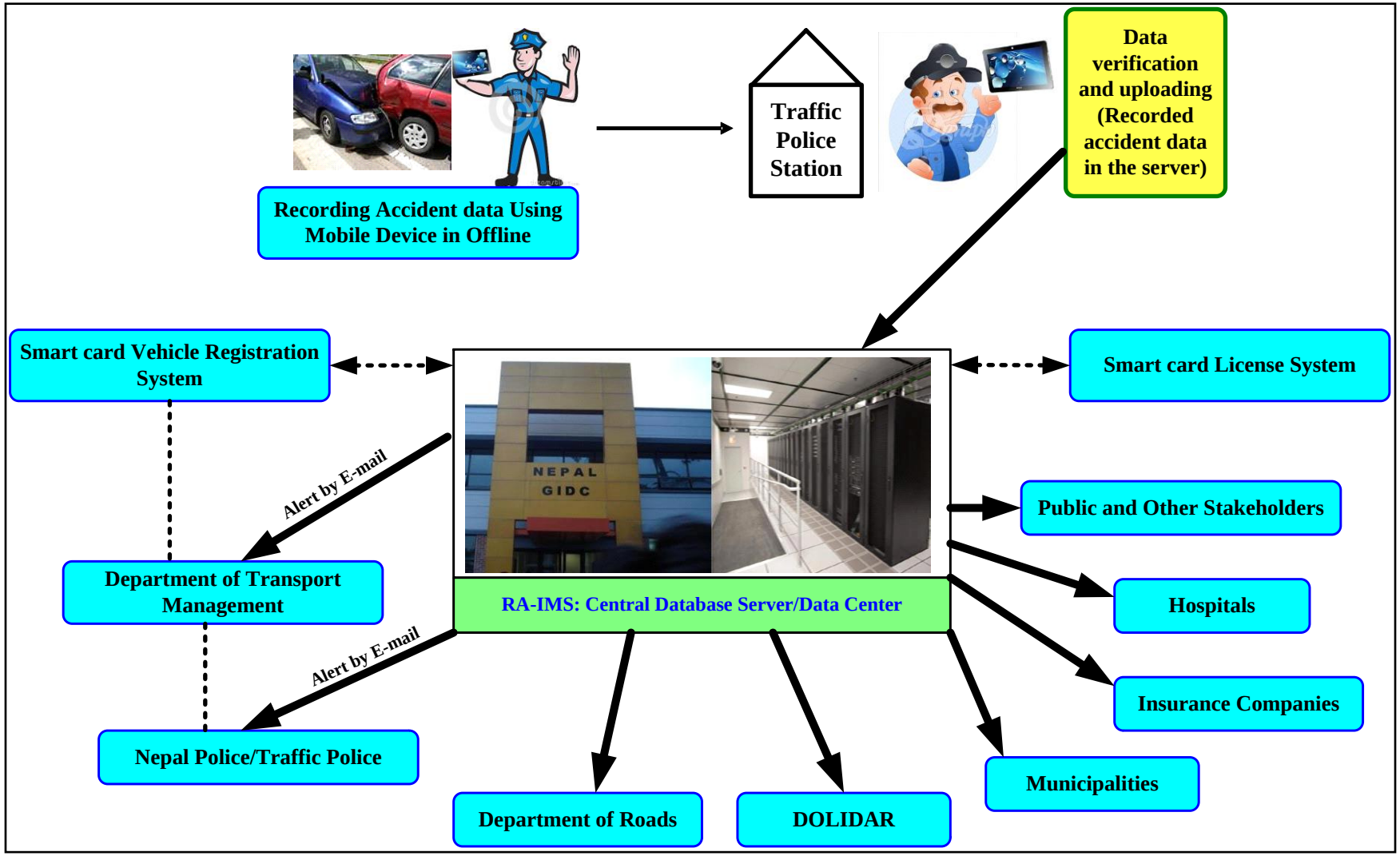

Figure 5 Recommended type of RA-IMS

3. SCOPE OF THE SERVICE

The scope of the proposed service is to study the existing process and prepare the system requirement specifications, develop a web based RA-IMS integrated with mobile application for the effective implementation. The consultant undertakes to perform the services with the highest standards of professional and ethical competence and integrity. The Consultant of the RA-IMS shall carryout activities but not limited tothe following in close consultation with the Executing Agency (EA) to achieve the objectives of the Project:

a) Carry out detailed system study including functional requirement assessment, finalize the system requirement specifications and system design document of the RA-IMS with the integration of mobile application for accident data recording in close consultation with the designated team.

b) Submit and present the Design Report of RA-IMS

c) Upon approval of design from EA, carry out system development

d) Shall be fully responsible for installation, configuration, commissioning and hosting of the System established at the GIDC for online access.

e) Shall be fully responsible for installation of required applications and software including database software for successfuloperation and hosting of RA-IMS.

f) Prepare Acceptance Test Procedure and carry out testing of complete systemin the presence of the EA. The test shall include: Quality Assurance and Bug Testing, Multiple Browser Compatibility, Application Security, Performance - Load and Stress Testing, Unit Testing, etc.

g) Upon completion of the work awarded, provide training/orientation to designated team of EA (DoTM), Traffic Police, DOR, etc.

h) Submit a complete report including handbook/manuals on Operation andMaintenance of the RA-IMS

i) Handover the Complete Error-Free RA-IMS System including Source Code acceptable to the EA in fully Operational Condition.

j) Provide full Service warranty with one year operation and maintenance support and extended support warranty for the additional period of three years.

k) The Consultant shall be fully responsible for any discrepancies and errors occurred during the project period.

4. FEATURES AND SPECIFICATIONS

Design and Development of RA-IMS: The web based Road Accident Information Management System (RA-IMS)is dynamic web sites combined with server side programming which provide functionalities such as interacting with users, connecting to back-end databases, and generating results to browsers.

The RA-IMS shall be user-friendly with high data security. The RA-IMS shall be integrated with the Domain of Executing Agency (EA) Department of Transport Management (DOTM) http://www.dotm.gov.np.The link of RA-MIS shall also be included in the domain of Nepal Police, DOR, etc. according to the understanding of the stakeholders.

The web based RA-MIS shall have the facility for recording accident data and generating standard as well as dynamic reports for further analysis and decision-making. The System shall also have the facility of accident recording and browsing standard reports using Mobile Devices. Therefore, the Consultant shall integrate mobile application with the core web based RA-IMS for providing easy access to the computer as well as mobile users. The mobile application shall be compatible for the Android users.

The RA-IMS shall be developed on the basis of Road Accident Form (**Figure 2** and **Figure 3**) with the provision of scalability according to the future requirement.

The RA-IMS shall support GIS Maps, Open Street Mapsand Google Maps enabled for recording accident data and analysis of various data and generation of reports. In case if the system shall be enabled with the GIS Map, required GIS Mapsand licenses for Maps if any shall be provided by the EA for integration with the system.

After determining the appropriate forms, formats, information and database, the Consultant needs to design and develop the RA-IMS. The RA-IMS shall be able to produce and maintain big volume, storage and speed for instant online data entry, recording, retrieving, producing and analyzing the data and its contents.

The RA-IMS shall have major sections like Accident Recording Engine, GIS Engine, Safety Analysis Engine, Standard Reports, Dynamic Standard and Spatial Query Builder and Administration and Tools sections.

Accident Recording: The main feature of the proposed system i.e. RA-IMS is the application of mobile device for the recording of accident data. The data saved on the mobile device would be then transferred to the central server. A typical specification of the mobile device is given below:

7.0 inches TFT LCD 1280 x 800 pixels and 16M colors

1.2 GHz Quad-core + 1.5 GB RAM

Storage: 8GB inbuilt, micro SD up to 64 GB

Camera: 3.2MP Rear + 1.3MP Front

Operating System: Android OS, v4.4.2 (Kit-Kat)

Battery: Li-Po 4000 mAh battery

Others: Wifi 2G & 3G network, SNS integration, Document viewer, Geo-tagging

The data transmission of the recorded files will be done by ADSL Router. The specification of router is given as:

- 150Mbps 11N WLAN, ADSL/ADSL2/2+ Router with4-Port Ethernet built-in

Accident Recording Enginehelps in capturing accident data.

GIS Engine helps to plot accidents on digital maps and has the capability of accident analysis. This includes plotting options, polygon searches, creating monitor sites and black spot identification. Grid analysis, cluster analysis and monitoring sites are also enabled.

Safety Analysis Engine enables cross tab analysis, kilometer analysis.

Standard Reports Module generates routine reports like accidents based on severity, accidents classified according to type of area, time, weather conditions, road conditions, vehicle types, and passenger/pedestrian casualty statistics, etc.

Dynamic Query Builder helps create user-defined query or constraints and view sub-sets of accident data. The user can run the Safety Analysis Engine for this set.

Administration and Tools Module allows for system administration and maintains the digital map versions. Granting access rights, periodic backlog file and distribution of data are controlled by the Administration module. Importing digital maps, interfacing with different systems, creating monitor areas, updating accident symbols and collision symbols and labeling the maps are done through the tools module.

On the basis of above major engines, not limited to the following, the system shall have the following features satisfying the system requirements:

- **A web-based System:** The RA-IMSshall be user-friendly, dynamic and interactive with higher level of data security. The system must accommodate all the web-based system features. The communication shall be done with 256 bit AES encryption over SSL layer. The authentication will be done with industry recommended standard of three legged OAuth 2.0 protocol.

  The system shall be integrated with Mobile Application for recording accident data and browsing standard reports.The systemshall be able to make data entry in the forms or formats developed for information capture from the accident location using Mobile Devices and Computer/Laptops. The data with mobile platforms shall support offline recording and synchronize with online servers when internet is available after all verifications have been completed.

  The RA-IMS is a web based system; therefore the data could be accessed using any browser at any location.

- **Technologies:**Open source scripting languages and open source database server built based on a Relational Database Management System (RDBMS) capable of handling a large concurrent database connection are proposed for developing RA-IMS. For android,technology shall be used over native Android SDK using Java.

  - The technology for coding shall be Server Side Scripting/Coding.
  - The System must be developed on compatible platforms of Windows and Linux.

- **Data Entry or Uploading Functions:** The RA-IMS shall have both the features of data entry online as well as offline for recording accident data at accident locations and uploading filled forms to the Central Server after verification carried out by the authorized In-charge of Local Traffic Police Stations. The verified accident data shall be uploaded through Internet connection. The system shall ensure data security during the process of recording data and uploading data to the Server.

- **Secure Login Screen**: The System shall provide secured access through the login screen where each of the users can access the system via their web browser.
- **Data Entry Module**: The system shall have built-in data entry module which allows designated users the ability to add or edit records by typing or selected from a drop-down list. The priority shall be given to the selection from a drop down list.

- **Content:** The Consultant needs to determine the data contents, forms, formats and other related information in close consultation with the EA, however, as general guideline it may contain the following:

  - **Road Accident Form (Figure 2 and Figure 3)**
  - **Road Safety Related Information**
  - **Information of stakeholders involved in Road Safety**
  - **Rules and Regulations on Road Safety**
  - **Team working on Road Safety**
  - **Suggestion Box**
  - **Contact Information, etc.**

- **Visibility and Accessibility:** The site should have highly visibility and be easy to find via all major search engines and must be compatible with all major web browsers.

- **Access Control:** The system shall have different access control features as per user levels and user privileges. This access control feature should be dynamic in nature so that rights of a particular module may be assigned to any user apart from his/her level. Every stakeholder shall be provided with User Login facility according to their roles and responsibilities. This shall be defined in consultation with the EA.

- **Powerful and Scalable:** The system shall be dynamic to adopt the change the parameters as defined in government acts, rules, regulation, directives, etc. Database shall be robust, agile and able to expand and scale up more easily and shall be able to handle big volume of data and complex SQL queries.

- **Maker and Checker System:** Update ofstored accident date needs to be validated by the EA, therefore it is recommended to have the facility of maker and checker as separate authority for check and balance of the transactions carried out.

- **Audit Trail:**The System shall have inbuilt facility for detecting security violations, performance problems, and flaws in applications.

- **GEA/NGIF Compliance:** The RA-IMS shall follow Nepal Government Enterprise Architecture (GEA) and Nepal Government Interoperability Framework (GIF). Compliance of these features by any government software systemwill facilitate the data interchange among different government agencies.

The RA-IMS shall have the provision of inter connection with the systems especially Smart Card Licensing System, Embossed Vehicle Registration System, Citizenship, etc.

System should have English and Nepali User Interface with a single click of a button at any level of its operation. System shall support Nepali Unicode as well as English/Nepali dates.

Security: The code used in the system development must be written carefully in order to avoid any vulnerability andshall be secured through layers of security system to combat today's cyber security threats and vulnerabilities. The security system shall enable the smooth operation of the RA-IMS. The system shall have an integral security system including following security features:

Coding Level Security: Security issue shall be taken into account while coding RA-IMS. All communications shall be done with 256 bit AES encryption over SSL.

Access Level Security: Stateless REST API shall reduce the threats of session hijacks, signed requests shall ensure API is consumed by trusted clients only, blowfish password hashing with 3-legged OAuth 2.0 authentication, ACL for role based access.

Database Level Security: Access to database and their roles, read/write permission, access to database, session monitoring, etc.

Network Level Security: Access of system inside/outside, IP and port filtering, etc.

Data Storage and Back-up System: The system shall have the automatic data storage system as and when the data are entered or fed in regular intervals. So the system shall have in-built back-up system to avoid any data loss.

Data Export System: The database system shall have facility to export the data to other application program such as SPSS and STATA, MS-Excel for further analysis of data.

Functionalities to be supported: The System shall have functions not limited to the following:

- Search and view accidents on the Map
- View the accidents on the map using display options
- Perform analyses on searched accidents
- View the Monthly/Half Yearly/Yearly trend of accidents
- View the latest updates

Management Dashboard: Commonly used reports shall be displayed via the dashboard which allows users to monitor recent trends quickly and easily.Charts can be quickly modified to display as a bar, line, or column.

GIS Related Features: System shall support the integration of GIS Maps and some public maps like Open Street Map, Google Maps, etc.

System shall support the following features on map:

- Option to drag the map to view locations outside the view port
- Option to zoom in / zoom out
- Option to view history forward / backward
- Option to measure distance between two locations in the map
- Option to select accidents by drawing a feature (select by rectangle, select by circle)
- Option to print own digital or open source maps with accident location and labels
- Option to export own digital or open source maps with accident location and labels, as JPEG, PDF files

Cluster Analysis: The System shall have the facility to review collision hotspots using the advanced cluster analysis feature.

Corridor Analysis: The System shall have the facility of corridor and route analysis since these are the common features of collision analysis systems.

Black spots Analysis: The System shall generate accident concentration zones or carry out the black spots Analysis.

Kilometer analysis: The System shall analyze accidents along a selected stretch of road.

Accident rate analysis: The System shall carry out accident rate analysis and generate reports.

Grid Analysis: The System shall have the facility of Grid Analysis for identifying the frequency of accident hotspots.

Powerful Cross Tabulation Module: The system shall have the facility to cross-tabulate datasets using common attributes and a number of measures.These analyses can be saved and re-run on a regular basis making local management information preparation quick and easy.

Creating Custom Charts: The System shall generate different chart and have the facility to view, customize, print and export for use in local offline reports.

Viewing Collisions on the Map: The map is used to quickly show the locations of collisions using a number of mapping base layers. It should have facility to quickly change the zoom levels to suit the requirements and even change the display to show vehicle icons in place of the normal casualty pins.Collisions can be selected using queries or by drawing polygons around map features.

Searching the Map: The system shall have the facility for searching quickly for a road on the map by clicking on the button and entering the search parameters

Comparing Query Results: The system shall have side-by-side comparisons of the query results and the whole collision dataset with information on vehicles, casualties and severity breakdowns included.

Standard Reports: The system shall generate traditional tabulated reports which can be viewed online or downloaded for local analysis.

Dynamic Reports: The system shall have the facility to select from any of the Accident Data Form fields entered to create report by defining the row and columns.

Summary Reports: Shall be able to generate all the accidents that are retrieved from the system as a result of a search, query or an analysis.

Displaying Summary Collision Information: Summary information about a collision on the mapping screen shall be displayed by the selection ofinformation tool and click on the individual marker.

Plotting Query Results: Once the query is completed, the system shall be ableto browse quickly the results on the map.

Entering Casualty Details: Simple data entry shall be provided through the use of helpful drop-down boxes with symbolized entries.

Condition and Collision Drawing: The system shall have the facility of condition and collision drawing sketch according to the requirement of Road Accident Form (Accident Location Sketch and Collision Diagram Sketch) in mobile devices as well as Computer/Laptops. Other symbolized entries shall be provided through the use of helpful drop-down boxes.

System Integration: The system shall be integratedwith the software systemsANPR enabled Vehicle Registration and Smart Card License Registration. The system shall have provisions of integration with the Citizenship, applications of Municipalities, Insurance Companies, Hospitals, etc. wherever possible.

Data Migration and Transfer: The system shall be fully capable of data migration and transfer facility.

Support and Maintenance: After the handover of the RA-IMS to the EA, the Consultant shall provide full Service warranty with one year maintenance and support and extended warranty for the additional period of three years where a regular support, maintenance and regular updates shall be carried out by the Consultant. The support level depends upon the complexity of the task, which shall determine the service should either be remote support or on call support.

5. TRAINING AND KNOWLEDGE TRANSFER

The Consultant shall prepare the technical, user and operational training manuals and session plans for the successful design, development and operation of the system. The trainings shall be conducted for the designated staffs of EA (DoTM), Traffic Police, DOR, etc.

The training shall be organized centrally by the Consultant in consultation with the EA.Training shall include:

a) Intensive ‘Training of Trainers’ programs

b) IT Administrators Training

c) Hands on Operational Training

6. DELIVERABLES

The Consultant shall furnish following documents during the project period:

1. Inception Report with Work Plan and Manning Schedule
2. Original RA-IMS Software and System (with in-built security system) in Electronic Version
3. The Source Code
4. System Requirement Specifications
5. Design Document
6. Testing Procedures and Test Reports

7. Completion Report
8. Operational/User Manuals

7. OPERATION AND MAINTENANCE OF SYSTEM

The Consultant shall provide full service warranty for at least one year operation and maintenance support from the date of final acceptance by the EA. During the warranty period, the Consultant shall address all the errors, bugs, gaps in the functionality offered by the system at no additional cost.

The terms of reference also requires extended support warranty for the additional period of three years after the completion of one year support warranty.

8. FACILITIES TO BE PROVIDED BY THE CLIENT

In order to support the supplier, DOTM will provide the following:

a) Liaison officer to facilitate the discussions with the government authorities and other agencies;
b) Introductory letter to stakeholders to introduce and authorize the consultants to observe the operation of the systems to be integrated
c) Venue for the presentation and/or discussion.

9. QUALIFICATION AND WORK EXPERIENCE

9.1 Qualification and Experience of the Firm:

1. Firms interested to participate in the bid must have minimum five years of existence or any of the partners in case of JV and/ or in association.
2. Must have documented experience in design and development of minimum of 5 web based systems, 2 GIS Maps and 2 Android applications or any of the partners in case of JV and/or associate partners.
3. Interested firms must furnish information indicating that they are qualified to perform the services. Firms may submit proposal solely or form an association with other firms.
4. Other relevant documents like company registration, VAT registration, latest tax clearance certificate, etc. must be included in the Proposal.

9.2 Professional Staff and Key Expert

The input of key expert is shown in **Table 9.1**.

Table 9.1 Key Expert Input

Description		**Person Man- Months**	
1. Key Professionals :	**No.**	**Input**	**Total**
1.1 Team Leader	1	6	6
1.2 System Analyst	1	2	2
1.3 Database Designer	1	2	2
1.4 Web Programmer/Developer	2	4	8
1.5 Android Application Developer	1	3	3
1.6 GIS Expert	2	3	6
1.7 Road Safety Expert	1	2	2
2. Non Key Expert: (to be proposed by the Firms as required if any)			

2.1.			
2.2.			
2.3			

9.3 Qualifications and Responsibilities of Key-Experts

a) Team Leader

The Team Leader must have at least Masters Degree in Computer Engineering / Computer Science / Information Technology with at least 10 years of working experience in web based database management system designing, development and implementation.

The Team Leader must be responsible for overall project management, system integration, quality assurance, coordination and liaison, etc. S/he shall work in close coordination with the EA.

b) System Analyst

The System Analyst must have at least Masters Degree in Computer Engineering / Computer Science / Information Technology with at least 10 years of working experience in web based database system analysis, designing, development and implementation. S/he shall have experience in development of web based database management system in open source scripting languages and open source database server built based on a Relational Database Management System (RDBMS).

c) Database Designer

The Database Designer must have at least Bachelor Degree in Computer Engineering / Computer Science / Information Technology with at least 5 years of working experience in development of database management system in Open source scripting languages and open source database server built based on a Relational Database Management System (RDBMS). S/he shall have demonstrated experience of designing, development, implementing and maintenance of databases including data recovery, security, scalability and disaster recovery.

d) Web Programmer/Developer

The Web Programmer/Developer must have at least Bachelor Degree in Computer Engineering / Computer Science / Information Technology with at least 5 years of working experience in web based system programming, preferably having experience in development of data management system in Open source scripting languages and open source database server built based on a relational database management system (RDBMS). S/he must have demonstrated experience of developing web based applications.

e) Android Application Developer

Android Application Developer must have at least Bachelors Degree in Computer Engineering / Computer Science / Information Technology with at least 2 years of working experience in designing and development of Android Applications for mobile devices. S/he must have demonstrated experience of developing Android Applications.

f) GIS Expert

GIS Expert must have at least Masters Degree in GIS/Geo Informatics/Civil Engineering/Computer Engineering/Computer Science/ Information Technology with at least 5 years of working experience in preparing GIS based database and creating GIS data and maps and have experience in implementing spatial design plan using open source GIS framework.

g) Road Safety Expert:

Road Safety Expert must have at least Masters Degree in Road Safety / Civil Engineering / related field with at least 10 years of working experience in transport sector and road safety.

10. SELECTION METHOD

The consulting firm selection method shall be Quality and Cost Based Selection (QCBS) as per the guideline of The World Bank.

11. PROJECT PERIOD

The consulting firm shall complete all the tasks, obligations and reporting within six (6) monthsfrom the date of signing the Contract Agreement. The firm shall present the work schedule covering all the tasks to be covered under this project.

12. EVALUATION CRITERIA

Evaluation of the REOI for the shortlisting of consultant firm is done on the basis of following criteria:

a) Firm Registration
b) VAT/PAN Registration
c) Tax clearance up to FY 2070/071
d) Firm's Contact Information

The detailed criteria and sub-criteria and respective point system for the evaluation of Full Technical Proposals are given in the **Table 12.1**.

Table 12.1Evaluation Criteria

1	**Experience of the Consultants Firm (any of the partners in case of JV or in association):**		**15**
	a	Experience of the firm in the design and development of web based system:	5
	b	Experience of the firm in the design and development of Android applications	5
	c	Experience of the firm in GIS:	5
2	**Adequacy of the proposed methodology and work plan in responding to the Terms of Reference**		**35**
	a	Technical approach and methodology	20
	b	Work plan and manning schedule	10
	c	Understanding of Terms of Reference	5
3	**Key professional staff qualifications and competence for the assignment**		**45**
	a	Team Leader/Project Manager	15
	b	System Analyst	5
	c	Database Designer	5
	d	Web Programmer/Developer	5
	e	Android Application Developer	5
	f	GIS Expert	5
	g	Road Safety Expert	5
4	**Transfer of knowledge (training) program:**		**5**
	a	Relevance of training program, training approach and methodology	5

APPENDIX - 2: TOR FOR NETWORK AND SERVER EQUIPMENT REQUIREMENT

Government of Nepal

Ministry of Infrastructure and Transport

Department of Transport Management

NEPAL INDIA REGIONAL TRADE AND TRANSPORT PROJECT

SUB-PROJECT OFFICE

Terms of Reference

Network and Server Equipment Requirement to be installed at GIDC, Singhadurbar

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LIST OF TABLES

ACRYNMS AND DISAMBUGIATION

ALC-MIS	Axle Load Control Management Information System
DOR	Department of Roads
DMZ	Demilitarized Zone
DOTM	Department of Transport Management
EA	Executing Agency
GIDC	Government Integrated Data Center
IP	Internet Protocol
ISP	Internet Service Provider
Mbps	Megabit Per Second
NIRTTP	Nepal India Regional Trade And Transport Project
RA-IMS	Road Accident Information Management System
VPN	Virtual Private Network
VLAN	Virtual LAN

1. INTRODUCTION AND BACKGROUND

1.1 RATIONALE

Road network is the most important means of transport in Nepal. The road network mainly comprises of Strategic Road Network of about twelve thousands kilometers and Local Road Network of about 50 thousand kilometers. The huge public investment and assistance from the various donor agencies as well as community participation made it possible to connect 73 district headquarters (out of 75) by the road network in the country. Road transportation provides access to the services and facilities to the local community and considered to be one of the keys for development of the area. Road transport mainly boosts the direct opportunity to the road user by providing access to the services and facilities. At the same time, it plays significant role to support overall economic growth of the country.

Sustainability and efficiency of road transportation sector are dependent on the adopted transport management and maintenance practice, and safety indicators. In road construction and maintenance the vehicle overloading is one of the major contributors for early deterioration of the pavement condition. Vehicle overload control and or axle load control is very important to achieve the full life of the road pavement and attain the expected return from the investment on road infrastructures. Road transport management with proper safety consideration is another crucial factor to achieve effective and safe road transport. In Nepal, the Department of Transport Management (DoTM) needs to play a significant and proactive role in managing the vehicle transport in roads. DoTM, under financing from Nepal India Regional Trade and Transport Project (NIRTTP), intends to establish centralized web based Database Management System for Road Accident and Axle Load Control for proper management of information and implement activities to enhance the road transport safety and axle load control.

For the effective implementation of Web Based Road Accident Information Management System (RA-IMS) and Web Based Axle Load Control Database Management System (ALC-MIS), DOTM intends to establish its Network and Server system at Government Integrated Data Center (GIDC).

1.2 OBJECTIVES

The major objective of this Service is to have an efficient, technically viable and cost effective networking and server equipment to run hassle free system to run the Web Based Road Accident Information Management System and Axle Load Control Management System.

1.3 SCOPE OF WORK

The successful bidder shall supply, deliver, installation, commission all the required hardware, software, accessories and networking equipments and hand over the complete system satisfactory to the DoTM;

1. Carry out detailed design and upon approval from the Executing Agency implement the work satisfactory to the DOTM
2. Supply and deliver Networking Equipments, Servers, Storage, Operating System Software, Accessories, etc.
3. Install all the Networking Equipments, Servers & Storage, Operating System Software, Accessories, etc.
4. Complete installation, configuration and commissioning of the Network, Server & Storage Hardware with software at GIDC for hosting and operating web based Road Accident Information Management System and web based Axle Load Control Management Information System.
5. After signing the contract, the bidder shall be fully responsible for supply, delivery, installation, configuration, commissioning, testing and for any discrepancies in the bid.
6. Prepare Acceptance Test Procedure and carry out Testing of complete system in the presence of the EA
7. Upon completion of the work awarded, provide training/orientation to the designated staffs of DoTM.
8. Submit a complete report including handbook/manuals on operation and maintenance of the complete system.
9. Handover the Complete System acceptable to the employer in fully operational condition.
10. Provide full warranty including one year operation and maintenance support. The bidder shall also provide an extended support for the period of three years after the completion of one year support period.
11. The bidder shall be fully responsible for any discrepancies and errors occurred during the project period.
12. The bidder shall complete all the tasks of supply, installation, configuration, other obligations and reporting of the project within two (2) months from the date of signing the Contract Agreement. The bidder shall present the work schedule covering all the tasks to be covered under this project.

2. PROPOSED NETWORK AND SERVER SYSTEM

For the effective service delivery and for achieving the objectives of DoTM efficiently without any delay and breakage in the connection, the Network and Server System is proposed as below. The proposed system including the Network Design and its hardware and servers specifications are presented below:

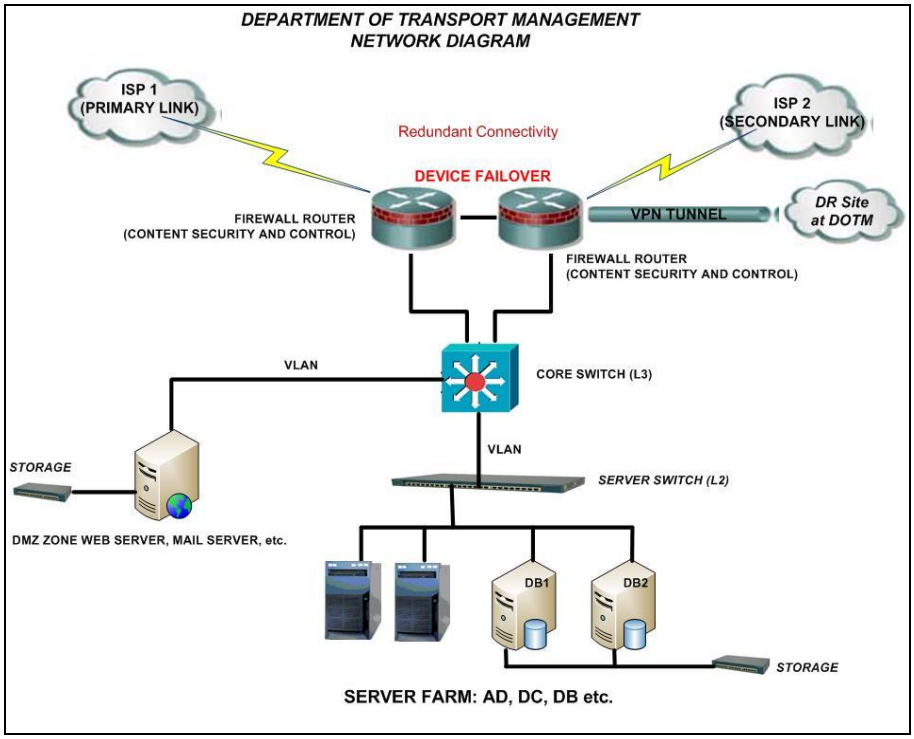

Figure 1 Proposed Network and Server System

In the proposed design, redundant connectivity, core networking devices for failover and servers are proposed. In the DMZ Zone, Server for web based applications RA-MIS and ALC-MIS are designed for higher reliability of data, load balance, enhanced performance as well as for providing better data storage. The mail server of DOTM shall also be configured and established. The servers shall be in server virtualization environment for higher security and reliability of different databases.

Possibility of huge data for processing in real time, the proposed system is designed with High End Servers for the smooth operation from the first day of installation without any interruption. The High End Servers are proposed for Web Server at DMZ zone and the Database Servers (DB1 and DB2) at Server Farm.

Realizing the importance of services and data for DoTM, Traffic Office, DOR, a backup of Database Server DB1 shall be replicated in DB2.

The proposed network is proposed to be established and installed in the Government Integrated Data Center (GIDC). The network shall be connected with two different internet service providers as a redundant connectivity with the capacity minimum of 5/5 Mbps capacity for each link.

Both the links of 5/5 Mbps Dedicated Fiber Optic Internet bandwidth with static IP (ISP 1 and ISP 2) including installation and commissioning shall be provided by DOTM through two different Internet Service Providers (ISPs) so that the installation and configuration of Networking and Server equipments can be carried out effectively by the bidder.

Realizing the importance of services and data for DoTM, a backup of Data Center shall be established and connected to the Data Center already established at DoTM for Disaster Recovery (DR).

3. BILL OF QUANTITY

The section includes the bill of quantities required for the installation of network server system at GIDC.

Table 1 Networking and Server Equipment

Item No.	Item	Qty
1	Firewall Router	2
2	Core Switch	1
3	Server Switch	1
4	Server	3
5	Storage	2
6	24 Port Patch Panel	1
7	Patch Cord (CAT 6, 1 mtr)	10
8	Patch Cord (CAT 6, 3 mtr)	5

Table 2 Software Requirement for the Server

Item No.	Item	Qty
1	Red Hat Enterprise Linux Standard Subscription	3

Table 3 Installation, Commissioning and Support

Item No.	Item	Qty
1	Installation and Commissioning	1 lot
2	1 Year Support	1 lot
3	Three years extended support	1 lot

4. SPECIFICATION OF EQUIPMENTS

Specification of equipments is summarized in **Table 4**, **Table 5**, **Table 6**, **Table 7, Table 8 and Table 9**.

Table 4 Requirement for the Core Switch

Feature	Specification	Compliant / Non-Compliant
Copper Ports	24 10/100/1000Base-T RJ-45 auto-MDI/MDI-X ports	
SFP/Mini-GBIC Slots	4 SFP slots, 100/1000Base-X SFP transceiver compatible Shared with Port-21 to Port-24	
Expansion Slots	2 slots for PLANET XGS3-2SFP+, 2-port 10G SFP+ optic module Support module hot-swappable	
Switch Processing Scheme	Store-and-Forward	
Switch Fabric	128Gbps	
Throughput	95Mpps@64bytes	
Address Table	16K entries	
Share Data Buffer	1.5Mbytes	
VLAN Table	4K	
ACL Table	1K	
Routing Table	13K	
Layer 3 Interface	1K	
Port Queues	8	
Flow Control	IEEE 802.3x pause frame for full-duplex Back pressure for half-duplex	
Jumbo Frame	9Kbytes	
IPv4 Layer 3 Functions		
IP Routing Protocol	Static Route, RIPv1/v2, OSPFv2, BGPv4 Policy-based Routing (PBR) LPM Routing (MD5 authentication)	
Multicast Routing Protocol	IGMP v1 / v2 / v3, DVMRP, PIM-DM/SM, PIM-SSM	
Layer 3 Protocol	VRRP v1/v3, ARP, ARP Proxy	
Routing Interface	Per VLAN	
IPv6 Layer 3 Functions		
IP Routing Protocol	RIPng, OSPFv3, BGPv4+	
Multicast Routing Protocol	PIM-SM/DM for IPv6 MLD for IPv6 (v1) MLDv1/v2 MLD Snooping, 6 to 4 Tunnels Multicast receive control Illegal multicast source detect	
Layer 3 Protocol	Configured Tunnels, ISATAP, CIDR	
Layer 2 Functions		
Port Configuration	Port disable/enable Auto-negotiation 10/100/1000Mbps full and half duplex mode selection Bandwidth control on each port Port Loopback detect	

Feature	Specification	Compliant / Non-Compliant
VLAN	802.1Q Tagged Based VLAN, up to 4K VLAN groups Q-in-Q GVRP Private VLAN Voice VLAN MAC-based VLAN Protocol-based VLAN	
Spanning Tree Protocol	STP, IEEE 802.1D (Spanning Tree Protocol) RSTP, IEEE 802.1w (Rapid Spanning Tree Protocol) MSTP, IEEE 802.1s (Multiple Spanning Tree Protocol, spanning tree by VLAN) Root Guard BPDU Guard	
Link Aggregation	Static Trunk IEEE 802.3ad LACP Supports 16 groups of 8-port trunk	
QoS	Traffic classification based, Strict priority and WRR 8-level priority for switching Port Number 802.1p priority DSCP/TOS field in IP Packet Policy-based DiffServ	
Multicast	IGMP v1 / v2 / v3 snooping IGMP proxy IGMP Querier mode support MLD v1/v2, MLD v1/v2 snooping	
Access Control List	Supported Standard and Expanded ACL IP-based ACL / MAC-based ACL Time-based ACL ACL Pool can be used for QoS classification Up to 4K entries	
Security	Supports MAC+ port binding IPv4 / IPv6 + MAC+ port binding IPv4 / IPv6 + port binding Support MAC filter ARP spoofing prevention ARP Scanning prevention IP source guard	
Authentication	IEEE 802.1x Port-based network access control AAA Authentication: IPv4 / IPv6 over RADIUS	
SNMP MIBs	RFC-1213 MIB-II IF-MIB RFC-1493 Bridge MIB RFC-1643 Ethernet MIB RFC-2863 Interface MIB RFC-2665 Ether-Like MIB RFC-2674 Extended Bridge MIB RFC-2819 RMON MIB (Group 1, 2, 3 and 9) RFC-2737 Entity MIB RFC-2618 RADIUS Client MIB RFC-2933 IGMP-STD-MIB RFC-3411 SNMP-Frameworks-MIB	

Feature	Specification	Compliant / Non-Compliant
	IEEE 802.1X PAE LLDP MAU-MIB	
Management Functions		
System Configuration	Console, Telnet, SSH, Web Browser, SSL, SNMPv1, v2c and v3 Management Supports the unit for IPv4 / IPv6 HTTP and SSL Supports the user IP security inspection for IPv4 / IPv6 SNMP Supports MIB and TRAP Supports IPv4 / IPv6 FTP/TFTP Supports IPv4 / IPv6 NTP Supports RMOM 1, 2, 3, 9 four group Supports the RADIUS authentication for IPv4 / IPv6 Telnet user name and password Supports IPv4 / IPv6 SSH The right configuration for users to adopt radius server's shell management Supports the function for timing-reset bases needs Supports CLI, Console (RS-232), Telnet Supports SNMPv1 / v2c / v3 Supports Security IP safety net management function avoid unlawful landing at nonrestrictive area Supports TACACS+	
Standards Conformance		
Regulation Compliance	FCC Part 15 Class A, CE	
Standards Compliance	IEEE 802.3 10Base-T IEEE 802.3u 100Base-TX IEEE 802.3z Gigabit SX/LX IEEE 802.3ab Gigabit 1000Base-T IEEE 802.3ae 10 Gigabit Ethernet IEEE 802.3x Flow Control and Back pressure IEEE 802.3ad Port trunk with LACP IEEE 802.1d Spanning Tree protocol IEEE 802.1w Rapid Spanning Tree Protocol IEEE 802.1s Multiple Spanning Tree Protocol IEEE 802.1p Class of Service IEEE 802.1Q VLAN Tagging IEEE 802.1x Port Authentication Network Control IEEE 802.1ab LLDP	
Warranty	3 years manufacturing warranty	

Table 5 Requirement for Access Switch (Server Switch)

Feature	Specification	Compliant / Non-Compliant
Copper Ports	24 10/100/1000Base-T RJ-45 Auto-MDI/MDI-X ports	
SFP/mini-GBIC Slots	4 100/1000Base-X SFP interfaces, shared with Port-21 to Port-24 Compatible with 100Base-FX SFP	
SFP+ Slots	4 10GBase-SR/LR SFP+ interface (Port-25 to Port-28) Compatible with 1000Base-SX/LX/BX SFP	
Console	1 x RS-232 DB9 serial port (115200, 8, N, 1)	
Switch Architecture	Store-and-Forward	
Switch Fabric	128Gbps / non-blocking	
Throughput	95Mpps@64Bytes	
Address Table	16K entries, automatic source address learning and ageing	
Share Data Buffer	1392 kilobytes	
Flow Control	IEEE 802.3x Pause Frame for Full-Duplex Back pressure for Half-Duplex	
Jumbo Frame	10Kbytes	
Layer 2 Function		
Basic Management Interfaces	Console, Telnet, Web Browser, SNMP v1, v2c	
Secure Management Interfaces	SSH, SSL, SNMP v3	
Port Configuration	Port disable / enable Auto-Negotiation 10/100/1000Mbps full and half duplex mode selection Flow Control disable / enable	
Port Mirroring	TX / RX / Both Many-to-1 monitor	
VLAN	802.1Q Tagged based VLAN, up to 256 VLAN groups Q-in-Q tunneling Private VLAN Edge (PVE) MAC-based VLAN Protocol-based VLAN Voice VLAN MVR (Multicast VLAN Registration) Up to 256 VLAN groups, out of 4094 VLAN IDs	
Link Aggregation	IEEE 802.3ad LACP / static trunk Support 14 groups of 8-Port trunk support	
QoS	Traffic classification based, strict priority and WRR 8-Level priority for switching - Port Number - 802.1p priority - 802.1Q VLAN tag - DSCP/TOS field in IP Packet	
IGMP Snooping	IGMP (v1/v2/v3) Snooping, up to 255 multicast Groups IGMP Querier mode support MLD Snooping MLD (v1/v2) Snooping, up to 255 multicast Groups	

Feature	Specification	Compliant / Non-Compliant
	MLD Querier mode support	
Access Control List	IP-Based ACL / MAC-Based ACL Up to 256 entries	
SNMP MIBs	RFC-1213 MIB-II IF-MIB RFC-1493 Bridge MIB RFC-1643 Ethernet MIB RFC-2863 Interface MIB RFC-2665 Ether-Like MIB RFC-2819 RMON MIB (Group 1, 2, 3 and 9) RFC-2737 Entity MIB RFC-2618 RADIUS Client MIB RFC-2933 IGMP-STD-MIB RFC-3411 SNMP-Frameworks-MIB IEEE 802.1X PAE LLDP MAU-MIB	
Standards Conformance		
Regulation Compliance	FCC Part 15 Class A, CE	
Standards Compliance	IEEE 802.3 10Base-T IEEE 802.3u 100Base-TX/100Base-FX IEEE 802.3z Gigabit SX/LX IEEE 802.3ab Gigabit 1000T IEEE 802.3ae 10Gb/s Ethernet IEEE 802.3x Flow Control and Back pressure IEEE 802.3ad Port trunk with LACP IEEE 802.1D Spanning tree protocol IEEE 802.1w Rapid spanning tree protocol IEEE 802.1s Multiple spanning tree protocol IEEE 802.1p Class of service IEEE 802.1Q VLAN Tagging IEEE 802.1x Port Authentication Network Control IEEE 802.1ab LLDP RFC 768 UDP RFC 793 TFTP RFC 791 IP RFC 792 ICMP RFC 2068 HTTP RFC 1112 IGMP version 1 RFC 2236 IGMP version 2 RFC 3376 IGMP version 3 RFC 2710 MLD version 1 FRC 3810 MLD version 2	
Warranty	3 years manufacturing warranty	

Table 6 Firewall Router (Unified Threat Management Appliance)

S.N.	Descriptions	Compliant / Non-Compliant
1	**General Specification**	
	The proposed solution should match following criteria:	

S.N.	Descriptions	Compliant / Non-Compliant
	At least 18 x 10/100/1000 GE Interfaces	
	75,000 or more number of new sessions per second	
	3 Million or more concurrent sessions	
	3 Gbps or more Firewall Throughput	
	1.5 Gbps or more IPS throughput	
	1 Gbps or more Antivirus Throughput	
	8 or more Virtual Systems	
2	**Administration, Authentication and General Configuration**	
	The proposed solution should have HTTPS, SSH, telnet, console management accesses	
	The proposed solution should support Local user database and Remote user authentication services such as: LDAP, Radius , 2-Factor authentication	
	The proposed solution should support PKI and certificates such as: X.509 certificates	
	The proposed system should support User and Device based policies	
3	**Operation**	
	The proposed solution must support NAT and transparent (bridge) operating modes	
	The proposed solution should support following NAT features: Static NAT, dynamic NAT, PAT	
4	**Networking**	
	The proposed solution should support Static and Policy based Routing	
	The proposed solution should support link load balancing and redundancy .	
	The proposed solution should support link health check monitoring	
	The proposed solution must be able to support Dynamic Routing Protocols such as : RIP,OSPF,BGP	
	The proposed solution should support content routing such as : WCCP and ICAP	
	The proposed solution should have traffic shaping and QOS feature	
	The proposed solution should support Wan Optimization feature	
5	**Virtual Private Network (VPN)**	
	The proposed solution should have following VPN Features:	
	IKE Versions : IKEv1 and IKEv2	
	Encryption Algorithms : DES,3DES,AES128,AES256	

S.N.	Descriptions	Compliant / Non-Compliant
	Authentication : MD5, SHA1, SHA256,SHA512	
	1.2 Gbps or more IPSec VPN Throughput	
	300 Mbps or more SSL VPN Throughput	
	1800 or more Site to Site IPSEC VPN Tunnels	
	250 or more concurrent SSL VPN users	
6	**Intrusion Presentation System (IPS)**	
	The proposed solution should have following IPS features:	
	should have an integrated Intrusion Preventation System (IPS) engine	
	should have packet logging option	
	should support rate based detection	
	should support protocol anomaly detection	
	should support custom attack signatures	
	should support automatic signature update from signature database	
7	**Threat Protection**	
	The proposed solution should have following Threat Protection features:	
	should have an integrated Anti-Virus protection	
	should have an integrated Antimalware protection	
	should support protocols: HTTP/ HTTPS , SMTP /SMTPS , POP3 /POP3S , IMAP /IMAPS, FTP /SFTP	
8	**Email Filter**	
	The proposed solution should have an integrated Email Filtering feature	
9	**Web Filter**	
	The proposed solution should have following Web Filtering features:	
	should have real-time web categorization feature supporting over 70 categories	
	should support user defined local categories	
	should support DNS web filtering	
	should support URLs rating by domain and IP address	
10	**Application Control**	
	The proposed solution should support application control blocking features:	
	should have Deep Application Visibility such as: login names ,	

S.N.	Descriptions	Compliant / Non-Compliant
	files/video activities	
	should support SSH inspection feature	
	should support custom application signatures	
11	**Security Features**	
	The proposed solution should have Botnet protection feature	
	The proposed solution should have Network Vulnerability Scanning feature	
	The proposed solution should support GeoIP Addressing	
	The proposed solution should have Data Leak Prevention (DLP) feature	
	The proposed solution should have End Point Control feature	
	The proposed solution should support Operating System Sandboxing feature	
	The proposed solution should have Wireless Controller feature	
	The proposed solution should have Client Reputation feature	
	The proposed solution should support Token Server with provisioning of Hardware and Soft OTP Tokens	
	The proposed solution should support SSL inspection for Web Filtering , Application Control, Antivirus and IPS	
12	**High Availability**	
	The proposed solution should support Active-Active, Active-Passive failover	
13	**Logging and Reporting**	
	The proposed solution should support logging and reporting of network traffics, users, devices ,applications and threats.	
	The proposed solution should support syslog server	
14	**Certification**	
	The proposed solution must have following certifications:	
	ICSA Labs Firewall – Corporate	
	ICSA Labs IPSEC Basic	
	ICSA Labs Network IPS	
	ICSA Labs Antivirus	
15	**Warranty**	
	The proposed solution should have 1 (one) year security subscription and hardware replacement warranty	

Table 7 Server Requirements

Features	Description	Compliant / Non-Compliant
Processor	Intel Xeon E5-2630 v3 2.4GHz,20M Cache,8.00GT/s QPI,Turbo,HT,8C/16T (85W)	
Chipset	Intel C610 series chipset	
Memory	128 GB RDIMM, 2133 MHz upgradeable Up to 768GB	
Hard Disk	4x1.2TB 10K RPM SAS 6Gbps 2.5in Hot-plug Hard Drive	
RAID Controller	Raid controller with 1 GB cache	
Optical Drive	DVD+/-RW ROM, SATA	
Communication	Dual-port 1Gb NIC	
Power	Dual, Hot-plug, Redundant Power Supply	
Management Software	Server Configuration Management software	
Form Factor	2 U Rack mountable	
Rail Kits	2U Cable Management Arm and Ready Rails 2U Sliding Rails	
Warranty	3 Years Manufacturer's warranty for Parts and Service	

Table 8 Requirement for U-Server Rack

Feature	Specification	Compliant / Non-Compliant
Basic Structure	Comply with ANSI/EIARS-310-D, DIN41491; PART1, IEC297-2, DIN41494; PART7, GB/T3047.2-92 standard. Compatible with metric ETSI and 19 inch international standard. Cold-rolled steel sheet. Thickness for frame 1.2mm, mounting rail,2.0mm(1.5mm for 1000 mm depth cabinet), fixed shelf 1.2mm , side panel 1.2mm.	
Front Door	Perforated single door with lock and easy detachable hinges.	
Back Door	Perforated double doors with lock and easy detachable hinges.	
Side Panel	Fixed Side Panel with top & bottom vented for easy air flow.	
Space	Height – For 42U overall height	
	Width – 800mm	
	Depth – 1000mm	
Heat Management	Rack provided with 4 fans directly mounted on the roof top as an exhaust from the cabinet.	
Powder Coating Details	Thickness Powder Coating of 80 to 100 Microns with scratch resistance properties.	
	To avoid corrosion & rusting : Rack to be powder coated with Nano ceramic pre-treatment process using a zirconium coat,	
Power Management	2 X 8 ways Power Distribution Unit with surge protection.	
Manufacturers Details	Manufacturer should have ISO 9001-2000 & 14001-2004 Certifications,	

Table 9 Equipment Requirement for Storage

Feature	Specification	Compliant / Non-Compliant
CPU	Intel® Xeon® E3-1200 v3 Family 3.4 GHz Quad Core Processor	
System memory	32 GB (8 GB x 4) DDR3 ECC RAM	
Total memory slots	4	
Flash Memory	512MB DOM	
Hard Drive Bays	12 slots x 3.5-inch SATA 6Gbps/3Gbps hard drive or 2.5-inch SATA	
LAN Port	4 x Gigabit RJ-45 Ethernet port (Expandable up to 8 x 1 Gb LAN or 4 x 10 Gb + 4 x 1 Gb LAN by installing optional dual-port 10 Gb and 1 Gb network card)	
USB	4x USB 3.0 port (rear) 4x USB 2.0 port (rear)	
Form Factor	2U, Rackmount	
PCIe Slot	2 (1* PCIe Gen3 x8, 1* PCIe Gen3 x4)	
Fan	4 x 6 cm smart cooling fan	
Operating System	QTS 4.1 (embedded Linux)	
Disk Management	Thin-provisioning with space reclamation supported Online Volume Expansion Online Storage Pool Expansion Single Disk, JBOD, RAID 0, 1, 5, 6, 10 RAID Hot Spare and Global Hot Spare Online RAID Capacity Expansion and Online RAID Level Migration Bad Block Scan and Hard Drive S.M.A.R.T. Bad Block Recovery RAID Recovery Bitmap Support	
Supported Clients	Windows Server 2003 onward, Apple Mac OS X onward, Linux & UNIX	
File System	EXT4 (internal Hard Disk Drive) EXT3, EXT4, NTFS, FAT32, HFS+(External Hard Drive)	
Networking	TCP/IP (IPv4 & IPv6: Dual Stack) Quad Gigabit NICs with Jumbo Frame* Failover Multi-IP Settings Port Trunking/NIC Teaming (Modes: Balance-RR, Active Backup, Balance XOR, Broadcast, IEEE 802.3ad/Link Aggregation, Balance-TLB and Balance-ALB) Optional Dual-port 10 GbE and 1 GbE Network Expansion Cards* Service Binding Based on Network Interfaces* Proxy Client, Proxy Server DHCP Client, DHCP Server Protocols: CIFS/SMB, AFP (v3.3), NFS (v3), FTP, FTPS, SFTP, TFTP, HTTP(S), Telnet, SSH, iSCSI, SNMP, SMTP, and SMSC UPnP & Bonjour Discovery, USB Wi-Fi Adapter Support	
Security	IP Filter & Policy-based Automatic IP Blocking	

Feature	Specification	Compliant / Non-Compliant
	Network Access Protection with Auto-blocking: SSH, Telnet, HTTP(S), FTP, CIFS/SMB, AFP Encrypted Access: HTTPS, FTP with SSL/ TLS (Explicit), SSH/SFTP (admin only), Encrypted Remote Replication (Rsync over SSH) CIFS Host Access Control for Shared Folders Antivirus Protection FIPS 140-2 Validated AES 256-bit Volume-based Data Encryption** AES 256-bit External Drive Encryption* Importable SSL Certificate Instant Alert via E-mail, SMS, Beep, and LCD Panel*	
iSCSI (IP SAN)	iSCSI Target Multi-LUNs per Target Up to 256 Targets/LUNs Combined Supports LUN Mapping & Masking Block-based LUN Thin-provisioned LUN with Space Reclamation supported Online LUN Capacity Expansion Supports SPC-3 Persistent Reservation Supports MPIO & MC/S iSCSI LUN Backup, One-time Snapshot, and Restore iSCSI Connection and Management by QNAP Finder (Windows) Virtual Disk Drive (via iSCSI Initiator) Stack Chaining Master Max No. of Virtual Disk Drives: 8	
Server Virtualization & Clustering	VMware vSphere (ESX/ESXi 4.x, 5.x) VMware VAAI for iSCSI and VAAI for NAS vSphere Plug-in Citrix XenServer (6.0) Windows Server 2012 Hyper-V Supports Microsoft ODX Windows Server 2012 Failover Clustering	
Power Management	Wake on LAN* Internal Hard Drive Standby Mode Scheduled Power on/off Automatic Power on after Power Recovery USB and Network UPS Support with SNMP Management	
Domain Authentication Integration	Microsoft Active Directory (AD) LDAP Server LDAP Client Domain Users Login via CIFS/SMB, AFP, FTP, and File Station	
Syslog Server	Centralized Log Monitoring and Archiving Immediate Email Alerts Supports Log Filtering	
Hard Disks	5 x 3TB Enterprise Storage Hard Disks	

5. TRAINING, DELIVERABLES AND FACILITIES

5.1 TRAINING AND KNOWLEDGE TRANSFER

The bidder shall prepare the technical, user and operational training manuals and session plans for the network and server system. The trainings shall be conducted for the designated team of EA (DoTM).

The training shall be organized centrally by the bidder in consultation with the EA. Training shall include:

- Intensive Training on Networking equipments
- Intensive Training on Server equipments including Server Virtualizations
- Hands on Operational Training

5.2 DELIVERABLES

The Bidder shall furnish following documents during the project period:

1. Inception Report
2. Design Document
3. Testing procedures and Test Reports
4. Completion Report
5. Operational/User Manuals

5.3 OPERATION AND MAINTENANCE OF SYSTEM

The Developer shall provide full warranty for at least one year including operation and maintenance support from the date of final acceptance by the EA.

The Terms of Reference also requires extended support for the additional period of three years after the completion of one year support.

6. FACILITIES TO BE PROVIDED BY THE CLIENT

In order to support the supplier, DoTM will provide the following:

- Liaison officer to facilitate the discussions with the government authorities and other agencies;
- Introductory letter to stakeholders to introduce and authorize the consultants to observe the operation of the systems to be integrated
- Venue for the presentation and/or discussion.

7. QUALIFICATION OF THE BIDDER

1. Bidders interested to participate in the bid must have minimum of ten (10) years of company establishment. Legal documents - company registration certificate, VAT registration certificate and latest tax clearance must be included in the bid.

2. Interested firms must furnish information indicating that they are qualified to perform the services.

3. Audited evidence of average annual turnover during last three years of NRs. 50,000,000.00.

4. The minimum amount of liquid assets or working capital or credit facility should be of NRs. 10,000,000.00.

5. The net worth of the bidder should be positive as on the end of last fiscal year to justify the reputation and financial worthiness of the bidder. The latest audited balance sheet of last three years should be attached with the bid.

6. Bids submitted by an agent other than the manufacturer shall be accompanied by a letter from the manufacturer stating that the bidder is the authorized agent of the said manufacturer for this bid. The letter of authorization should clearly state the extent of power delegated to such agent with respect to price quotation and negotiation. The principal/manufacturer is bound to honor any commitment of whatever nature made by his agent so authorized on behalf of his principal.

7. The goods offered shall be of latest brand under standard production.

8. The bidder is required to state clearly the specifications of his proposed goods alternatives, if any. Compliance with or variation from the buyer's requirement of the technical specifications shall be duly filled in and signed in the offered specification column of the technical specification supported by relevant technical catalogues/leaflets.

9. The bidder must sign the Bid Forms, Bid Data Sheet and the Price Schedules of the Bid Document. Any erasures or change shall be initiated by the person signing the bid.

10. Bidder must propose at least one RHCE Certified Personnel and one MCSE Certified Personnel. Curriculum Vitae of proposed personnel must be attached.