

MAINSTREAMING APPROPRIATE LOCAL ROAD STANDARDS AND SPECIFICATIONS AND DEVELOPING A STRATEGY FOR THE MPWT RESEARCH CAPACITY

SEACAP 3.01



Completion report

UNPUBLISHED PROJECT REPORT



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Prepared for: Project Record: **SEACAP 3.01. Mainstreaming Appropriate Local Road Standards and Developing a Strategy for the MPWT Research Capacity**

Client: DfID; South East Asia Community Access Programme (SEACAP) for Department of Roads (DoR), Ministry of Public Works and Transport (MPWT) Lao PDR

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ABBREVIATIONS & ACRONYMS

AADT	Average Annual Daily Traffic
ADT	Average Daily Traffic
ASEAN	Association of South East Asian Nations
CBR	California Bearing Ratio
CNCTP	Cambodia National Community of Transport Practitioners
CRC	Community Road Committees
CSA	Crushed Stone Aggregate
CSIR	Council for Scientific and Industrial Research (South Africa)
DBM	Dry Bound Macadam
DBST	Double Bituminous Surface Treatment
DCP	Dynamic Cone Penetrometer
DfID	Department for International Development
DoR	Department of Roads
EADT	Equivalent Average Daily Traffic
EDCs	Economically emerging and Developing Countries
ENS	Engineered Natural Surface
esa	equivalent standard axles
FHWA	Federal Highways Association (US)
FM	Fines Modulus
FWD	Falling Weight Deflectometer
GMSARN	Greater Mekong Sub-region Academic and Research Network
GoL	Government of Lao PDR
gTKP	global Transport Knowledge Partnership
GVW	Gross Vehicle Weight
GWC	Gravel Wearing Course
HDM4	Highway Development and Management Model
HQ	Headquarters
HRD	Human Resource Development
IFG	International Focus Group
IFRTD	International Forum for Rural Transport Development
ILO	International Labour Organisation
IRI	International Roughness Index
km	kilometre
LCS	Low Cost Surfacing
LRD	Local Roads Division (DoR)
LVRR	Low Volume Rural Road
m	metre(s)
MCTPC	Ministry of Communication, Transport, Post and Construction (now MPWT)
MERLIN	M achine for E valuating R oughness using L ow-cost I Nstrumentation
mm	millimetre(s)
MoU	Memorandum of Understanding
MPa	Mega Pascals
MPWT	Ministry of Public Works and Transportation (formerly MCTPC)
NGPES	National Growth and Poverty Eradication Strategy
NUOL	National University of Lao

OCTPC	Office of Communication Transport Posts and Construction (District Level)
OPWT	Office of public works and transport (at district level – formerly OCTPC)
ORN	Overseas Road Note
PAD	Personnel and Administration Division (MPWT)
PCU	Passenger Car Unit
Pen Mac	Penetration Macadam
PIARC	World Road Association
PTD	Planning and Technical Division (DoR)
QA	Quality Assurance
Ref.	Reference
RRGAP	Rural Road Gravel Assessment Programme (Vietnam)
RRSR	Rural Road Surfacing Research (Vietnam)
RRST	Rural Road Surfacing Trials (Vietnam)
RT1	Rural Transport 1 st Project, Vietnam
RT2	Rural Transport 2 nd Project, Vietnam
RT3	Rural Transport 3 rd Project, Vietnam
SBST	Single Bituminous Surface Treatment
SCC	SEACAP Coordinating Committee
SEACAP	South East Asia Community Access Programme
SIDA	Swedish International Developments Cooperation Agency
SOE	State Owned Enterprise
T	Tonne
TRL	Transport Research Laboratory
UK	United Kingdom
UNOPS	United Nations Office for Project Services
VN	Vietnam
VOCs	Vehicle Operating Costs
VPD	Vehicles per day
WBM	Water Bound Macadam
WLAC	Whole Life Asset Costs
WLC	Whole Life Costs

1 Introduction

1.1 Project Objectives

SEACAP3.01 contributes to the overall SEACAP goals of sustaining poverty alleviation through the development and mainstreaming of local resource-based standards for Low Volume Rural Roads (LVRRs). This allows regionally available rural road design and maintenance standards and guidelines to be improved for the specific circumstances of Lao PDR and permits more efficient and optimal use of the limited financial and physical resources available for the sector.

The objectives of SEACAP 3.01 were to:

- Develop and mainstream appropriate local road standards and specifications into the MPWT together with an associated initial training programme.
- Develop an affordable and sustainable strategy for attaining the necessary road research capacity.
- Increase the awareness of good practice from this project by disseminating the outcomes at national, sub-regional and international levels.

1.2 The Report Objectives

This report seeks to summarise the activities and outcomes from the SEACAP 3.01 contract. Outcomes from the principal tasks as defined in the ToR are outlined, with reference being made to the appropriate Documents and Technical Papers. The resources employed by the Consultant are also summarised.

Recommendations are made as to the way forward for key aspects of this important research programme,

1.3 Contractual arrangements for the project

The Agreement for the project was established under a Memorandum of Understanding (MoU) between the Ministry of Communication, Transport, Post and Construction (MCTPC), on behalf of the Government of Lao PDR and the Department for International Development (DfID), UK. The MoU defined the scope of the project to be undertaken by TRL Limited as the appointed Consultant and implemented under the Terms of Reference. The MoU also expresses certain Exemptions and Facilities to be provided by MCTPC to the Consultant to facilitate implementation of the project. The MoU was signed on the 16th of October 2006.

During the project the Ministry was renamed the Ministry of Public Works and Transport (MPWT) and this revision is used henceforth throughout this report.

TRL provided DfID with a comprehensive technical and financial proposal for carrying out the project and subsequently entered into a contractual arrangement with Crown Agents (acting as Agents for DfID). TRL were appointed on 21st of November 2006. The original duration of the project was planned as being 12 calendar months from mobilisation, although this was later extended by 2 months to be able to complete dissemination.

TRL has been supported in its undertaking of the project by named associate firms and by competent and experienced individual consultants. The principal named associate firm was Lao Technical Engineering Consultants (LTEC) who provided comprehensive local consulting services.

TRL entered into a contractual agreement with LTEC to provide a total of 68 person months of services over the duration of the project. Forty-Eight (44) person months were for engineering and translation services and 24 person months were for administrative, secretarial and coordination services.

The other associate firm is Intec Associates consulting engineers who have worked extensively with TRL on other SEACAP projects in the region. Intec provided a short-term specialist role on this project similar to that provided by the individual consultants.

1.4 Structure of the Project

Activities within the project were programmed into three components containing a total of 11 Modules which were carried out in four principal Task Groups, Figure 1.

1.5 Mobilisation

Mobilisation of SEACAP-3 commenced in week beginning 29th January 2007 with the arrival in Vientiane of Dr J Cook and Mr M O'Connell. Lao Transport Engineering Consult (LTEC) mobilized their staff at the same time.

Following discussions with the Department of Roads (DoR) and LTEC it was agreed that the Project Office would be set up in the LTEC main office at Km 5, Thadeua Road. The option of setting up a Project Office with the Local Roads Division (LRD) was considered and whilst from a working point of view this would have been an ideal situation, there was insufficient readily available space. Close contact was maintained both with LRD and Planning and Technical Division (PTD) through counterpart engineers located within their respective organisations.

The SEACAP-3 office at LTEC was fully mobilised on 1st February with telephone and internet communications.

1.6 MPWT / Local stakeholders

Clear working relationships between the various project stakeholders were established and maintained throughout the duration of the project and in particular with; the Local Roads Division (LRD) and the Planning and Technical Division (PTD) within the DOR. Frank and cooperative discussions on key issues were encouraged from the outset and this approach has greatly benefited project delivery, which is very much seen as a joint DOR-SEACAP effort.

The links with the key stakeholders are set out in the sections below.

1.7 MPWT and SEACAP management

Figure 2 shows the working relationship of the project. Crucial points were:

1. The early establishment of a SEACAP Coordination Committee (SCC) through which Project strategy and progress was coordinated in conjunction with SEACAP management.
2. Operational links were established through the LRD and PTD.
3. Day to day coordination was through the DoR counterparts, who were officially appointed by Director General DoR.

Table 1 lists the key DoR personnel in the coordination procedure and Figure 3 presents the composition of the DoR and links within that to SEACAP 3.01. An additional link to the MPWT Information Technology Department was established to facilitate the development of a website for the dissemination of Project outputs.

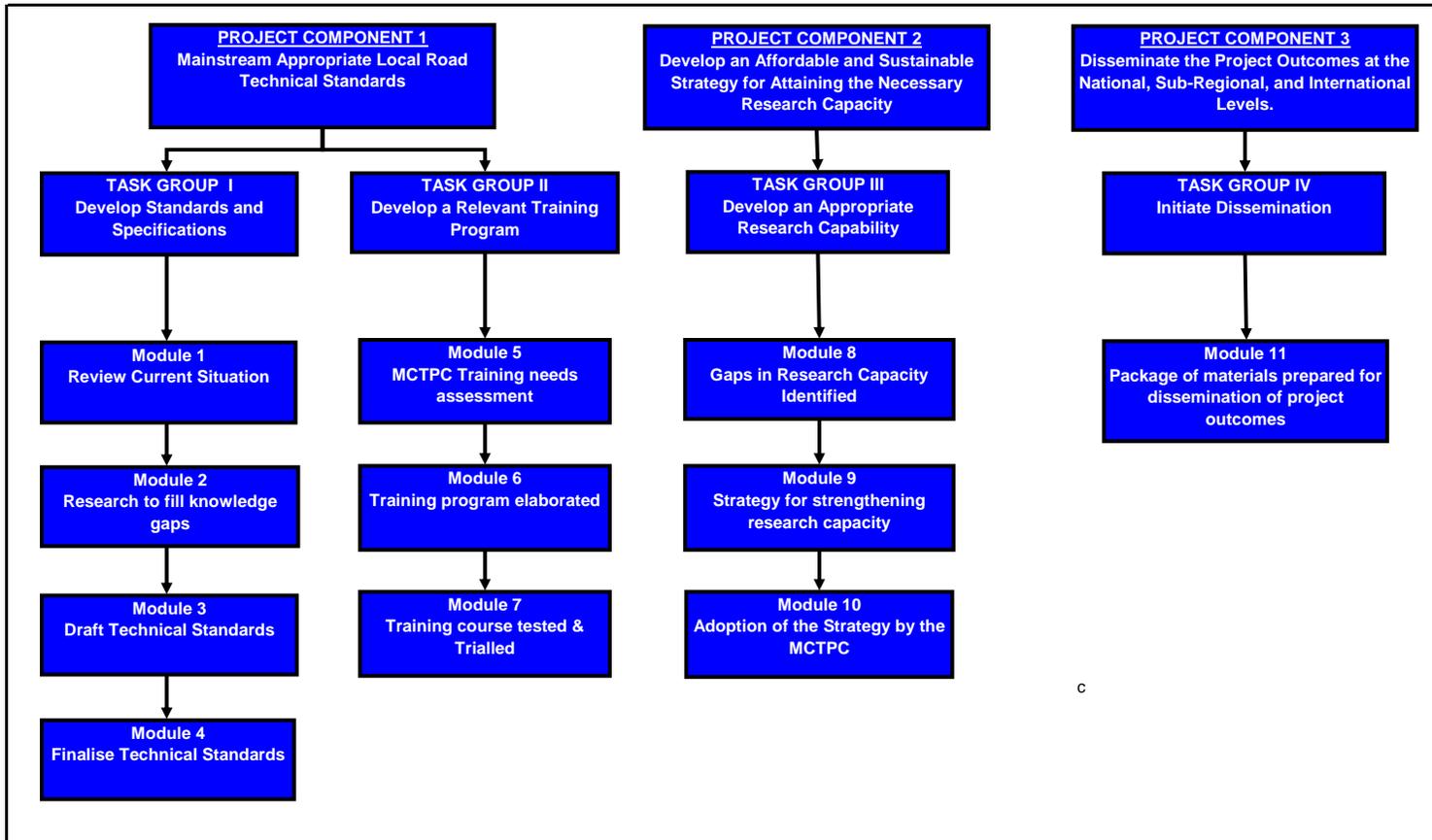


Figure 1. Project Components

Table 1 Links with MPWT

Personnel	Position	Cooperation Links to SC 3
Laokham Sompheth	Director General, DOR	Coordination Committee Chairman
Sengdarith Kattignasack	Director of Local Roads Division, DOR	Coordination Committee Vice Chairman
Dr. Maysy Viengvilay	Director of Planning & Technical Division, DOR	Coordination Committee
Chanh Bouphalivanh	Director of Road Administration Division, DOR	Coordination Committee
Khampaseuth Panyanouvong	Civil Engineer (LRD)	Project Counterpart
Ounheuane Siriamphone	Senior Technical Staff (PTD)	Project Counterpart

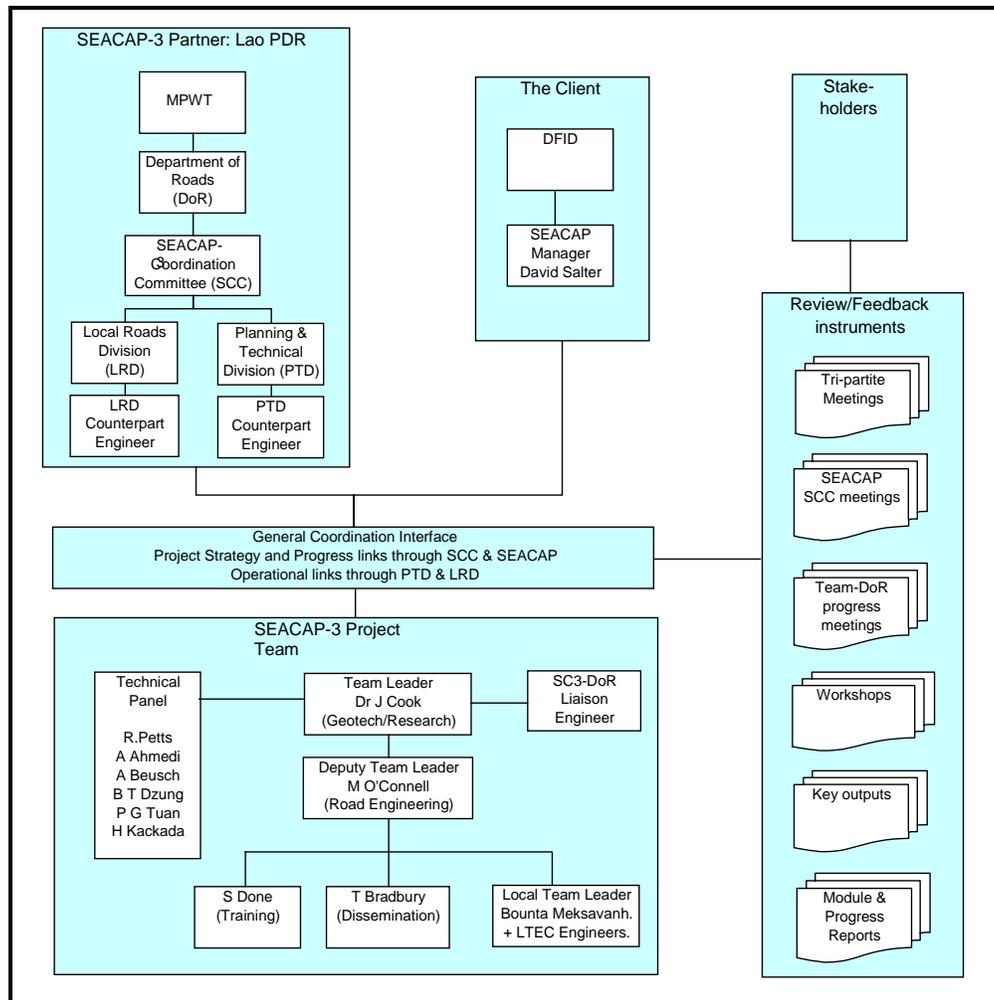


Figure 2 Working relationships for the implementation of the Project

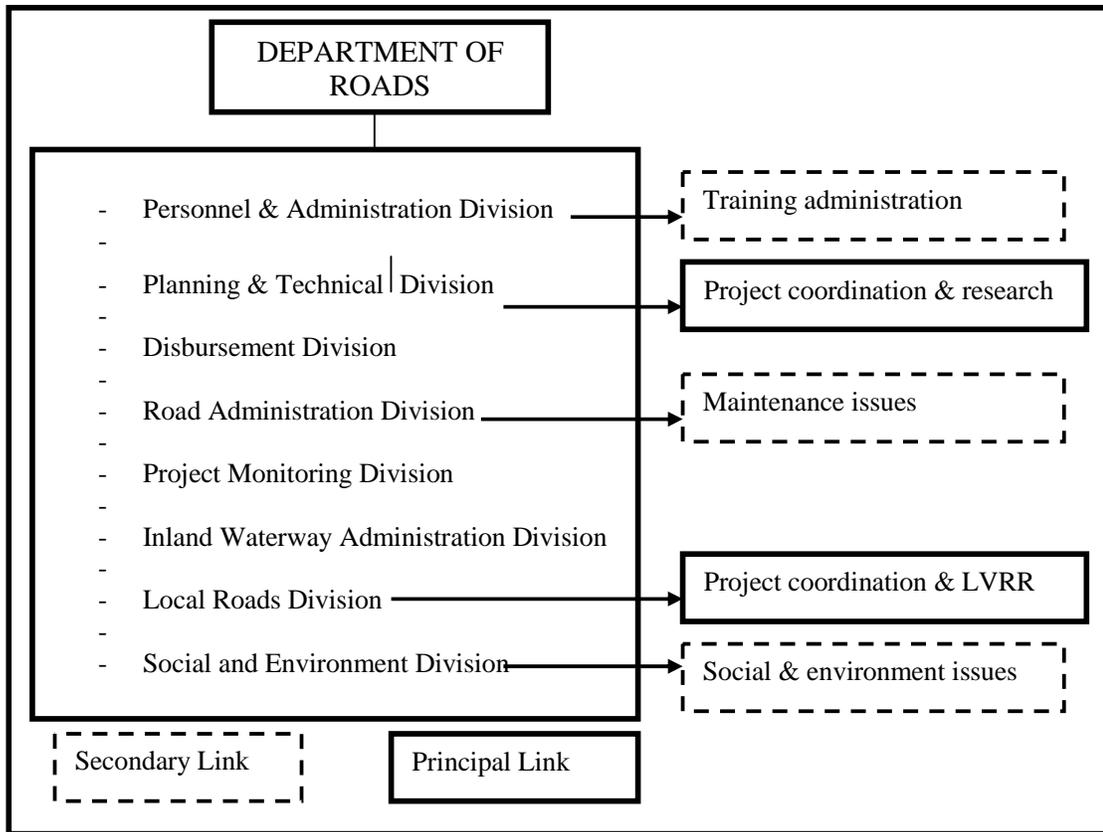


Figure 3 Structure of DoR and links to SEACAP 3.01

1.8 Non-Ministry stakeholders

A number of important stakeholders were identified outside the MPWT whose cooperation has been very beneficial for the delivery of the project. These links are listed in Table 2. Discussions with these key personnel have been held on a frequent and regular basis throughout the duration the project.

Table 2 Cooperation links with non MPWT stakeholders

Organisation	Key Personnel	Cooperation Links
SIDA (HIFAB)	Belal Hussain Ulf Brudfors	1. SIDA funded Basic Access programme in developing appropriate low volume road specifications. 2. Development of research capacity available to MPWT, possibly through the NUOL 3. Development links with NUOL Rural Engineering Modules
National University	Nhinxay Visane Khampaseuth Thepvongsa Chankhachone Sonemanivong	1. Development of research links in LVRR sector. 2. Future use of staff/student research teams for gathering data (e.g. traffic) 3. Development of links for uptake of SC3.01 outputs by NUOL undergraduate. modules
SweRoad	Dick Jonsson Voitto Kuronen	1. Sharing of information on maintenance strategies and maintenance procedures for road options 2. Possible cooperation on spot improvement strategies
ADB	Richard Tomkins Jeffrey Miller	1. Exchange of information on access road pavements option costs and designs
KfW/GITEC*	Thongkhanh Thammavong Dr Philipp Kohlshreiber	1. Exchange of information on access road and bridge design and performance (Bokeo)
World Bank*	Dr M M Nunez	1. (RMP II) Exchange of information on maintenance regime for whole country

1.9 SEACAP Relationships

Effective linkages with current and completed SEACAP programmes were an essential feature for the effective delivery of the project. Table 3 lists pertinent SEACAP projects and summarises their status during the implementation of SEACAP 3.01.

Table 3 Links to other SEACAP projects

SEACAP	Summary Description	Key Links to SEACAP-3
1 (Vietnam)	Development, trialling and monitoring a range of sustainable road surfaces that better use local resources, minimising Whole-life-Costs and supporting the Vietnam Government's poverty alleviation and road maintenance policies.	Technical specifications. Pavement trial performance & whole-life cost model
2 (Cambodia)	Cambodia transport mainstreaming partnership (TMP); support for a range of complementary transport sector initiatives, which assist the aims and policies of the Government of Cambodia, to provide benefits such as improved rural access, lower transport costs and create local employment and enterprise opportunities for rural communities. The Cambodia TMP is aims to consolidate past research outputs and setting up a unified information system.	Procedures for technical dissemination and co-ordination of research outputs
4 (Vietnam)	Collection, collation and analysis of field assessments of condition of 276 unsealed road links in Vietnam.	Unsealed gravel road performance
8 (Cambodia)	Assessment of low cost surfacing trials and associated costs, together with related key issues of maintenance and axle overloading in the rural road sector	Technical specifications. Pavement trial performance & whole-life cost model
17 (Lao PDR)	Development, trialling and monitoring a range of sustainable road surfaces that better use local resources in Lao PDR.	Technical specifications.
19 (Cambodia)	A series of rural road research and research development projects aimed at providing a continuation of the work commenced under SEACAPs 2 and 8.	Research outputs on key paving options. Earth road construction trial data. Low cost structures manual
20 (Vietnam, Lao & Cambodia)	Assessment of contractor and construction plant related issues within the rural road sector in Vietnam, Cambodia and Lao PDR.	Contractor capabilities and plant availability
21.(Lao PDR)	The development and application of technologies and approaches for appropriate slope stability management in Lao PDR.	Inputs into the technical standards and alignment aspects of LVRR classification
22 (Vietnam, Lao & Cambodia)	Time and distance studies in 3 Lao PDR provinces representing differing conditions .	Background information on travel modes

1.10 Core Staff on the Project

Table 4 lists the core team members and their responsibilities. Only minor adjustments to their time inputs occurred during the implementation of the project. The core team were supported by the quality assurance and review panel as listed in Table 5. In addition TRL also provided Dr John Rolt as Quality Assurance Review Officer on technical matters concerned with the project deliverables. Dr

Rolt also contributed to the first workshop describing the outcome of the Module 1 review and some of the road design issues that were addressed.

Table 4 Project Professional Staff and Responsibilities

Name	Position	Key Project Responsibilities and Inputs
Dr Jasper Cook (TRL)	Team Leader Geotechnical Specialist	Project technical direction and management. Appropriate LVRR technical specification development. Research development and application.
Michael O'Connell (TRL)	Transport and road engineering specialist and Deputy Team Leader	TRL Project Manager. Road and pavement engineering. Standards development. Research and training needs assessment
Simon Done (TRL)	Training Specialist	Road engineering, training and capacity building
Trevor Bradbury (TRL)	Dissemination and IT specialist	Engineering and dissemination. Design and set-up of LVRR website
Bounta Meksavanh (LTEC)	Local Team Leader and Road Engineer Specialist	Project management and road engineering
Saysongkham Manodham (LTEC)	Road engineering specialist	Local road engineering
Chittakone Maniphon (LTEC)	Training Support	Road engineering and training
Keithiphan S (LTEC)	IT Support	Engineering and IT support

Table 5 Quality Assurance and review panel

Name	Key Project Responsibilities and Inputs
Rob Petts (Intech)	Review of the LVRR standards and specifications
Andreas Beusch (Intech)	Review of research capability and training needs
Akram Ahmedi (TRL)	Transport and road research capacity
B T Dzung (Vietnam)	Review of the Vietnamese local road standards in comparison with the Lao situation
P G Tuan (Vietnam)	Review and adaptation of the SEACAP 1 cost model for application in Lao

1.11 Inception Report

After an initial series of meetings with the stakeholders and the Coordination committee, the inception report was delivered in draft on the 9th March 2007. The Inception Report workshop was held on the

19th March 2007 and its general principles were agreed. The Inception Report recorded that the structure and scope and time schedule of the project remained as described in the proposal and contract for the project. It also recorded that agreements had been completed with the local engineering firm, LTEC and with the members of the review team.

The consulting staff inputs and those for the technical review panel are summarized below and a detailed schedule of the implemented inputs is given in Appendix A. These inputs are very similar to the planned inputs.

Table 6 Consultancy staff inputs

Input Group	Person months	
	Planned	Delivered
International	13	13.75
Domestic	68	68
MPWT	24	24
Technical panel	4.25	3.5

1.12 Coordination Committee Meetings

The project was effectively guided through to delivery through scheduled Coordination Committee meetings at significant stages and frequent formal and informal meetings and discussions as necessary with the Divisions (LRD and PTD) responsible for operations within SEACAP 3.01. The significant SCC meetings are listed in Table 7.

Table 7 Summary of Principal Coordination Committee meetings

Meeting	Subject	Dates
1	Progress meeting	11 April 2007
2	DfID/SEACAP Peter O'Neill (DfID) John Gothard (Crown Agents) David Salter (SEACAP Manager)	28 April 2007
3	Progress meeting	29 May 07
4	Post review workshop meeting	26 July 2007
5	Training Module structure	13 September 2007

2 Task Group 1: Development of Local Road Technical Standards and Specifications

2.1 Review

More than 100 documents were identified, accessed and reviewed as part of the process to review both the existing situation in Lao with regard to LVRRs and with regard to relevant road classifications and standards available in the international domain. A number of these documents were of key importance to the project. A list of the documents reviewed is given in Appendix B.

2.1.1 The Lao PDR Infrastructure Context and Poverty Alleviation

The Government of Lao PDR is engaged in a comprehensive infrastructure development plan encompassing all classes of roads in the country. This development plan has set the provision of villages with access roads by the year 2020 as an important target. The promotion of Kum Ban planning is a priority for the National Growth and Poverty Eradication Strategy (NGPES); each Kum Ban should have all-year access among its constituent villages and to the district centre.

The development plan is in line with the long term National Growth and Poverty Eradication Strategy, established in 2004, which aims to eradicate mass poverty by 2010. There is clear evidence in Lao that reducing transport costs through rural road improvement generates significant reductions in poverty. Some research indicates that the initial provision of dry season access results in a reduction in poverty incidence of about 17 times of that when dry season access only roads are upgraded to all weather access roads, although both are of course necessary.

2.1.2 The Road law

The Road Law for Lao PDR (1999) defines its purpose as being to assure and facilitate traffic all year round between provinces, cities and remote areas in order to contribute to the socio-economic development and to support the defence and securities of the country. Six classes of road are defined, namely: National; Provincial; District; Urban; Rural and Specific.

The road law defines the rights and duties of each of the above levels of governance in a hierarchical system, as shown below:

1. The Ministry of Public Works and Transport (MPWT);
2. The Departments of Public Works and Transport (DPWT) at Province level,
3. The Offices of Public Works and Transport (OPWT) at District or Municipal level;
4. The Village Authorities.

2.1.3 The rural road network

The total road network comprises some 32,600 kms of which about 15,000km are described as District and Community roads. About half of the national roads, linking major towns and provincial capitals and providing connections to neighbouring countries are now paved, with the remainder having gravel or earth surfaces. District and Community (or Rural) roads are essentially all unsealed.

Three types of roads within rural areas have been identified in terms of access:

- No vehicular access; Pathways through which the village is normally reached which cannot accommodate conventional motorized vehicles,

- Dry season only access; Roads which are predominantly unpaved. These are only accessible by conventional motorized vehicles during the dry season,
- All weather access. All weather access roads which can be used by conventional, motorized vehicles during the dry and wet seasons.

The RTIP report in 2006 assessed that whereas 19% of rural roads provide all year access, 40% of villages have no access at all. The PRoMMS database on “maintainable” roads comprises information on 5,700km of the rural road network; which indicates that a further approximately 9,000kms of identified rural roads are deemed to be in a non-maintainable condition.

A Road Maintenance Fund (RMF) has been in operation since 2002 of which about 10% is currently allocated to “local roads”. However, it is not expected that the fund will be able to fully cover local roads maintenance needs within the next 10 years.

2.1.4 Low volume classification and geometric standards

The Lao PDR Road Design Manual originally defined seven road design divisions; from Class I to VII based on decreasing traffic volumes (Class I with more than 8,000 vehicles per day to Class VII with less than 50 vehicles per day). This was subsequently modified (MCTPC, 2003) to split the lowest Class (VII) into two classes VII and VIII for traffic categories 21 to 50 ADT and less than or equal to 20 ADT, respectively. This sub division permits alternative cost-effective designs more suitable for low volume roads. It was understood that this proposal had not been officially adopted within the Road Law.

The current Lao Road Design Manual does not, however, address specific issues relating to the design of LVRRs through the recognition that designs need to support the function that the road is providing as well as recognising the important influences of the road environment on deterioration mechanisms.

A review of international information on LVRR classification shows a significant variability in approach. They are based predominantly on traffic volume (generally ADT) and take terrain into account to varying degrees. However axle loading is only quantified in terms of a vehicle description. Notably in Lao, it is necessary to take account of a large number of non-vehicular or non-4-wheeled vehicles and provide shoulders and safe havens for these more vulnerable road users.

2.1.5 LVRR technical specifications

The current Lao PDR Road Design Manual is not tailored to the specific needs of LVRRs although it does offer some relaxation of pavement design standards for low volume roads. The only pavement specification included specifically for LVRRs is a gravel wearing course. A review of regional and international design manuals related to environmental factors in Lao indicates that it is not appropriate to simply import those documents into technical specifications for Lao.

Also, there is a need to provide a range of appropriate LVRR specifications that are suitable for use by small contractors and local consultants in Lao PDR, with an emphasis on a simplified design process.

Other SEACAP projects, notably SEACAP 1 in Vietnam and SEACAP 8 in Cambodia have constructed trial sections using alternative road surfacing and pavements. Although these trials have been carried out relatively recently in performance assessment terms, most of them have used pavement construction materials and procedures proven elsewhere. More recently, trials sections based on customised technical specifications have been completed under SEACAP 17.

It is clear from the review that alternative pavement and surfacing solutions for low-volume roads are now recognised as a necessity, and it is no longer acceptable in the context of sustainability and whole life costing to consider unsealed gravel as a total solution in all road environments.

2.1.6 Lao PDR road environment factors

The road environment factors likely to influence the construction and sustainable performance of LVRRs in Lao have been reviewed. The key points are:

- **Materials:** natural materials available for road construction occur as function of the controlling geological and geomorphological influences within four general geological-terrain systems. Principal material types are rock aggregate; alluvial sand and gravel; hill gravel and laterite gravel.
- **Climate:** the Lao climate is essentially seasonally wet tropical with an annual rainfall of between 1500 and 3000mm occurring principally between May and October. Climatic indices show that Lao falls outside the climatic envelope of recent research in Africa on LVRRs. On average about three tropical cyclones per year make landfall on Vietnam and then move through to impact upon Lao territory.
- **Terrain:** the topography of Lao can be related to the geological units with much of the terrain in the northern and eastern part of the country being mountainous, with lower lying more level ground and alluvial plains in the south and west.
- **Traffic:** an examination of available information from the SIDA funded maintenance management project shows that for maintainable rural roads the predominant traffic is light to moderate; that is up to 50 vehicles per day with up to 4 heavy vehicles, or up to 150 vehicles per day with 10 heavy vehicles per day.
- **Contracting Capacity:** according to the register of contractors in the year 2005, 147 contracting firms are registered in Lao PDR, of which 140 are registered for road works. The register shows three classes of capability in terms of the value of a road contract, namely Class 1 USD600,000 and above, Class 2 between USD300,000 and USD600,000 and Class 3 below USD300,000. The information indicates that contractors would seem to be generally suitably equipped for routine works such as the construction of gravel wearing course road surfaces but may not have enough suitable equipment or experience for constructing many of the types of pavements and surfacings included within the SEACAP research.
- **Maintenance Regime:** village based schemes for routine maintenance are in place in some provinces, however, these schemes rarely if ever include the vital capacity to maintain cross-fall on unsealed gravel roads and there remains some doubts as to their long term sustainability without external project support.

2.2 Knowledge Gaps

The cost-effective application of appropriate and sustainable standards and specifications for LVRRs requires that they be based firmly on local conditions. A local resource and task based roads strategy requires local knowledge. The review of existing documents carried out under Module 1 has identified significant knowledge gaps, namely:

- There is lack of available data on the engineering performance of LVRRs in the Lao road environments.
- While there is useful general information on traffic levels contained within the PRoMMS database, it is based on informal local evidence, some of it anecdotal. There is clear need for more detailed traffic information.
- Specifications and designs should be based on the use of local materials where possible. Whilst information on road construction materials is held in individual project reports or construction records, as such it is not a readily accessible resource.
- At present decisions are made on the basis of road construction cost whereas it should be based on whole life asset cost. An approach to LVRR whole life cost modelling has been

developed under SEACAP 1 in Vietnam to support decisions on rural road surface options, and could be modified to suit Lao PDR conditions.

2.3 Drafting and Finalising Low Volume Road Standards and Specifications

2.3.1 Road Standards and specifications

Based on the review and the identification of the road environment factors, road standards and specifications have been drafted for the LVRR's in Lao. The key outputs from Standards and Specification component of SEACAP 3.01 are:

1. A new LVRR Classification with a suitable set of Geometric Specifications
2. A matrix of pavement and surfacing design options
3. A guideline document associated with (1) and (2) above.

Key inputs to the development of these road standards and specifications were to establish the design vehicle types and the needs of non-vehicular traffic. These issues are discussed below.

2.3.2 Design vehicles

It is important that rural roads are designed to accept the most common type of 4-wheeled vehicle and to accept the largest vehicle that might use the road. The most commonly used light truck vehicles are the Hyundai Kolao Porter, the Isuzu-type medium truck, and the modified GAZ 66 flat-bed medium truck with a rice milling machine on the rear. The primary features of all these vehicles for road design are that they all have widths of less than 2.3 metres and the smallest have a width of less than 1.8 metres. Also, they all fall within an upper axle load limit of 4.5 Tonnes. In contrast, heavy vehicles have widths of about 2.6 metres and axle limits of about 9 Tonnes.

Using these three vehicle types instead of the full range of vehicles in the national, or international (transit) fleet, meant that more appropriate and cost saving road designs were able to be developed.

Given the number of movements expected on the roads, all roads have been designed with single carriageways.

2.3.3 Traffic implications

To meet non-vehicular traffic needs, wider road shoulders have been recommended, the width of these varies depending on the number and type of vehicles, Details of the geometric designs are given in Standards and Specification Document I (2008).

Document I clearly indicates that if the road under consideration does not fall within the LVRR traffic envelope it must be designed in accordance with the Lao Pavement Design Manual (LRDM, 1993) rather than as per LVRR Standards and Specifications.

2.3.4 Pavement design and standard specifications

The development of suitable pavement designs for the LVRR's required an understanding of the road subgrade conditions and the expected traffic loading over the design life of the pavement.

Subgrade conditions are largely dependant on the climate and data for Lao show a high rainfall environment where sub-grade conditions can be expected to be at least seasonally wet. Therefore measurements to assess the strength of the sub-grade in the laboratory for use in pavement design procedures should be undertaken with the material in the soaked condition.

Given the design vehicle types, two cumulative traffic groups have been established. Traffic Group A with less than 10,000 equivalent standard axles (esa's) over the design life and Traffic Group B with greater than 10,000 esa's and less than 100,000 esa's over the design life. The design life has been set to 12 years.

Thus, a set of subgrade strengths categories were developed which when used with either of the two traffic groups, pavement thicknesses were minimized. Importantly, capping layers were introduced to limit the use of more expensive sub-base (or gravel wearing course) materials.

The quality of the pavement materials has been considered carefully in the pavement design process and lower strength materials have been specified for use when the expected vehicles types in the traffic mix, are sufficiently lightly loaded such that the materials are not over stressed.

A suitable but limited number of pavement types covering the range of anticipated design options for the Lao road environment have been developed based on the above principles. These options are:

- Unsealed gravel
- Sealed gravel (stone chip or Otta Seal)
- Sealed armoured gravel (stone chip or Otta Seal)
- Sealed waterbound or drybound macadam
- Non reinforced concrete

It is anticipated that this initial short list of pavement options will be added to as the analysed results of SEACAP 17 become available.

Details of the designs and pavement options, material and construction specifications are given in Document II, and guidelines on the application of the designs are given in Document III.

2.3.5 LVRR drainage and structures

Adequate road drainage is commonly acknowledged as being of fundamental importance to satisfactory road performance. This holds true no less for LVRRs, particularly with respect to unsealed gravel or earth roads. It is essential therefore that suitable drainage measures are designed and constructed. The LVRR designs utilize the drainage designs given in the Lao Road Design Manual. Essential elements of these have been reproduced in the LVRR design Documents.

It is proposed that the issue of LVRR structures be dealt with by considering the suitability of the DfID-funded draft Low Cost Structure Manual that is currently being reviewed as part of SEACAP 19 in Cambodia.

2.3.6 Construction Unit Costs

The spreadsheet-based cost model set up under SEACAP 1 in Vietnam was adapted for preliminary use in developing relative costs for the initial pavement options. The model permits calculation of the cost of constructing and maintaining any of the pavement options so that whole life asset costs can be estimated, leading to the selection of the most economic pavement solution for the environment of the road.

This cost model requires further development for use within the LVRR sector in Lao.

2.4 Approval and Finalisation

In Modules 1 to 4 local, regional and international technical specifications were reviewed and from these an approach towards the development of suitable low volume rural road standards and specifications was outlined. The outline to the standards and specifications was first presented to the SCC in June 2007 and an executive summary of the review was reported in July 2007. Thereafter, the

standards and specifications were developed in detail. A further workshop was held in November to present the draft standards and specifications for discussion. Valuable suggestions and recommendations were received helpfully noting the experience of the Ministry and other stakeholders.

The final versions were presented at the dissemination workshop in March 2008. The finally approved documents were then translated into Lao.

3 Task Group 2: Development of a Relevant Training Programme

3.1 Training Needs Assessment

It was appreciated at early stage in the programme that the LVRR documents need to be aimed at use by District level (OPWT) engineers. The **OPWTs** are currently responsible for the implementation of rural road works together with VMCs. However, their capacity to independently manage the existing work was assessed at present as being limited and in need of development (Technical Paper 3). The additional burden of taking on board the roll-out of a new framework of Standards and Specification would place severe strains on PPWT capacity and it was logical that training needs should be focussed at this level.

The key aspects of this training were seen to be that it should:

- Clearly explain the background of the LVRR concepts
- Lay out in a logical manner the key aspects of the LVRR Standards and Specifications
- Fully describe the necessary procedures required to practically implement the LVRR Standards and Specifications
- Include a practical “hands-on” elements
- Contain an element of feed-back and course assessment.

3.2 Training Programme Elaborated

At an early stage of SEACAP-3 the concepts for the pilot training programme were developed and through discussions with DoR the training programme was made compatible with the existing training commitments for the year.

The training course was prepared on a modular basis and resource materials were identified, and presentations and associated materials were prepared. This included a site visit and preparation for a one-day practical exercise in the field. The course followed an overall pattern of background, detail and practice. The course was prepared in Lao language and all presentations were given by the associate local consulting, staff or the counterpart Ministry staff. Based on the agreed content for effective training, the duration required was four consecutive days.

Bearing in mind that the purpose of the pilot training was to prove the training materials for future courses that would be conducted by the Ministry, the LRD and PAD identified suitable staff. Competency of individuals for the training was therefore based not only on the ability to take-up the technical content of the low volumes rural road standards, but also on their potential suitability as future training course presenters. The number of course participants was limited to approximately 20 to ensure sufficient interaction occurred during the course and that feedback on both the course content and its quality was received. Course participants were drawn from four Provinces; Salavanh; Barikhamxai; Savannakhat; and Vientiane.

3.3 Pilot Training Programme Tested and Trialled

Preparations for the course were made during September and October 2007 and the course was held in late November (27th to 30th). The participants were advised at the outset of the need to provide feedback on the training course and therefore the importance of concentrating not only on the technical content of the course but also on the course content and materials. Thus the participants

were introduced to the concepts and outputs from the project. Details of the Modules and sessions are given in Table 8 and Table 9.

Table 8 Content and objectives of Modules 1 and 2

	Session title	Objective of the session
	Introduction	What are the objectives of the course and the piloting?
Module 1 – LVRR Background		
1.1	The purpose of LVRRs	What is the ultimate purpose of LVRRs?
1.2	The LVRR management framework	How are LVRRs managed in Lao?
1.3	The problems of LVRRs	What problems affect the provision of LVRRs?
1.4	The road environment	Is traffic level the main factor influencing the design of LVRRs?
1.5	Current LVRR design in Lao	How are LVRRs currently designed in Lao?
1.6	Review of Module 1	
Module 2 – LVRR Environment		
2.1	Road design and deterioration	A summary of the main aspects of road design and deterioration
2.2	Environmentally Optimised Design	What are the many factors influencing the design of LVRRs?
2.3	Variable longitudinal design principle	A road does not need to be uniform in design along its length
2.4	LVRR whole life asset costs	How are total construction and maintenance costs calculated?
2.5	Review of Module 2	

Table 9 Content and objectives of Modules 3 and 4

Module 3 – LVRR Design process		Objective of the session
3.1	Traffic	A detailed explanation and discussion of the LVRR design process, with standards and specifications introduced at the appropriate stage
3.2	LVRR envelope	
3.3	Alignment	
3.4	Sectioning	
3.5	Cross sections	
3.6	Surfacings	
3.7	Pavement design	
3.8	Variable longitudinal design options	
3.9	Whole life asset costing	
3.10	Design review	
	SEACAP 17 – summary	Introduce the pavement option trials constructed in Bokeo
	SEACAP 21 – summary	Introduce the slope stabilization trials constructed in Luang Prabang
3.11	Review of Module 3	
3.12	Preparation for site exercise	
Module 4 – LVRR Design in practice		
4.1	Visit 1 – Site discussion	An opportunity to discuss the LVRR design process on site
4.2	Visit 2 – Site exercise	An exercise in the use of the LVRR design process on site
4.3	Preparation of presentations	
4.4	Presentations	Participants present their road designs to the group
4.5	4.5 Review of Modules 1-4	
4.6	4.6 Review of pilot course	
4.7	Certificates and closing	

3.4 Evaluation of the Training Course

The participants were asked to complete questionnaires about the training course. The questions are given below together with the respondents' replies. In Table 10 the respondents gave their overall views on the course and further details are contained in Technical Paper 4.. Overall the pilot training course was assessed by the participants fairly evenly between needing more and about right. None viewed the course as needing less training.. These responses indicated that the course was successful.

Table 10 Overall assessment of the pilot training course

Did the course have a good mix of presentations, discussions, exercises and site exercise?						
		Need more		About right		Need less
Presentations		13		6		0
Discussions		10		9		0
Exercises		7		12		0
Site exercise		9		10		0

The following notes further summarise the comments made by the participants. The comments indicated satisfaction with the course and provided useful pointers for when a main LVRR training programme is rolled out in the future.

Pilot Training Course:

- The course generally met expectations and objectives
- Participants were satisfied with the course, although would prefer a little more technical detail
- More requested time for discussions and exercises, especially for the traffic analysis and the site exercise, and would like more explanation before the exercises of what is to be done
- The course was well facilitated
- The course was about the right duration
- Satisfaction with the food, transport and room arrangements
- Presentations were generally sufficient and good.

Technical content

- Participants understood the technical content and had gained knowledge that would be useful in their work
- General understanding of the benefits of applying the technical content on LVRRs
- Would like more detail on the use of different pavement materials and their specifications
- Would like drainage structures to be added to the standards.

Handouts

- Problems were reported with the translations, in terms of consistency of technical terminology and some typing errors
- Handout fonts, especially those used for the slides, were sometimes too small to read
- More photos included in the handouts
- Handouts were generally sufficient but should be made clearer.

Next steps

- Participants were enthusiastic about starting to use the standards and specifications
- The course should be given across the LVRR sector
- The standards and specifications should be made available across the LVRR sector
- The course should be put into the curriculum of the national university.

In the light of the comments, the training materials were revised. It would be valuable, however, for the Lao versions of the training materials be reviewed further and adjusted for clarity of meaning where necessary. A possible solution for this would be for the NUOL to undertake this process. This point has been brought forward to the recommendations given in this report.

4 Project Component 2: Develop an affordable and sustainable strategy for attaining the necessary research capacity for all categories of roads

4.1 Gaps in Research Capacity Identified

The National Growth and Poverty Eradication Strategy (NGPES) of the Lao PRD clearly states that infrastructure development and human resource development (HRD) are key strategy pillars for achieving the set objectives.

Better-informed transport development is understood to be particularly pro-poor and LVRR Standards are important milestones towards achieving the stated poverty reduction goals. Continued research is essential in ensuring innovation and further development of locally applicable solutions to road design, choice of materials and approaches to work.

A review of the current strength of the institutional and research capacity in Lao was undertaken within the project in order to develop the strategy (Technical paper 3). The review led to several observations and recommendations which were presented as a basis for discussion on the way forward. .

The four mainstays of Human Resource Development were reviewed as the basis of developing the strategy. These are:

- Supply of basic Education
- Supply of Higher Education
- Demand for Knowledge and Skills for Industry
- Innovation Research and Development.

The review found that the basic education was satisfactory and Higher Education was adequate, but that the remaining two were lacking in some respects with regard to the effective dissemination of knowledge and to attaining a research capacity in the construction sector.

Each year 120 to 200 students graduate with engineering degrees and a further 12 graduate at a higher level. Engineering course content has recently been enhanced for the road sector at undergraduate level by the introduction of three new courses on Rural Road Engineering at the National University of Lao. However, it was found that vocational training was not institutionalized and tended to be supported only by ongoing projects rather than by a strategically implemented training programme held and administered by the Ministry.

It was also noted that professional organizations such as a contractors association and a consultants association did not exist. Such professional associations can be effective in implementing training and providing a focus for expressing the capacity building needs of the industry.

Whereas, innovation and research clearly have a strong role in recognizing problems in infrastructure development leading to applied research to resolve them, the present capability for undertaking research was found to be low in practical terms. It is important to enhance the research capacity in Lao.

While raising issues for discussion, the review also found the opportunities for being successful in mainstreaming the LVRR standards and developing the research strategy, as listed below:

- A willingness from many partners to deal with the challenges
- A common understanding amongst government departments and support agencies that providing road access is an issue which requires locally resourced based solutions
- Donor supported projects such as the SIDA basic access programme provide an excellent platform for dissemination training and mainstreaming of LVRRs.

- NUOL is keen to absorb new locally-based engineering solutions and practices as well as playing a key role in implementing research programmes to achieve full complement of engineers for Local Roads Division DPWTs and OPWTs.

4.2 Strategy for Strengthening Research Capacity

During the SEACAP 3.01 project, progress on developing the research capacity was achieved through discussing and agreeing a strategy in principle whereby the Ministry held a management and resourcing role for applied research projects to be carried out by the NUOL. It was suggested that stakeholders, principally the Ministry, would be represented by a Research and Development Coordination Committee, Figure 4.

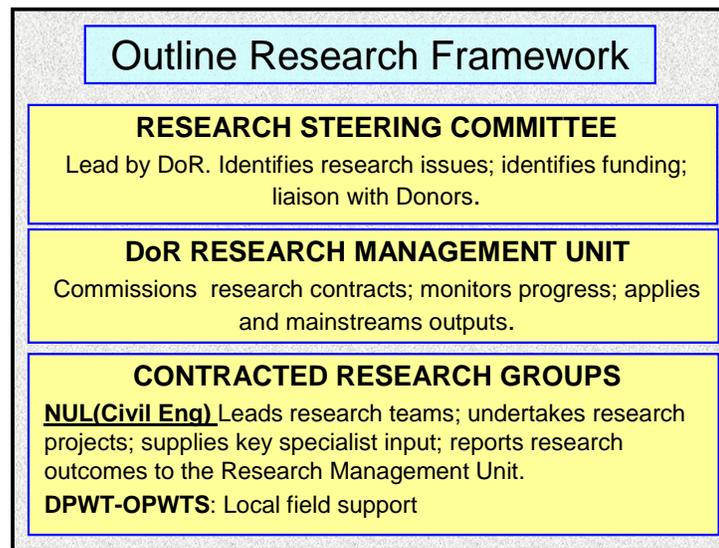


Figure 4. Outline Research Strategy

The strategy is centred on the identification, management and mainstreaming of research by professional engineers with a clear grasp of the practical requirements of the Rural Road sector, whilst the actual data collection and analytical work may be undertaken by teams with academic and vocational strengths. It is suggested that the DPWTs and OPWTs could play a crucial role in terms of local support and knowledge.

As a means of “kick-starting” take-up of the strategy a number of key research topics were identified. The research topics themselves would be project based and initially of short duration focused on applied research topics with clear benefits from their successful conclusion.

In terms of urgent technical needs for the roads sector the following topics were identified during the review work carried out within Task Group 1 as being likely to provide valuable technical information in the short term. These topics have been termed SEACAP Research Studies (SRS)

- SRS 1: Performance of locally adopted sealing options on laterite gravel
- SRS 2: Unsealed road performance in Lao PDR
- SRS 3: LVRR traffic patterns in Lao PDR
- SRS 4: Appropriate vehicle operating and road management costs for Lao PDR

4.3 Adoption of the Strategy by the MPWT

The adoption of the proposed research strategy is an largely internal matter for the MPWT, and the DOR in particular, and outside the control of the SEACAP 3.01 team. However, the indications are that the strategy was in general well received by key DOR departments.

It is our strong recommendation that the funding of the identified SRSs would provide a major contribution towards the trialling and development of a sustainable research capacity within the MPWT .

5 Task Group 4: Initiate Dissemination

5.1 General

Recommendations from a Speciality Session Group on dissemination at the SPM held in June 2006 highlighted the need for more effective dissemination to improve ownership and better response to the specific challenges faced in each country. The Group also determined that effective dissemination strategies were needed to reach not only technical and academic practitioners, but also the most influential people such as politicians.

Clearly dissemination in national languages as well as in English, for example, greatly improves awareness and the take-up of the research nationally and regionally. All major outputs from SEACAP3.01 have been translated into Lao.

5.2 Materials for Dissemination of Project Outcomes

5.2.1 Websites

A review of the possible mechanisms for disseminating the project's findings and reports widely within Lao and in the region was carried out under SEACAP 3.01. One of the mechanisms identified was a project website from which internet enabled users could access the available project documentation. Various website design, technology and hosting options were considered with respect to the capabilities and capacities of the local organizations, (Technical Paper 2).

A number of technical inputs are required to provide a website and also the correct mechanisms and institutional arrangements need to be put in place to ensure that the website is sustainable. Technically a website requires a domain name, web space on a web server for hosting the website content. These are commonly leased from dedicated hosting companies.

Importantly, the website must be designed and coded in either 'static' or dynamic' format where the former just provides viewable content and the latter provides content that is generated from a database and which maybe downloaded, such that reports and documents can be received. The latter is preferable. An agreed system for managing, maintenance and updating of the site is also essential.

Following the review, the design and construction of a static website has been established under the LTEC site as an intermediate dissemination measure until such time that it may be taken up by the MPWT . This website will hold all the key project outputs.

In addition to the temporary SEACAP 3.01 website, all project materials will be available for dissemination from the main SEACAP website.

5.3 Presentations

During the project opportunities were taken to disseminate knowledge at regional and national meetings as well as all Coordination Committee progress meetings. A list of national or regional meetings at which presentations were made is given in Table 11.

Table 11 Summary of National and Regional Presentations

Subject	Dates
SEACAP Practitioners meeting, Hanoi	12 -13 September 2007
SEACAP 17 Knowledge exchange workshop, Bokeo Province	6 – 8 November 2007
ADB review mission, Bokeo Province	11 th December2007
SEACAP 3.01 Final dissemination workshop	25 March 2008

6 Project deliverables

6.1 Project Progress Reports

Monthly progress reports were issued as planned. These described progress on the project and recorded significant events, meetings and the delivery of outputs.

6.2 Project Technical Outputs

The project formal outputs are the standards and specifications as listed in Table 12 and four technical papers as listed in Table 13. Collectively, these fully record the technical and informative deliverables for SEACAP-3.

Table 12 Technical standards and specifications

Subject	Dates issued	
	Draft	Final
Document I: Classification and geometric standards	Oct 07	March 08
Document II: Technical standards and specifications	Nov 07	March 08
Document III: Guideline to implement the standards	Feb 08	March 08

Table 13 Technical papers

Technical papers	Subject	Dates issued	
		Draft	Final
TP-1	Module 1 Technical review	Sep 07	May 2008
TP-2	Dissemination: Website Recommendations	Oct. 07	May 2008
TP-3	Dissemination, Mainstreaming and Training Strategy Review	Oct. 07	May 2008
TP-4	Pilot Training Course	Dec. 07	May 2008

6.3 Workshops

At each significant stage of the project, workshops were held to inform and importantly discuss and agree the developments of the projects. These cumulated in March 2008 with the dissemination workshop which encompassed the deliverables from the project.

Table 14 Summary of workshops

Subject	Dates
Inception report	19 March 07
Technical Review and draft research strategy	26 July 07
Working Group session on the draft standards (to LRD)	13 November 07
The Draft standards	16 November 07
Pilot training course	27 – 30 November 2007
SEACAP 3.01 Dissemination workshop	25 March 2008

6.4 Inventory of Equipment

The equipment procured for the project is listed below in Table 15. All items are in good condition. In addition over 100 technical documents that have been accessed and catalogued. These are a valuable technical resource for the future.

Table 15 Inventory of equipment procured

Item	Description	Brand	Model	Serial Number	Number procured
01	Desk top computer	HP	Intel Pent. D	CNX70917TK	1
02	Desktop computer	HP	Intel Pent. D	CNX7090BVV	1
03	Laptop computer	HP COMPAQ	Intel Core Duo	2CE7190C9P	1
04	Black and White printer	Canon	LBP2900	N/A	1
05	Colour printer	HP	LaserJet 2600n	N/A	1
06	Camera - digital	Panasonic	Lumix TZ1	FA6DA02460	1
07	GPS unit	Garmin	Cs60	A203014159	1
08	Dynamic Cone Penetrometer (DCP)	TRL		N/A	1
09	Microsoft Office Pro. 2007	Microsoft		XJM28-H6TG6-KBVDH-GM4YB-HKYRD	1
10	Microsoft Office Pro. 2007	Microsoft		Q3PQY-7HD24- 6R7J7-H69HD-7XH4D	1
11	Microsoft Office Pro. 2007	Microsoft		WV7DX-8YWWR-RRV9K-CKG63-HJXV3	1
12	External Hard Disk USB port	Sumsung		N/A	1

7 Achievements and Recommendations

7.1 Achievements

The implementation of the project has provided a focused insight to the immediate needs of the research and road engineering community in Lao that would assist the Ministry in meeting its poverty alleviation target of all villages having all-weather road access by the year 2020. These communities can then contribute more to the economic development of Lao.

Following discussions at the Project Tripartite Meeting it is considered that the project has successfully met its delivery targets.

The project has informed and provided stakeholders with the means of contributing to poverty reduction through the effective provision of appropriate standards and specifications for low volume rural roads. It has also developed a Pilot Training Course related to the effective application of these Standards and Specifications.

The project has also defined a direction for the development of a research capacity, and through presentations and a website has provided a means of mainstreaming these important innovations to the stakeholders, practitioners and professionals.

7.2 Recommendations; Project Issues

The following recommendations are made as to the further development and mainstreaming of the LVRR concepts in Lao

- The Standards and Specifications should be trialled on an appropriate rural road to provide both a research base for their possible enhancement and to provide a demonstration of the benefits from environmentally optimizing the design approach to rural roads.
- The range of LVRR pavement options should be extended in the light of information from SEACAP 17 as it becomes available. They should also be extended to include the use of stabilisation (of materials) for regions where materials of adequate quality are not available.
- A means should be sought to further mainstream the use of the research by encouraging and causing the international donor community to adopt the standards for the design and construction of all LVRRs in Lao.
- The LVRR specifications should be integrated into a standard set of specifications for use on all roads in Lao. This would encourage the take-up of the LVRR standards.
- The pilot training should be rolled out nationwide. It should be also taken up by the NUOL as part of their Rural Engineering Modules.
- A means of encouraging the adoption of the research capacity strategy should be sought, and focussed initially on conducting applied research on the identified SRSs. There is also regional demand for this essential knowledge to promote greater economic savings in the sector.
- A means to encourage and develop contractor and consultant capability should be supported through the establishment of professional societies able to inform and influence development and knowledge.
- The establishment and support of website linkages is recommended to readily inform the professional community and encourage feedback on key LVRR issues. The information should be available in the Lao language.

7.3 Recommendations; General Issues

A number of general recommendations can be made, with the benefit of hindsight, as to the structuring of similar projects in the future.

1. Greater time might be allocated to the uptake and mainstreaming of documents such as Ministry-backed technical standards and specifications. A 10 to 12 month contract period is sufficient to allow for adequate research, document drafting and Ministerial approval, but insufficient for if meaningful mainstreaming at provincial and district level is required.
2. It is estimated that a further 10 to 12 month period following Ministerial Approval would be required for a full programme of mainstreaming and associated demonstration and training down to district level. Such a Dissemination Module would not necessarily require a high foreign specialist input, but could be undertaken by a combination of local consultants and established training institutions with limited specialist back-stopping and Quality Assurance.
3. It is acknowledged that delays in Ministerial approval could constitute an unacceptable contractual risk and that it would be necessary to separate activities into contractually distinct modules. Budgets for follow-on modules could be allocated in readiness for contract implementation. Strategic programmes such as SEACAP should be ideally suited to this form of pragmatic approach to effective dissemination.
4. In projects such as SEACAP 3 with limited budgets it is suggested that greater emphasis could be placed on key central issues, otherwise there is a risk of diluting the available resources on subsidiary activities that could be better deployed for delivery of the main objective.

Acknowledgements

This report was produced as part of the SEACAP 3.01 project contracted to TRL Ltd in principal association with Lao Transport Engineering Consultant (LTEC). The project team responsible for the drafting of this document comprised Dr J R Cook (OtB Engineering); Mick O'Connell (TRL); Bounta Meksavanh and Saysongkham Manodham (both of LTEC).

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Government of Lao PDR (1999) The Road Law for Lao PDR

LRDM, 1993. Lao Pavement Design Manual

MPWT 2008. Low Volume Rural Road Standards and Specifications: Part I: Classification and Geometric Standards.

MPWT 2008. Low Volume Rural Road Standards and Specifications: Part II: Pavement Options and Technical Specifications.

MPWT 2008. Low Volume Rural Road Standards and Specifications: Part III: Application of LVRR Standards and Specifications.

MCTPC, (2003), Specification for Local Roads (District and Rural Roads)

SEACAP 3.01 COMPLETION REPORT

Appendix A. Consultant's Time Inputs

Schedule of Consultant's Time Inputs

ID	Task Name	Position	2007												2008		
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1	Project Duration		[Solid blue bar across all months]														
2	International		[Solid blue bar across all months]														
3	J Cook	Team Leader Geotechnical	[Blue bars: Feb-Mar, May-Jun, Aug-Sep, Nov-Dec]														
19	M O'Connell	Transport and road eng. Spec. & Training specialist	[Blue bars: Feb-Mar, May-Jun, Aug-Sep, Nov-Dec]														
28	S Done	Training specialist	[Blue bars: Sep-Oct, Nov-Dec]														
31	T Bradbury	Dissemination expert	[Blue bars: Aug-Sep]														
33																	
34	Domestic LTEC		[Solid blue bar across all months]														
35	Bounta MEKSAVANH	Local Team Leader and Road	[Solid blue bar across all months]														
39	Saysongkham MANODHAM	Road engineering specialist	[Solid blue bar across all months]														
43	Keithphan SENAM AHMOUNTRY	IT Engineer	[Blue bars: Jul-Aug, Oct-Nov, Dec]														
46	Somphit BOUNNAPHOL	Training support	[Blue bars: Jul-Aug, Oct-Nov, Dec]														
48	Thipdavane VONGSAY	Project coordinator	[Solid blue bar across all months]														
51	Chanthida PHAPHIBOURN	Secretary / Office Manager	[Solid blue bar across all months]														
55	Xoumaïtri PANYANOUVONG	Translator	[Blue bars: May-Jun, Aug-Sep, Nov-Dec]														
64																	
65	MCTPC Counterpart staff		[Solid blue bar across all months]														
66	Khampaseuth Panyanouvong (LRD)	Civil Engineer (LRD)	[Solid blue bar across all months]														
68	Ounhe uane Siriaphone (PTD)	Senior Technical Staff (PTD)	[Solid blue bar across all months]														
70																	
71	Technical Panel		[Blue bars: Jun-Jul, Sep-Oct, Nov-Dec]														
72	R Petts	Quality Assurance	[Blue bars: Jun-Jul, Sep-Oct, Nov-Dec]														
77	A Ahmedi	Research capacity	[Blue bars: Sep-Oct, Nov-Dec]														
79	A Beusch	Training	[Blue bars: Sep-Oct]														
81	B Dzung	SEACAP - Vietnam	[Blue bars: Jun-Jul]														
83	P Tuang	SEACAP - Vietnam	[Blue bars: Jun-Jul]														

SEACAP 3.01 COMPLETION REPORT

Appendix B. List of Documents Reviewed

SEACAP 3 Document Registration.

Ref No.	Description
SEACAP 3 - 001	Technical Proposal. TRL Limited.
SEACAP 3 - 002	Appropriate standards and specifications for Rural Roads. 6 th IFG Meeting, Maputo, Mozambique, 20 th -22 nd November 2006.
SEACAP 3 - 003	Materials Resource Planning for Appropriate Road Construction
SEACAP 3 - 004	Rural Road Surfacing Research for Sustainable Access and Poverty Reduction in South East Asia
SEACAP 3 - 005	Surfacing Alternatives for Unpaved Rural Roads (The World Bank) December 2004
SEACAP 3 - 006	Environmental Guidelines of MCTPC; April 1999
SEACAP 3 - 007	Institutional Capacity Building RPM2 (Training Programs 2005-2006)
SEACAP 3 - 008	Road Law (Part 1 General Disposition); April 1999
SEACAP 3 - 009	Draft Summary of Sixth National Socio-Economic Development Plan (2006-2010); Committee for Planning and Investment, Vientiane 2005
SEACAP 3 - 010	National Growth and Poverty Eradication Strategy (NGPES)
SEACAP 3 - 011	Regulation of the Minister to Prime Minister's Office and President of the Science Technology and Environment Agency on the Endorsement and promulgation of the Technical Guidelines on Compensation and Resettlement
SEACAP 3 - 012	Transport Infrastructure and Poverty Reduction; ADBI research policy brief No. 21
SEACAP 3 - 013	Report on Present Traffic Carried Out by LTEC Survey Team (18 – 27 May 2006)
SEACAP 3 - 014	Institutional and Regulatory Framework for Road Transport Services in Lao PDR (February 2006)
SEACAP 3 - 015	Population and Housing Census; Year 2005 (Preliminary Report)
SEACAP 3 - 016	Transport Sector Issues Review (Final Report; June 2004)
SEACAP 3 - 017	Long Term Development Plan 2001-2020 on Communication Transport Post and Communication of Lao PDR; Vientiane 2001
SEACAP 3 - 018	Road Design Manual (Provisional Use); Vientiane 1996
SEACAP 3 - 019	Road Note 29; A Guide to the Structural Design of Pavements for New Roads
SEACAP 3 - 020	1997 Interim Revisions to the Standards Specifications for Highway Bridges
SEACAP 3 - 021	Overseas Road Note 31
SEACAP 3 - 022	Field Manual for Labour-Based Rural Feeder Road Maintenance

SEACAP 3 - 023	Summary of Rural Road Investment In 18 Provinces, Lao PDR
SEACAP 3 - 024	Handbook for Construction/Maintenance of Rural Roads (CRM)
SEACAP 3 - 025	Guidelines for Road Classification (Province, District & Rural)
SEACAP 3 - 026	Village Survey Manual (PRTP). By LRD/DoR MCTPC
SEACAP 3 - 027	Local Road Network year 2003 book 1/3 (8 Provinces in Northern, Lao PDR)
SEACAP 3 - 028	Local Road Network year 2003 book 2/3 (6 Provinces in Middle, Lao PDR)
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SEACAP 3 - 051	SEACAP 21; <i>Knowledge Exchange Workshop</i>
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