



Development of a Road Research Strategy for Mozambique

Final Report

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This is the final report for the 'Development of a Road Research Strategy for Mozambique' report for AFACP. The project was carried out between November 2012 and March 2013. This report includes the results of the inception report, preliminary report and subsequent workshop. A kick-off meeting was held in November 2012, after which an inception report was completed and all of the stakeholders were interviewed to find their opinions and suggestions on the main issues addressed by the project. Following the interviews during December 2012 a preliminary report was produced, which provided the main points for consideration at a workshop held in Maputo on 8th February 2013.

Table of Contents

Executive Summary	1
1 Introduction	2
2 Background	2
3 Methodology	2
4 Results of additional interviews	3
5 Outputs from the Project	3
5.1 The case for research	3
5.1.1 Benefits from research	5
5.2 The Funding of Research	6
5.2.1 ANE Funding	6
5.2.2 Roads Fund	6
5.2.3 Other Government Budgets	6
5.2.4 Private sector funding	6
5.2.5 Donor funding	6
5.3 Institutional Structure	7
5.3.1 Institutional location of an RRC	7
5.3.2 ANE based	7
5.3.3 Steering Committee	7
5.3.4 Technical Committee	8
5.3.5 Staffing	8
5.3.6 Laboratories	8
5.3.7 Physical location of the RRC	8
5.4 Road Research Strategy	9
5.4.1 Draft Road Research Strategy	9
6 Programme	12
6.1 Steps to establish an RRC	12
6.2 Project Programme	13
7 Conclusions	13
8 Recommendations	14

Appendices

- Appendix A - List of additional interviews
- Appendix B - Workshop agenda
- Appendix C - Workshop participants
- Appendix D - Workshop proceedings
- Appendix E - Work programme

Glossary of Terms

ACV – Aggregate Crushing Value

AFCAP – African Community Access Programme

ANE – Administração Nacional de Estradas

ARRB – Australian Road Research Board

CSIR – Council for Scientific and Industrial Research

DFID – Department for International Development (British Aid)

DIMAN – Department of Maintenance

DIPRO – Department of Projects

DIPLA – Department of Planning

DIAFI – Department of Administration and Finance

DG – Director General

FEHRL – Forum of European National Highway Research Laboratories

GDP – Gross Domestic Product

ILO – International Labour Organisation

ISUTC - Instituto Superior de Transportes e Comunicações

IT – Information Technology

LEM – Laboratoro de Engenharia de Mozambique

LNEC - Laboratório Nacional de Engenharia Civil (Portugal)

MoU – Memorandum of Understanding

Norad – Norwegian Aid

RRC – Road Research Centre

RRIP – Rural Road Investment Programme

Sida – Swedish Aid

TRL – Transport Research Laboratory

UEM – Universidade Eduardo Mondlane

VOC – Vehicle Operating Costs

Executive Summary

This report includes the results of the inception report, preliminary report and workshop. A kick-off meeting was held in November 2012, after which an inception report was completed and all of the stakeholders were interviewed to find their opinions and suggestions on the main issues addressed by the project. Following the interviews during December 2012 a preliminary report was produced, which provided the main points for consideration at a workshop held in Maputo on 8th February 2013. The methodology set out in the inception report has been followed.

The main issues discussed at the workshop were:

- Institutional location of a potential RRC
- How to involve other stakeholders in the RRC
- Laboratories; how to manage for effective Research
- How to secure sustainable funding for the RRC
- Confirm the Road Research Strategy

In addition the participants were asked to consider:

- Essential criteria for a successful RRC
- The potential scope of activities for a next phase

The discussions were lively and productive and consensus was found on the following points:

- The RRC should be located in ANE with a cross-cutting function
- The RRC does not need a new building and its establishment should be modest.
- It is appropriate for the RRC to start small and grow, based on quick wins.
- Politicians need to be made aware of the benefits of road research.
- A steering committee should be established to provide guidance to the RRC. A technical committee may also be necessary.
- Funding:
 - Some funding can be managed from within ANE via projects.
 - The Roads Fund is a potential source of funding.
 - Donors will be requested to support the establishment phase of the RRC.
- Laboratories.
 - LEM are an important stakeholder and must be included.
 - Existing laboratory equipment should be adequate but will need to be reviewed.
- The Draft Road Research Strategy needs more time for consideration.
- Staffing is important and will be considered further during the next phase.
- A broad agreement was found on how to move forward. Details of institutional structure, funding and other issues to be decided during the next phase.

The recommendations for the establishment of an RRC focus on establishing a practical and functional institutional structure for the RRC within ANE. This will be the main factor that determines its success, but it will also be necessary to raise awareness of the benefits of road research in order to get political buy-in. The next phase of the project will determine the detailed structure, but the establishment should be based on starting small and growing, based on quality results and quick-wins. The staff of the RRC were recognised as being central to its success and they will need to be diverse, committed and motivated with a transparent career path.

How other stakeholders are involved is also important, as a steering committee will be established to guide the direction of the RRC. It is expected that the RRC will establish partnerships and links with main stakeholders as well as regionally and internationally, through which research results can be disseminated and RRC staff can learn from the experience of others. Finally capacity building will also be necessary to enable the RRC to produce quality results.

1 Introduction

This report is the culmination of the preliminary report and workshop for the project to develop a Road Research Strategy for Mozambique. A kick-off meeting was held in November 2012 with the main stakeholders in ANE and with Crown Agents, after which an inception report was completed and approved. The inception report identified the main stakeholders to be interviewed for involvement in the Research Strategy Project and established the activities to be undertaken by the consultant for the remainder of the Project. Following a subsequent visit by the consultants to interview the main stakeholders during December 2012, a preliminary report was produced which provided the main points for consideration at a workshop held in Maputo on 8th February 2013.

The workshop was scheduled for one day and all of the main stakeholders were invited by ANE. The findings of the preliminary report were presented and the consultants facilitated discussions and dialogue on the contents and recommendations therein. The main outcomes of the workshop were to agree an institutional structure for the proposed Research Centre and to discuss and agree the Road Research Strategy for Mozambique.

In addition, discussions were held at the workshop on the possibility and required resources for a 'next phase' of the project, which is proposed to support the further establishment of a road research centre in Mozambique.

A number of countries in Africa have begun investing in building indigenous research capacity, often with the help of the donor community. For example, Kenya and Ethiopia are also at various stages of establishing Road Research Centres.

2 Background

The challenges faced by Mozambique to establish an effective road network were outlined in the preliminary report. An effective road network is essential to the development of the country, specifically through recent efforts to exploit natural resources and increase agricultural output. All of these activities need an extensive and reliable transport infrastructure to thrive.

Mozambique has had very high GDP growth in recent years, but GDP per capita is still one of the lowest in the world. More than 75% of the population engages in small-scale agriculture, which still suffers from inadequate infrastructure.

The government is faced with the challenge of how to continue and expand growth to ensure steady poverty reduction. The Ministry of Planning and Development has set the development context, challenges and opportunities to maximise infrastructure investments, including the existing special economic zones and forming a favourable legal framework for the development of public and private partnerships to tackle the infrastructure deficit.

The government has also recognised that sound infrastructure is crucial to achieve all the goals set out in the new Country Partnership Strategy (World Bank website article - Tackling the Infrastructure Deficit in Mozambique, 2012). Mozambique needs research in roads to help improve the road network cost effectively and ultimately transform its natural assets into higher growth and lower poverty.

3 Methodology

The methodology has been followed as set out in the inception report. The consultation phase with the main stakeholders was completed in December 2012 and the Preliminary report was finalised in January 2013. The workshop that was planned for 5th February 2013 was eventually rescheduled and took place on the 8th February 2013.

A number of additional interviews were undertaken before the workshop with people who were not available during the consultant's previous visit. Additional interviews were also carried out after the workshop to ensure that all views had been noted and understood. A list of the additional people interviewed can be seen in Appendix A.

The workshop served the purpose of providing a consensus on the key issues and giving all of the stakeholders an opportunity to gain ownership of the concept. The draft final report was translated and circulated for comments and this final report was produced based on the comments received. Some additional time was given for feedback following the draft final report. The work programme is shown in Appendix D of this report.

4 Results of additional interviews

The main issues that arose from the interviews in February 2013 are similar to those identified before in the preliminary report, but some additional issues were identified:

- With the effects of climate change, the need for research into roads has become more important, as can be seen from the damage created by the recent excessive floods across the country (during January 2013).
- It is recognised that the synergy and communication between departments within ANE is not effective and needs to be improved.
- ANE have inherited a new laboratory facility at Nampula through the MCC road maintenance project. The consultants were encouraged to consider this as an option for the location of an RRC. Alternatively there could be recommendations on how best use can be made of the equipment housed there.
- The Ministry of Public Works is considering establishing two research centres for construction materials. Mr. Jaime Matsinhe suggested that the wider organisation structure of the Ministry would be useful to consider from an institutional perspective. An RRC must fit in with existing legislation.

5 Outputs from the Project

The project outputs are similar to those presented in the preliminary report, but have been adjusted based on feedback and comments received during the workshop.

5.1 The case for research

The Preliminary report presented the case for research. This was also outlined in a presentation at the workshop. At present there are a number of road-related research projects that have recently been completed or are currently being undertaken in Mozambique, with the majority being undertaken by ANE or with ANE involvement. They are largely managed by expatriates with local counterparts. The expatriate contribution is usually provided by donor funding with the counterpart contribution and the costs of the construction of trials funded locally.

The procedures necessary for establishing an indigenous research facility that is locally staffed and funded was discussed at the workshop and there was agreement that this is the direction that Mozambique should move in. This principle was endorsed by the Director General in his opening speech at the workshop.

At present almost all research is being initiated internationally, although the identification of actual research projects is being managed locally. Therefore, a fundamental change in approach will need to be implemented to establish the sustainable local capacity required to undertake research. This includes maximising the potential for local funding of research as part of ongoing construction and maintenance

projects, especially the inclusion of research sections, the facility for which already exists but is not being fully utilised.

Universities are carrying out some roads research, mainly through projects being undertaken by students as part of the process towards attaining a higher degree or similar technical qualification. Closer cooperation between these institutions and ANE will present additional opportunities for such research projects, with all stakeholders benefitting from closer links with a road research centre. The importance of linking with Universities to promote research and make students aware of research as a career path was recognised at the workshop.

The possibility for broadening the scope of research in Mozambique was also presented at the workshop, as well as the need for a more diverse workforce. Some potential areas that would benefit from research are shown below, but there would still need to be a process to identify and prioritise these subjects in terms of potential benefits:

- Road building materials
- Bridges and water crossings
- Road safety
- Transportation
- A materials location database
- Use of alternative materials

The case for research is relatively easy to make given the problems related to road building materials in Mozambique and the need to increase road access across the country. Local practitioners are often well aware of the existence of materials-related and other problems in the road sector. However, there is a need for the establishment of a dedicated team of local researchers to identify, prioritise and solve these problems, which at present is being done informally through existing projects but without formal coordination. The best way of doing this is through a Road Research Centre staffed by dedicated researchers working in an environment conducive to solving problems in the road sector.

The need for indigenous research is clear. Building capacity to undertake research through a Road Research Centre will;

- enable the required research to be carried out by local practitioners,
- help to develop their research skills,
- provide a repository for knowledge developed through research
- facilitate the implementation of results produced from the research.

Another strong argument for developing indigenous road research is the strong political backing it receives in Mozambique. The importance of research itself is appreciated to some extent in Mozambique, although some additional awareness-raising may be necessary.

Workshop Quote: "We need to organise lectures, conferences, workshops and put out press releases to raise the profile of research in Mozambique."

Past road planning, construction and maintenance practices, experience and research need to be used to inform the sector and to introduce new, innovative and more cost-effective technologies and improvements into the industry. Such experiences and best practices need to be documented and put into practice through periodic updating of the existing manuals and specifications that guide the road construction, maintenance and rehabilitation interventions.

Mozambique has benefited to some extent from international research and application and some progress in road planning, construction and maintenance has been achieved in recent years. However, progress is often stifled by local challenges caused by the complexities of poor materials, the variety of geological and geomorphological conditions

and traffic growth that can outstrip the expectations of design. The application of currently accepted and often imported technologies can give less than optimal road performance, whilst the provision of adequate road safety remains a serious challenge.

A better understanding of road performance in Mozambique, its management and maintenance can only be achieved through a long-term engagement in collecting and properly analysing local data, undertaking specialised and locally focused research and testing and bringing innovation and appropriate standards into practice. To maximise the benefits accruing from significant investments in research and data collection, efficiency improvements are also needed that cannot be realised in the absence of suitable national institutional arrangements for research, dissemination and application.

There is also a wide range of experience in roads research within Africa and internationally. Access can be provided to this experience in order to guide the development of road research in Mozambique.

5.1.1 Benefits from research

The benefits of research were presented at the workshop. One of the main questions was how to convince politicians of the benefits without involving major costs to establish a road research centre. It was agreed that a large new building would not be necessary and that the most important aspect of developing a centre initially is to build a team of dedicated and motivated researchers who are committed to their work. No estimate has been made of the costs of accommodating the research centre.

Workshop Quote: "How can we sell this idea to the politicians without seeming to re-invent the wheel?"

Raising awareness of the benefits of research is a good way to demonstrate its value. Research is the mechanism for the advancement of knowledge and a country's economic growth is directly linked to its investment in research (outlined in a paper by Greening/O'Neill 1999). Research is also linked to innovation and countries that fail to invest in research are not only likely to lag behind in the development of appropriate local solutions to their problems, but also in economic development.

Local problems need local solutions and foreign practitioners are not usually best placed to understand local needs. A far better way of addressing these problems is to invest in building the local research capacity needed to develop appropriate, innovative solutions required to solve local problems. However, any investment in research must be matched by a local commitment to sustain a research capability and must also include creating an environment that will attract and retain skilled professionals with an interest in research. In this way the benefits of research will be maximised.

In a national development context, some of the main benefits that will accrue from the establishment of a research centre in Mozambique are:

- Advancement of knowledge
- Development of new ideas/innovative solutions
- Finding LOCAL solutions that are value-for-money and relevant to local needs
- Tailoring research-based evidence from elsewhere to the local environment
- Support for longer-term research projects that yield the major advancements in knowledge and the largest benefits
- Support for increasing local sustainable research capacity (i.e. as opposed to ad-hoc support through projects)

A wider and more indirect benefit from road research would be a more efficient road network and the implications this would have for the country on economic growth, poverty reduction and social development.

5.2 The Funding of Research

Several potential sources of funding for a Road Research Centre were presented at the workshop. These included:

- ANE
- Roads Fund
- Other government budgets
- Private Sector Funding
- Donor funding

It was recognised that sustained funding in the long term is essential. Research often takes considerable time to generate meaningful results and even longer to implement and mainstream those results, so the centre must have long-term guaranteed funding year on year to be able to plan for research projects that may span several years. Funding of research will need to be confirmed during the next phase of the project.

5.2.1 ANE Funding

It was recognised that recurrent funding for staff, resources and other logistics would need to be provided through ANE and through their own budget. There was also agreement that the provision to include research into projects as experimental sections should be maximised; at present this responsibility rests within DIPRO. This provision is available now, but it is not being used. The suggestion from the workshop was that this facility should be exploited to increase the amount of research being undertaken.

Senior ANE staff indicated that funding was not expected to be a problem.

5.2.2 Roads Fund

The Roads Fund is a potential source of funding. At present the Roads Fund supports mainly maintenance, but there is interest in supporting research.

5.2.3 Other Government Budgets

It is also possible that other government departments could fund research into roads via the RRC. It is hoped that cross-sectoral coordination will be promoted and other government departments will be able to provide some funding for road research when it has the potential to benefit their sector.

5.2.4 Private sector funding

Funding generated directly from the private sector was presented as an option, either the commercial provision of laboratory testing facilities or using the RRC as an accreditation centre for other laboratories or testing facilities in the country. It may take some time to establish this facility and the necessary legislation to support it, but this should be a long-term goal of the RRC.

5.2.5 Donor funding

It was recognised that donor funding should be sought for the establishment phase of the RRC. There is a history of donor support for road research in Mozambique and there should be interest amongst donors to support the RRC establishment.

5.3 Institutional Structure

It was recognised that an appropriate institutional structure is essential to the successful establishment of a road research centre.

5.3.1 Institutional location of an RRC

During the workshop there was discussion on the institutional location of the RRC. There was a consensus that the RRC should be based within ANE, but should have strong involvement from LEM. It was also recognised that universities such as UEM and ISUTC should be involved as they are then potential suppliers of graduates and staff to the RRC.

Workshop Quote: "It is a huge challenge to establish a functional centre! LEM should be a main stakeholder. Most important is to provide the conditions whereby all main stakeholders can contribute and that commits all stakeholders to implementation."

The participants recognised the challenges involved in establishing a road research centre and some useful discussions were held.

The options given in the Preliminary report for the institutional location were:

- Based in LEM, with support/assistance from ANE and others
- Based in ANE, with support/assistance from LEM and others
- Based in a third party, such as a University, with support from ANE, LEM and others.

5.3.2 ANE based

ANE has been driving the proposal for the establishment of a road research centre and is committed to hosting the centre. ANE has been carrying out road research for several years in Mozambique and has the necessary resources and experienced staff to initiate such a project. ANE also has the mandate and the opportunity to pilot, implement and mainstream the results of any research undertaken.

The main issue for an RRC based within ANE is how it will be integrated within the ANE institutional structure. This issue was presented and discussed at the workshop and the consensus was that the RRC should have a cross-cutting facility that would serve to support all of the departments of ANE on an equitable basis. Cross-cutting essentially means that the RRC is not under the control of any one department of ANE, but it is allowed to serve all of the departments equally, so it cuts across the range of ANE disciplines. As such it should report directly to the Director General of ANE.

The RRC would have links with all technical departments as well as the administration department. In this way it will not be beholden to one department. Also relevant to this discussion is the unconfirmed new institutional structure for ANE, which indicates that ANE should become involved in research, seemingly through DIPRO.

5.3.3 Steering Committee

There was agreement that a steering committee should be established to guide the direction of the RRC. This steering committee should be structured to include the main stakeholders and be chaired by the Director General of ANE. It should contain the main stakeholders, but be limited to approximately 9 persons and should sit no more often than once per year. The details and terms of reference for a steering committee will be determined during the next phase.

5.3.4 Technical Committee

A technical committee was also proposed as a body that can review and authorise proposals for research projects. This technical committee should be formed from the main technical departments of ANE, with a member from LEM and possibly a representative from one of the universities. The technical committee will sit more often than the steering committee, but probably only two or three times per year, depending on the projects being proposed and their progress. The details and terms of reference for this committee will also be determined in the next phase of this project.

5.3.5 Staffing

During the workshop it was confirmed that staff recruitment and retention should not be a problem. There is no career structure for researchers at present and there was some doubt whether this could be established under ANE. It is the consultant's view that a career structure is necessary in the first place to recruit appropriate staff, but also to ensure that those staff are content working for the RRC, that they see a future in staying with the organisation and that they are motivated to carry out high quality research.

Even though research does not have a very high profile within Mozambique it is recognised as being essential to develop appropriate road technologies and it is believed that people will be interested to join and work for such a centre. In general ANE does not have a problem in recruiting and retaining staff and staff turnover is low. This is a very positive factor in favour of a road research centre being able to develop indigenous capacity.

A road research centre will also need staff from a variety of different backgrounds, not just civil engineering. TRL and other international road research centres employ a wide range of specialists in order to ensure quality research at all levels and in all areas. An RRC in Mozambique should consider employing a wide range of skills and expertise in order to achieve the same goal.

During the next phase it will be necessary to identify a staffing structure, a recruitment plan and produce job descriptions for the main positions. The most important aspect of staff recruitment is that staff are committed to research and that ANE creates an environment in which they are challenged, interested and appropriately rewarded for what they are doing.

5.3.6 Laboratories

It was recognised throughout the workshop and interviews that a high quality laboratory with up to date and relevant testing equipment is essential to the success of a road research centre. The involvement of LEM as a key player in the development of the RRC was therefore recognised. Although the future of road laboratories in ANE is uncertain in terms of how they will be managed and by whom, LEM need to be integrally involved in the development of the RRC.

5.3.7 Physical location of the RRC

There was discussion over the site of the proposed RRC unit. The main agreement was that the centre should start small and grow, and not request significant funds to construct a new building.

Workshop Quote: "We all agree there is no need for a huge structure and costs, we must not scare the politicians!"

It was recognised that the most important aspect of establishing an RRC is to form a professional and dedicated unit. The accommodation for this unit is less important, and in the short term it can be housed within ANE's present offices. It was agreed that the

physical location, with possible options of Chimoio, Maputo and Nampula, should be fully investigated and decided during the potential next phase of the project.

5.4 Road Research Strategy

The Draft Road Research Strategy was presented at the workshop. During discussions it became clear that the participants were not very familiar with the draft strategy, and requested additional time to review it and discuss it internally. There was also a suggestion that the strategy could be finalised during the potential next phase of the project. The draft strategy is shown below:

5.4.1 Draft Road Research Strategy

Vision and Mission

It will be necessary to establish a Vision and Mission for the new Road Research Centre in order to provide direction and purpose to road research in Mozambique. The development of a Vision and Mission must be a participatory process and all staff should have ownership of the statements.

Introduction

Mozambique is committed to establishing a Road Research Centre (RRC). This RRC would be located under ANE but would have strong links to other institutes that carry out research within Mozambique.

Current Situation

At present the RRC is in the process of being established, so this Strategy should remain flexible and should be regularly reviewed to take into account all of the changes that will inevitably come as the RRC develops and evolves.

There is an acute problem with road building materials in Mozambique. High quality gravels are scarce and bitumen has to be imported at a high cost, amongst other problems. Some research has been carried out into using alternative local materials and adjusting specifications accordingly; some of which is still ongoing. However, this research needs to be coordinated and focused and ultimately a set of specifications and regulations appropriate to Mozambique need to be developed.

A valid strategy to identify research issues that are both important to the country and potentially beneficial is to identify problems in all aspects of road construction and maintenance. From those problems potential solutions can be proposed and projects can be developed to solve them. Research should be demand driven wherever possible in order to gain the most benefit.

Way Forward

This strategy is to be guided by a Vision and Mission for the RRC. The first step is to establish these, which will inspire and motivate staff to achieve their goals.

Building a Research Culture – Road research does not have a high profile in Mozambique. In this respect it is important to make everyone aware of the potential benefits from research, especially the people who have the power to influence the funding for research and would be able to support it at a political level. This is where the

promotional aspects of the RRC would come into play, along with the knowledge sharing and dissemination.

Shared Responsibility – It is important that the RRC is not the responsibility of only one department within ANE. In order to gain a broad support for road research it will be necessary to involve and integrate other departments and institutions, such as LEM and the Universities. In this respect it is recommended that a steering committee is formed that involves all of the main stakeholders or representatives for certain groups; for example, the provinces could be represented by one person and this responsibility could be rotated so that all provinces are involved at some stage. In order to make quick decisions and to minimise demands on people's time, the steering committee should meet no more than once per year and should be limited to about nine representatives.

International Collaboration – In order to gain credibility and international respect, it is essential that the RRC forms links with other high status international research organisations. The main institutions that carry out similar work within an international context are:

- TRL (UK)
- CSIR (South Africa)
- ARRB (Australia)

The Laboratório Nacional de Engenharia Civil (LNEC) in Portugal is a member of FEHRL, which is an association of road research centres in Europe. There is no formal road research centre established in Brazil, but research is being carried out mainly through universities. It would facilitate exchange of information if links could be made to such organisations in these countries due to the common language and the colonial history of Mozambique. Some links are already established between ISUTC and universities in Brazil; existing links such as this could be a starting point for partnerships.

Planning for the future – If the establishment of the RRC goes ahead the centre will also need to develop a business plan to guide its establishment and management into the future. The development of a business plan is an activity that could be undertaken as part of a project to establish the RRC. Even though it is likely that the RRC will be a largely government and donor funded institution for at least the first few years, a business plan is essential to give a framework for implementation and expansion as well as providing a framework to monitor its progress.

Strategy Interventions

Identify research projects – research projects should be identified by gathering information and data on problems that exist on the road network. These problems should then be analysed in terms of their importance and relevance to both the road sector and other sectors that have priority to government, as well as the potential benefits that they could bring.

Project prioritisation – the next step is to prioritise the projects based on a set of objective and subjective indicators. The prioritisation process would probably take two phases; an initial screening phase to produce a shortlist and a second more detailed phase to identify the projects that will be undertaken.

Project approval – the projects should then be approved by an established person or body. This could be the Director General, or a committee could be established which would involve a selection of the stakeholders who are involved in road research.

Performance indicators - once projects are under way they will need to be assessed on the basis of a number of performance indicators to ensure they are on track and are going to achieve their objectives.

Making it Happen

Results focus – in order to gain credibility, respect and maintain the momentum that comes with establishing a new institution, it is essential that the RRC achieves 'quick wins'. This means that research projects should be initiated and completed as soon as possible and that the results must be high quality and must be disseminated widely. It is also advisable that projects are properly planned with defined objectives and are time-bound. However, researchers will also need to be given some flexibility to follow their instincts and develop results that respond to the research data and analysis as it develops.

Linkages and synergies – in the first instance the RRC must establish links with other research institutions in Mozambique. The most important links will be to LEM and the Universities. It is also important to have linkages to other sectors such as Transportation and Road Safety as research can also bring significant benefits in these areas and the RRC should be in a position to arrange or undertake such research.

Legislation – it is also important that the necessary legislation and regulations are established to support the research efforts of the RRC. This could range from legislation allowing the RRC to charge for its services, to legislation on accreditation and regulation that can be carried out by the RRC as the foremost authority in the country.

Funding – it is essential to have sustainable and long-term funding for research in order to produce substantial and meaningful results. Initially, the RRC will need to identify some quick-win projects to demonstrate impacts. However, it should also be recognised that the benefits from roads are long term and that longer-term projects usually provide the largest benefits. The RRC should seek donor funding to support the establishment of the centre, but government funding will need to be provided for long-term running of the centre and for the majority of research projects. Where possible, funding for research should be built into regular road projects being undertaken by ANE. In addition, there is potential for private sector funding, either through the provision of testing facilities for materials or from product testing.

Capacity building and training – in order to conduct high quality research and have a highly respected research centre, it will be necessary to build the capacity of the RRC staff to a high level. Thus the staff will need to be suitably qualified either when appointed or by attaining additional qualifications at MSc or PhD level, facilitated through the provision of specialist training courses. An essential part of any training programme for a research centre is to train in 'how to do research'. This is often overlooked or taken for granted that staff will know how to research, but in a new organisation such as the Mozambique RRC it is essential that such knowledge is established.

Monitoring and evaluation – research projects, plus company and staff performance, must be monitored on a regular basis. There are a number of internal checks and balances that can be carried out to achieve this. However, it is recommended that a system similar to the one used by TRL is used. This is called the 'Technical Review' system and involves an independent member of staff checking and signing off projects and progress of projects on a regular basis. This ensures that any mistakes or problems with the work are highlighted at an early stage and can be addressed before they become too serious or erroneous results are included in publications. This is particularly relevant to research work as even small early mistakes can render a large amount of work invalid or useless.

Knowledge transfer – this is an essential aspect of any research organisation. The RRC should establish an information centre which will act as a repository for all of the road research carried out in Mozambique. As well as being a place where research results can be stored, this centre should actively disseminate the results via a number of means such as publications, an RRC website, conferences, seminars and workshops.

Mainstreaming results – research is not complete until it has been institutionalised by, for example, being included in manuals that prescribe design and

construction practice in Mozambique. In the case of road research it is important that the results are accepted and mainstreamed and eventually become best practice. As well as justifying the original investment in the research and raising the profile of the RRC, this will lead to better roads and more benefits for the country as a whole.

Promotion – the RRC must continue to promote itself and its results. The promotion of research results is important in the process to establish the RRC and to secure future funding.

6 Programme

6.1 Steps to establish an RRC

During the workshop the steps to establish an RRC were used as a basis to discuss the resources and support necessary for a potential next phase of the project. It is envisaged that this next phase will support the establishment of the RRC within ANE. The following steps are in chronological order, but ANE will need to prioritise the activities based on what funds are available and what can be achieved within the given timescale.

- Review and confirm the institutional structure and location for the RRC.
- Determine which laboratories will be used and how. Formalise the involvement of LEM and how the other ANE laboratories will be managed.
- Make any legislative adjustments necessary to allow the RRC to function as planned.
- Establish a management structure for the RRC at a high level, such as a steering committee and a technical committee.
- Confirm the research strategy, as proposed under this project.
- Assuming that accommodation has been agreed, review this and recommend / procure any further resources or logistics required to allow the research centre to function effectively.
- Prepare an organogram, staffing plan and job descriptions.
- Establish a career structure, employ staff and carry out induction training.
- Develop a Vision and Mission for the RRC plus goals and objectives. Feed this into the preparation of a business plan for the organisation.
- Carry out a detailed assessment of the needs for road research in Mozambique based on local problems associated with road construction and maintenance.
- Develop a research project prioritisation procedure to allow the RRC to prioritise its projects and identify an appropriate number of 'quick win' projects to be carried out over the first 1-2 years of the establishment of the RRC.
- Review the capacity of the laboratories being used and review the existing testing equipment. Recommend and procure additional or replacement equipment necessary to meet the immediate needs of the RRC.
- Review the data storage and processing capacities required. Propose and procure appropriate resources to ensure sufficient data capture and storage in terms of hardware, software, applications and any other logistics. This is not limited to computers but should also include other office equipment.

- Develop a specialist training programme for research related subjects based on the capacity of the staff recruited, the future staffing needs and the initial subjects to be researched.
- Develop a professional training programme to train appropriate staff to MSc and PhD levels.
- Initiate the development of guidelines for the RRC as the organisation progresses and as projects are undertaken. This will include outline quality guidelines and consideration of future accreditation to international standards.
- Establish partnerships and linkages with other research organisations, both within Mozambique, regionally and internationally.

6.2 Project Programme

A programme for the remainder of this project is shown in Appendix D.

7 Conclusions

From the discussions, interviews and workshop the following conclusions have been drawn:

- Previous road research has been carried out in Mozambique successfully. Current research is demand driven with projects constructed using local funds, although most projects are managed by expatriates funded by donors and working with local counterparts. There is a clear need for road research in Mozambique, plus a good argument for developing indigenous capacity to address this need. Developing this capacity internally will help Mozambique to carry out more sustainable research and improve the road network more cost effectively.
- Mainstreaming the results of research is an essential challenge for the proposed RRC and this will be facilitated through building indigenous capacity.
- There is political will to establish an RRC and there are realistic expectations from its establishment. Despite this it will be necessary to raise awareness of the benefits of road research at all levels.
- The most appropriate place for the RRC to be based is within ANE, but LEM will need to have a significant role. There are institutional issues within ANE that may prevent the RRC from functioning effectively if it is based within one department. Therefore the most appropriate place for the RRC institutionally is as a cross-cutting facility reporting directly to the Director General.
- Sustainable funding is essential for any road research centre to progress. Research is, by its nature, a long process, which this requires that both the client and the researcher recognise the importance for long-term and sustainable funding. Feedback from the workshop is that funding should not be an issue.
- Staffing for a potential road research centre is not expected to be a problem. ANE is confident that it will be able to recruit suitably qualified and experienced staff and retain them for a substantial length of time. A career structure needs to be identified for researchers and their terms and conditions should be appropriate to retain them in the organisation.
- The scope of an RRC should be realistic and it should start small and grow, based on its results.
- The scope of road research projects needs to be wider. In Mozambique in the past research has been mainly focused on road building materials. In order to devise a balanced programme of research the centre will need to consider all aspects of road construction and maintenance, as well as transportation and road safety.

- The state owned university UEM is mainly involved in hydrological subjects but the private university ISUTC is more roads orientated. Both are keen to be involved in an RRC. It is important that such institutions are involved in the research centre and are given some responsibility for its direction.

8 Recommendations

The following recommendations have been made based on the initial meeting, interviews and recent workshop:

- Institutional Structure - The institutional structure has been broadly agreed. The RRC should be:
 - Based in ANE
 - Have a cross-cutting role, reporting directly to the Director General
 - Create a career path for RRC staff
- Research Steering Committee – it is recommended that a Research Steering Committee be established in order to guide the RRC. The steering committee should comprise the main stakeholders in the roads sector. It should not need to meet more than once per year.
- Technical Committee – it is also recommended that a technical committee is established to review and authorise research project proposals. This technical committee should comprise of members from the ANE technical departments and from LEM. Other members can be considered but the committee should be kept small and manageable.
- Raising awareness - One of the first tasks for a new RRC should be to raise awareness of the benefits of road research to politicians, as well as to society in general. To help secure the future of the RRC it is recommended to raise the profile of research through awareness campaigns to senior government officials, which will inform of the activities that the road research centre undertakes and the technical and economic benefits that road research can bring to the country. In this way sustainable and long-term support and funding can be achieved. Champions should be identified by the RRC to undertake such tasks.
- Staffing – It is recommended that a wide range of staff are employed to work in the RRC. Civil engineers will clearly be central to its operations, but in order to achieve high quality results in the full range of disciplines it will be necessary to involve a range of specialists from other branches of engineering (chemical, structural and others) to statisticians and librarians.
- Diversify research – A road research centre should attempt to diversify its research into all areas, i.e. road safety, transportation, design and other areas. Although construction materials seem to be the most important at present, it is advisable to be active in all areas should the need to react quickly arise.
- Start small and grow based on results – Quality results are important for a new organisation trying to build a reputation. The RRC will need to prove its worth before it can command substantial funding, so it is recommended that the establishment is not too ambitious, but should start small and grow based on results.
- ‘Quick Wins’ – Because politicians are often in power for a short time and road research does not often bring quick results, some of the initial research projects undertaken should be short-term projects that can demonstrate results within a short period of time and show some substantive results at that time. This will raise the profile of the RRC quickly and generate wider interest.

- Political support – This is essential for the RRC to become established and for funding to be secured. It is necessary for government to show commitment to the research centre and for politicians to support it.
- Partnerships and links – It will be very beneficial for the RRC to quickly establish links and partnerships with other research institutions within Africa and Worldwide. This will allow the RRC to share experiences and results and to put their own research into a wider context.
- Use new graduates countrywide – In order to identify the problems that will drive the research, it will be necessary to collect experiences from across the country. ANE has recently recruited many new graduates who are posted to the provinces, so they should be used to help identify problems and areas of potential research.
- Study tours – In order for government and RRC senior management to appreciate the potential of a road research centre and the benefits it can bring, it is recommended that a study tour to a recognised international institution is arranged. The most appropriate at this time would be TRL, LNEC, CSIR or ARRB.
- Repository for road research knowledge – There is a need to provide a repository for road research data and results in Mozambique. It is logical that this repository should reside within a road research centre, so it is recommended that a centre for knowledge and information be established within the RRC where the information can be stored, made available and disseminated as appropriate.
- Long term funding from government and donors – Long term funding is essential. It is recommended that the government commits to long-term funding of the road research centre and road research itself, either through ANE, the Roads Fund or other such institutions.
- Capacity Building – Once the location and institutional structure of the RRC is established the capacity building measures will need to be determined. This will involve identifying the human resources, logistics, equipment, accommodation and IT resources necessary and working out how they can be supplied or enhanced to provide a sound basis for the RRC to work from.
- Training – Training in research procedures will be an essential aspect of capacity building for any road research centre, as well as training in other subjects that will be subject to research. As the RRC will be a new institution, it is not necessary to undertake a formal training needs assessment because the staff will be new in their jobs and will have little awareness of the training they will need to carry out their jobs more effectively. However, a training programme should be developed to train staff in a wide range of subjects such as: research project identification, prioritisation and management, how to research and statistical analysis, based on their job descriptions and previous experience/qualifications.
- Invest in equipment – A review should be carried out to assess the existing equipment within ANE and LEM. This can then be used to determine any new equipment that may be required, based on research projects proposed and the aspirations of the RRC. A scoping study should also be carried out to determine the possibilities for commercial testing and the potential income that could be generated for the RRC. Again this will determine the equipment that should be procured.
- Technical support to initiate the centre – It is also recommended that the RRC receives technical assistance, possibly in the form of a small project, to initiate the establishment of the centre and to support in the production of a business plan, training programme, project structure and prioritisation process, identify initial projects and initiate staff recruitment.

Appendix A

Additional Interviews:

6th February 2013

- Cecilio Grachane, Director General ANE
- Luis Fernandes, Head of Maintenance ANE

6th February 2013

- Calado Ouana, Planning Director ANE
- Miguel Coanai, Director of Maintenance, DIMAN

8th February 2013

- Jaime Matsinhe, Director of Construction Materials, Ministry of Public Works

12th February 2013

- Luis Fernandes, Head of Maintenance ANE

Appendix B

Agenda

Road Research Strategy Project Workshop

Friday 8th February 2013

Cardoso Hotel, Maputo, Mozambique

Time	Subject	Presenter	Orgn.
8.30am	Arrival		
8.45am	Opening	Director General	ANE
9.00am	Overview of AFCAP	Nkululeko Leta	Crown Agents
9.10am	Background to Research	Tony Greening	TRL
9.30am	Overview of Preliminary Report: <ul style="list-style-type: none"> • The case for Research • Funding of Research • Institutional Structures • Road Research Strategy 	Robin Workman	TRL
10.10am	Potential Benefits of Research in Mozambique: <ul style="list-style-type: none"> • Existing Research Projects • Documentation & Road Safety 	Tony Greening Robin Workman	TRL TRL
10.30am	Coffee / Tea break		
11.00am	Plenary Session Issues to be discussed: <ul style="list-style-type: none"> ▪ Institutional location of RRC ▪ How to involve other stakeholders? ▪ How to manage the labs across Mozambique? ▪ How to secure funding for the RRC? ▪ Confirm the Road Research Strategy. 	Robin Workman/ Tony Greening	TRL
12.30pm	Lunch		
1.30pm	Continuation and summary of Plenary Session	Robin Workman/ Tony Greening	TRL
2.00pm	Breakout Groups <ul style="list-style-type: none"> • Group 1 – Essential Criteria for a successful RRC • Group 2 – Support necessary for the establishment of an RRC 	Tony Greening Robin Workman	TRL TRL
3.00pm	Report back, summary and close		
3.30pm	Coffee / Tea		

Appendix C

ROAD RESEARCH STRATEGY WORKSHOP - Friday 8 February 2013

List Of Participants who attended the Workshop

No.	Name	Country	Company	Position
1	Eng. Cecilio Grachane	Mozambique	ANE	General Director
2	Eng. Adérito Guilamba	Mozambique	ANE	Project Department
3	Eng. Miguel Coanai	Mozambique	ANE	Director of Maintenance
4	Eng. Luis Fernandes	Mozambique	ANE	Maintenance Department
5	Dra. Aurora Matlaba	Mozambique	ANE	Director of Administration and Finance
6	Eng. Virgilio Lichucha	Mozambique	ANE	Finance Department
7	Eng. Calado Ouana	Mozambique	ANE	Director of Planning
8	Eng. Ismael Sulemane	Mozambique	ANE	Director of Project
9	Eng. Jaime Matsinhe	Mozambique	MOPH	National Director Construction Materials
10	Eng. Dinis Chambo	Mozambique	Road Fund	Technician
11	Eng. Henrique Filimone	Mozambique	LEM	General Director
12	Eng. Carlos Cumbane	Mozambique	LEM	Engineer
13	Mr. Altamire	Mozambique	LEM	Assistant Researcher
14	Dr. Fernando Leite	Mozambique	ISUTC	Chancellor
15	Eng. José Chembeze	Mozambique	World Bank	Transport Specialist
16	Nkululeko Leta	South Africa	AFCAP	Technical Manager - Roads
17	Kenneth Mukura	Zimbabwe	TRL	Consultant
18	Tony Greening	UK	TRL	Senior Manager
19	Robin Workman	UK	TRL	Senior Manager

Appendix D

Proceedings of Workshop

1 Workshop

The main purpose of the workshop was to present the preliminary report and give all of the main stakeholders a chance to discuss the issues and come to a consensus, if possible. The participants were sent a Portuguese translation of the report by ANE in advance of the workshop, but it is accepted that not all participants will have had a chance to read it in detail. With this in mind the presentations were designed to give enough detail for the participants to enter into meaningful discussions on each subject. The workshop was facilitated by the consultants. The presentations were made in English with simultaneous Portuguese translation and the discussions were also subject to simultaneous translation in both languages.

1.1 Agenda

The agenda for the workshop included an introduction by the Director General, an introduction to AFCAP by Nkululeko Leta and an overview of the preliminary report presented by the consultants. The main discussion period was held in plenary, despite being planned for a combination of plenary and breakout groups. This change was decided on the day and agreed by the workshop participants. The Agenda can be seen in Appendix B.

1.2 Attendance

In total, 16 persons attended the workshop, plus Nkululeko Leta from Crown Agents and Tony Greening and Robin Workman from TRL. A list of participants can be seen in Appendix C.

1.3 Preliminary Report Presentations

The main content of the workshop presentations involved an overview of the findings of the preliminary report by the consultants. This was essentially a factual summary designed to give enough information to allow the participants to discuss the issues, even if they had not had enough time to read the report in advance of the workshop.

The presentations on the Preliminary Report included the following subjects:

- Introduction
- The case for research
- Funding of road research
- Institutional establishment of an RRC
- A Road Research Strategy

In addition, a further presentation was made to demonstrate the benefits of road research to the participants. The main parts of this presentation were:

- Present road research projects in Mozambique – an overview of past and present projects and some of the benefits they have brought to Mozambique.
- Research documentation and dissemination – how existing material can be used by researchers to form the basis of specifications and regulations for Mozambique.

- Road safety research benefits – an overview of road safety, why it needs research and some of the benefits that research could bring for Mozambique.

1.4 Plenary discussion session

The main plenary discussions were held based on the following issues:

- Institutional location of RRC
- How to involve other stakeholders
- Laboratories; how to manage for Research
- How to secure funding for the RRC
- Confirmation of the Road Research Strategy

During discussions the following points emerged and were discussed:

1.4.1 *Institutional location of an RRC?*

- Other countries' experiences are available from the AFCAP website, or directly through the AFCAP technical advisor.
- RRCs are in the process of being established in Kenya and Ethiopia, with other countries also considering undertaking similar initiatives.
- Ethiopia has struggled with staffing due to low remuneration. The concept was also very ambitious and doesn't match the resources available.
- It is necessary to raise the awareness of research benefits, but initial establishment costs should be modest.
- A steering committee has been recommended for the RRC. The details of this can be decided in the next phase.
- One of the main functions of the RRC will be to act as a repository for research results.
- A large building and organisation is not necessary for the initial establishment, it is the people who are important.
- Broad agreement that the RRC should be based in ANE.
- Best to start small, build a good team and expand based on quality results.
- An RRC with a cross-cutting function is preferred, reporting directly to the DG.

1.4.2 *How to involve other stakeholders?*

- Suggestion that LEM and ANE can host the centre together.
- Important to create conditions whereby all main stakeholders can contribute.
- Other country RRC set-ups; Kenya is semi-autonomous, Ethiopia is wholly within government under the operations department of the Roads Authority.
- Existing MoU with LEM can be utilised to facilitate a partnership.
- Proposal to include the Association of Local Consultants in the Steering Committee.

- Promotion of the RRC and its results is necessary.
- Some research could be carried out by external partners or bodies.
- The Steering Committee should be formed of participants at a suitably high level and be chaired by the DG.
- A technical committee should be established to review/approve research projects

1.4.3 *Laboratories; how to manage for Research?*

- Laboratories need a minimum level of testing equipment.
- Laboratories are already well equipped, many with new equipment (Nampula). Need to make the most of what ANE already has.
- The RRC may need some specialist testing equipment, but good idea to assess and utilise existing equipment if possible to reduce setting-up costs.
- May be best to set up a unit, work out a programme, research priorities and activities and then decide what equipment will be needed.

1.4.4 *How to secure funding for the RRC?*

- Budget is prepared with a research and studies component. Research can be included in this so funding should be simple.
- There is a provision for experimental sections in DIPRO for all contracts, but it is not being used.
- If DIPRO budget is used there will be no funding problems.
- It will be necessary to seek donor support for the initial establishment of the RRC.

1.4.5 *Confirm the Road Research Strategy*

- It was recognised that more time is required for ANE departments and other stakeholders to assess the Road Research Strategy and discuss amongst themselves.
- Some concern was expressed over the use of the word 'confirm' as this forum may not have the authority to 'confirm' the strategy.
- There was a suggestion that the Strategy can be 'confirmed' during the next phase.

1.5 *Exercise 1: The essential criteria for a successful RRC*

This subject was included to help the participants to think about how to make the RRC successful. It was discussed in plenary with the participants. The consultants explained the need to establish criteria for a successful RRC and why it is important.

The discussion produced the following criteria:

- Establish a culture of research – it will be necessary to raise awareness of the benefits of research.
- Recruit appropriate staff, criteria should be set to allow the RRC to appoint staff appropriate to their designated positions:

- Adequate remuneration – staff should be paid a competitive wage so that the RRC is able to recruit and retain them, and ensure that the investment that will be made in building their capacity will not be wasted.
- Good qualifications – it was noted that staff should be employed who have appropriate qualifications for the position they are appointed to.
- Relevant experience – although it may be difficult to recruit staff with extensive research experience, if they have some experience in roads it will be advantageous.
- Have courage; ready to take risks – this comment was made to highlight that researchers need to have initiative and push the boundaries of existing knowledge.
- Commitment – it is necessary to establish a good working environment that will encourage staff to be committed to the RRC and motivated to carry out their work to the best of their ability.
- Partnerships – it was suggested that partnerships should be formed with local universities so that young people can be mentored from university to become future researchers. A criteria could be that MoUs are established with universities and a target number of graduates are employed by the RRC each year.
- Identify and undertake relevant projects – it has been recommended that a system is established to prioritise research projects. This system can be used to produce criteria for undertaking relevant projects.
- Link training with other stakeholders: LEM, ISUTC, UEM and other educational institutions – this suggestion was made to ensure the involvement of all stakeholders in training. The criteria for this can be developed when a training needs assessment has been undertaken and training plans are developed.
- Provide incentives based on outcomes – this criteria was suggested as a way to motivate staff to achieve results. This can be looked at during the next phase, but the outcomes are likely to be long-term so proxy indicators would need to be developed if incentives were to be linked.
- Link with other countries / research institutions – recommendations for partnerships and links have already been made and this is seen as essential to the success of the RRC. Criteria could be developed to monitor this success, such as developing new technologies for research carried out in other countries.
- Have an appropriate institutional set-up – this is an essential aspect of the RRC and it will not be successful without an appropriate institutional set-up. However, this is more of an initial activity and not an ongoing criteria that can be monitored.
- Sustainability – sustainability is an aspect of all criteria.
- A number of other suggestions were made that could be developed into success criteria:
 - Establish 'Peer Review' procedures
 - Disseminate results, share knowledge
 - Assure quality
 - Identify 'Champions'

When the workshop had completed the above list, the consultants revealed a potential list of criteria that had been prepared earlier:

- Political commitment/support
- Strong institutional arrangements
- Sustainable funding

- Highly motivated staff
- Competitive remuneration
- Clearly defined career path
- Partnerships/links with local and international research organisations
- Projects that are well-conceived, prioritised and designed with clearly defined objectives and impacts
- Opportunities for staff to publish results in papers and journals and give presentations at local and international seminars and conferences
- Opportunities for visits/study tours to other research organisations
- Institutional environment conducive to creation of ideas and knowledge sharing

As can be seen there is a significant overlap between the two lists. This can be used to form a basis for the principles and direction of the RRC in the future.

1.6 Exercise 2: Define the support necessary for the next phase

It was suggested that the workshop consider the timescale within which a 'Phase II' project could take place and what should be achieved within that timescale. The programme from the Preliminary Report was shown and suggested as a possible list of tasks for the next phase.

Comments on the programme and proposed scope of activities were:

- The advanced training should include MEng qualifications as well as MSc and PhD. The consultant's agreed with this and suggested that an even wider range of qualifications would be appropriate, based on the staff to be recruited.
- The capacity of ANE to store and analyse data certainly needs to be assessed and upgraded.
- Monitoring of the progress of the RRC is important.
- The scope of activities should be designed to facilitate 'quick wins'.
- Legislation should not need to be changed, but it was suggested that it should be reviewed when the direction of the RRC has been agreed.
- There is a move to adjust the institutional arrangements of ANE this year; this should be borne in mind when recommending institutional structures.
- Suggestion that the consultants provide several options for institutional change and allow ANE to select the most appropriate, as is the practice with Japanese consultants.
- Important to determine how stakeholders will be coordinated.
- Establish a steering committee to guide the RRC, and a Technical Committee to approve research projects (DIPRO, DIMAN, DIPLA and possibly LEM).
- Necessary to have a career path for researchers. There was some doubt how this could be initiated within the ANE institutional structure.

1.7 Agreed points

Agreement was reached on a number of issues during the workshop.

- RRC should be located in ANE, with a cross-cutting function, possibly reporting directly to the DG.

- The RRC does not need a new building and its establishment should not need a large amount of additional funding. The decision on accommodation/physical location for the RRC will be made during the next phase.
- It is appropriate for the RRC to start small and grow, based on quick wins and producing quality results.
- Politicians need to be made aware of the benefits of road research as political buy-in is important.
- A steering committee should be established to provide guidance to the RRC. The details of this can be worked out in the next phase. A technical committee may also be necessary.
- Funding:
 - Some funding can be managed from within ANE via projects.
 - Roads Fund is a potential source of funding.
 - Donors will be requested to support the establishment phase of the RRC.
- Laboratories.
 - LEM are an important stakeholder and must be included in the development of the RRC.
 - Existing laboratory equipment should be adequate but this will need to be reviewed and assessed before any procurement of new equipment takes place.
- Draft Road Research Strategy. This needs more consideration from the divisions within ANE. They will consider and feed back results as soon as possible, preferably by the 15th February 2013 but at the latest by the 22nd February 2013.
- Staffing is important and will be considered further during the next phase.
- At this workshop a broad agreement was sought on how to move forward. The details of institutional structure, funding and other issues would be decided during the next phase of the project.

