



AFCAP



Development of a Road Research Strategy for Mozambique

Preliminary Report

RPN 2402

January 2013



This project was funded by the Africa Community Access Programme (AFCAP) which promotes safe and sustainable access to markets, healthcare, education, employment and social and political networks for rural communities in Africa.

Launched in June 2008 and managed by Crown Agents, the five year-long, UK government (DFID) funded project, supports research and knowledge sharing between participating countries to enhance the uptake of low cost, proven solutions for rural access that maximise the use of local resources.

The programme is currently active in Ethiopia, Kenya, Ghana, Malawi, Mozambique, Tanzania, Zambia, South Africa, Democratic Republic of Congo and South Sudan and is developing relationships with a number of other countries and regional organisations across Africa.

This material has been funded by UKaid from the Department for International Development, however the views expressed do not necessarily reflect the department's or the managing agent's official policies.

For further information visit <https://www.afcap.org>

This is the preliminary report for the 'Development of a Road Research Strategy for Mozambique' report for AFACP. The project was started in November 2012. This report includes the results of the inception report; 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 this preliminary report was produced, which provides the main points for consideration at a workshop to be held in Maputo on 8th February 2013.

TABLE OF CONTENTS

1	Introduction	1
2	Background	1
3	Methodology	2
4	Results of interviews	3
5	The case for research	4
5.1	Existing Research	4
5.2	Benefits from research	5
6	The Funding of Research	6
6.1	ANE Funding	7
6.2	Roads Fund	7
6.3	Other Government Budgets	7
6.4	Private sector funding	7
6.5	Donor funding	7
7	Institutional Structure	8
7.1	Options for location of an RRC	8
7.2	LEM based	8
7.3	ANE based	8
7.3.1	ANE Mission and Vision	9
7.3.2	Directorate of Planning (DIPLA)	9
7.3.3	Directorate of Maintenance (DIMAN)	10
7.3.4	Directorate of Projects (DIPRO)	10
7.3.5	Directorate of Administration and Finance (DIAFI)	11
7.4	Third Party based	11
7.5	Staffing	12
7.6	Chimoio	12
7.7	Institutional Structure Summary	12
8	Road Research Strategy	13
8.1	Draft Road Research Strategy	13
9	Programme	16
9.1	Steps to establish an RRC	16
9.2	Project Programme	17

10	Workshop	17
11	Conclusions	18
12	Recommendations	19

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
GDP – Gross Domestic Product
ILO – International Labour Organisation
ISUTC - Instituto Superior de Transportes e Comunicações
LEM – Laboratoro de Engenharia de Mozambique
MoU – Memorandum of Understanding
Norad – Norwegian Aid
RRC – Road Research Centre
RRIP – Rural Road Investment Programme
Sida – Swedish Aid
ToR – Terms of Reference
TRL – Transport Research Laboratory
UEM – Universidade Eduardo Mondlane
VOC – Vehicle Operating Costs

1 Introduction

This report is the preliminary report for the project to develop a Road Research Strategy for Mozambique. A kick-off meeting was held in November with the main stakeholders in ANE and 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. From this information a programme was developed.

A workshop has been planned for the 5th February 2013 for all of the stakeholders involved. This workshop will present the findings of the preliminary report and facilitate discussions and dialogue on the contents and recommendations therein. The main outcomes of this workshop are expected to be an agreed institutional structure for the proposed Research Centre and a Road Research Strategy for Mozambique.

The Terms of Reference mention a 'proposal' for road research in Mozambique. Following discussions it was found that this is not a formal proposal as such, but a concept to develop a Road Research Centre developed through discussions within ANE and with other internationally experienced researchers.

Mozambique has traditionally relied on international standards and specifications for road construction and maintenance. This has meant that appropriate materials that meet these specifications have been difficult to source in Mozambique, often leading to extensive haulage distances and high costs. Some of the recent research has been focused on developing more appropriate standards for Mozambique that will allow local materials to be utilised more effectively.

The evidence available clearly demonstrates that there is a link between research and development. Many countries worldwide that were considered under-developed just a relatively few decades ago are rapidly becoming economic giants. It is no coincidence that investment in research and development is a common factor in the economic development of these countries.

Mozambique, in common with many low and middle-income countries in Africa, has yet to develop an indigenous capacity in the form of a Research Centre specifically tasked to undertake research in the transport sector. Consequently as is stated in the Terms of Reference and in common with most countries in Africa, Mozambique still relies on International experts to lead in undertaking research activities. Most of the research projects in the transport sector are being carried out in partnership with ANE.

A number of developing countries in Africa and Asia have also begun investing in building indigenous research capacity, often with the help of the donor community. As an example Vietnam has increased investment in research in the sector and is already deriving the benefits from the results. In Africa, Kenya and Ethiopia are also at various stages of establishing Road Research Centres.

2 Background

Mozambique has approximately 30,000km of road, with almost 20% of that total being paved. The shape, geology and geography of the country make it challenging to establish an effective road network due to the large distances, the high cost of constructing roads and the scarcity of good materials. The coastline is almost 3,000km long and it borders several landlocked countries. In addition, Mozambique endured a long civil war during which infrastructure development was put on hold and the road network suffered as a result.

The economy of Mozambique is mainly based on agriculture, but has rich and extensive natural resources, most notably mining and oil/gas. Tourism is also growing, mainly from South Africa which borders Mozambique to the west. All of these activities need an extensive and reliable transport infrastructure to thrive.

Mozambique has had very high GDP growth in recent years. Annual GDP growth was high in early 2000's but has levelled off at between 6 and 7% since 2006 (World Bank – Mozambique country website 2013). However, GDP per capita is still one of the lowest in the world; in 2011 Mozambique was 171 on the World Bank list of GDP per capita at \$975 per year. A low Human Development Index and low life expectancy also prevail. More than 75% of the population engages in small-scale agriculture which still suffers from inadequate infrastructure. Also, a large proportion of Mozambique's arable land is still uncultivated.

Part of this problem in domestic production is the transport network within the country. At a recent summit in Mozambique, it was recognised that:

- The government is looking for ways to continue and expand the growth it has experienced since the end of the war.
- It is necessary to consider ways to build in areas that have mineral resources and agricultural promise.
- Infrastructure is an important part of ensuring steady poverty reduction in Mozambique

The government is faced with the challenge of how to continue and expand growth to ensure steady poverty reduction and invest in infrastructure, particularly where there are mineral resources and agricultural potential, to create greater spin-off to the rest of the economy. The Ministry of Planning and Development has set the development context, challenges and opportunities to maximise infrastructure investments. This includes the existing special economic zones as well as a favourable legal framework for the development of public and private partnerships to tackle infrastructure deficit.

The government has also recognised that sound infrastructure is critical to achieving 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 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 first task after completion of the inception report was to carry out consultations with the main stakeholders who are expected to be involved in the road research strategy and research centre. A number of interviews were carried out with these stakeholders in order to get a sound understanding of the background of this project, the need and potential benefits of a road research strategy and centre and to canvas people's ideas on how it could work and where it should be placed institutionally. The consultants were able to meet all of the main stakeholders.

The next step has been to consolidate the information from the interviews in this report. Even though a wealth of information has been collected, it will still be necessary to carry out additional interviews and discussions both before and after the forthcoming workshop to be held on the 5th February 2013.

This workshop is necessary to consolidate the differing views arising from the interviews, especially with respect to where and how the potential RRC will be located institutionally. The workshop will also provide an opportunity for all parties to discuss and refine the details of a road research strategy. The workshop is expected to provide a consensus on

the key issues and give all of the stakeholders an opportunity to gain ownership of the concept.

4 Results of interviews

From the 10th to the 16th December 2012 a series of interviews were carried out with the key stakeholders of the Project. The interviews were scheduled by Eng. Luis Fernandes who is one of the ANE counterparts on the project. The other counterpart, Eng. Joana Guiuele, was busy on field work during the time when the interviews were taking place.

The purpose of these interviews was to establish the status of road research in Mozambique as well as to canvas people's ideas regarding a road research strategy and a proposed road research centre; principally where the centre could be positioned institutionally and how it would operate in the future. Some of the people interviewed were aware of the proposed research centre, but some were not.

A list of the people interviewed can be seen in Appendix A.

The main issues that arose from the interviews are summarised below:

- ANE is carrying out the majority of research in the roads sector in Mozambique and the consultants were able to obtain a comprehensive list of the existing projects. The majority of the research is focused on materials.
- There is an acute problem due to a lack of suitable road building materials in Mozambique. This is recognised and has started to be addressed through donor-led research projects.
- The research to be carried out should be demand led, based on the problems existing for building roads in Mozambique.
- The experience of other countries in Africa should be taken into account when making recommendations for Mozambique. The research centre should be willing to form links and partnerships with other regional and international research centres in order to maximise the efficiency of its research, avoid duplication and 're-inventing the wheel!'
- Sustained funding is important. There are several potential sources of funding, but long term commitments to funding must be in place.
- Awareness and appreciation of the benefits of research is relatively low. However, most people interviewed were optimistic about raising the profile of road research.
- For a road research centre within ANE, staffing is not expected to be a problem. Recruitment and retention of staff is sustainable.
- The responsibility of the RRC needs to be determined, with several of the stakeholders being interested in managing it or at least being involved.
- It should be possible to include some research aspects in projects under DIPRO, whereby funding would be covered as part of the project. At present this is not done but DIPRO is open to the suggestion. (Most road projects provide an opportunity for undertaking research at just a small additional cost if provision for research is made at an early stage of project negotiations)

5 The case for research

5.1 Existing Research

At present there are a number of road-related research projects that have recently been completed or are currently being undertaken in Mozambique. These are:

- Engineering Standards Project – Unpaved road research under DIMAN, funded by ILO and Sida, designed to develop performance based specifications, now complete.
- Engineering Standards Project follow-up – Training programme based on the outcomes of the original project.
- Rural Road Investment Programme (RRIP) – Under AFCAP, spot improvements designed to alleviate bottlenecks, i.e. on steep sections.
- Spot Improvement Manual – For low volume roads, based on the research carried out under RRIP.
- RRIP Phase II – Includes design, innovation, trial sections, low cost surfacing, combined soils, etc.
- RRIP Phase III – Involves armoured bases and amalgamated surfacings.
- RRIP Phase IV – ‘Back analysis’ project investigating the performance of older sealed roads, especially those with stabilised bases, and comparison with newer roads.
- Calcretes project – Ongoing, looking at the availability and use of calcretes.
- Regional sands project – Under DIPRO, investigating the appropriate use of local sands.
- Hot sand asphalt research – Under DIPRO and funded by Sida. Some trials have been funded by the World Bank based on this project.
- Brick paving trials under DIMAN.
- Trials in geotechnical materials managed by Huesker has been agreed between UEM and ANE.

The majority of the above projects are being undertaken by ANE or with ANE involvement. They are using donor funds and are managed by expatriates with local counterparts. This highlights the possibilities for locally funded research; at present almost all research is being funded internationally so there is scope to increase local funding significantly.

The Universities are carrying out some roads research, mainly focusing on thesis projects being carried out by students, but this is limited. The UEM focus on hydrological subjects rather than civil engineering or roads, so research with UEM is likely to be concerned with drainage or other hydrological subjects.

As can be seen above, the current scope of road research in Mozambique is quite narrow, focussing mainly on road building materials. This is understandable as the country has an acute problem with the availability of local materials to meet the specifications currently in use. However, more recent research projects have focused on using locally available materials in innovative ways and adjusting the design and specifications of roads to allow this to happen. However, a newly established road research centre should consider a wider range of research topics such as planning, design, maintenance, road safety and other such important subjects.

The case for research is relatively easy to make given the problems related to road building materials in Mozambique and the need for more roads. 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. 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, will help to develop their research skills, will provide a repository for knowledge developed through research and will facilitate the implementation of the results of the research. Another strong argument for developing 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.

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 presented due to the complexities of poor materials and the variety of geological and geomorphological conditions. Materials meeting the current specifications for construction and maintenance of roads are scarce, whilst traffic growth can outstrip the expectations of design. The application of currently accepted and often imported technologies can give sub-optimal road performance and 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.

5.2 Benefits from research

Research is the mechanism for the advancement of knowledge and a country's economic growth is directly linked to its investment in research. 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.

There are numerous examples of foreign consultants proposing and implementing recommendations that are inappropriate to local conditions. This should not be surprising. Local problems need local solutions and foreign practitioners are not 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 sustaining a research capability and must also include creating an environment that will attract and retain skilled professionals with an interest in research.

There are three main aspects of research.

1. A problem for which a solution exists elsewhere but is unknown in country. The RRC would have the initial task of identifying the solution and then demonstrating it. It is likely that this may take some time because the industry needs to be trained.
2. Solution known elsewhere but needs modifying for Mozambique. This highlights the need for international links to other research organisations.
3. No solution known. If this is the case, it is unlikely that a newly established RRC will be able to solve it for many years, if at all. It is necessary to identify such problems as such, to avoid wasting time on them.

From the interviews and discussions it is clear that Mozambique could benefit from research into the following technical areas, although these subjects are not exhaustive:

- Road-building materials and linking them to appropriate specifications/design
- Bridges and water crossings
- Road safety; related to road design, driver behaviour, vehicle safety, etc.
- Transportation; route selection and appropriate transport management
- A Materials Database; this would provide a map of appropriate materials for the whole country
- The use of alternative materials, i.e. calcrete, laterites, sand, etc.

In a more general and less technical aspect, 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)

The wider and more indirect benefits from road research can be a more efficient road network. This has further implications on economic growth, poverty reduction and social development.

6 The Funding of Research

There are several potential sources of funding for a Road Research Centre. The main ones are explored below:

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

It is essential that any proposed road research centre has sustained funding in the long term. 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.

6.1 ANE Funding

It is envisaged, and confirmed by the interviews, that some support funding by donors would be necessary for the road research centre initially, although for the Centre to be sustainable it will need to be fully funded locally in the longer term. It is envisaged that if ANE is confirmed as the home of the research centre, it will provide the staffing and accommodation plus some development funds.

In order to attract and justify funding from other sources the RRC will need to generate quick and meaningful results.

It was the opinion of DIAFA that the RRC would probably need to be initiated with some donor support in the way of funding and/or technical assistance. When it demonstrates the value of its research, then the government and other agencies in Mozambique are more likely to provide funding, either through the Roads Fund or on a proposals basis.

6.2 Roads Fund

The Roads Fund is the most likely source of funds for the proposed RRC. The cost of research is very small as a proportion of the value of the road network and also as a proportion of the cost of road construction projects. The Road Fund collects funds through fuel levies, road taxes, etc. It also receives money from the government investment budget. Approximately 20% is spent on Road Maintenance. The Roads Fund has indicated that it could be possible for the RRC to use its funds for research projects.

6.3 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. It could be that there is potential for the development of an area agriculturally, but the access is poor and specifications do not allow for the use of local materials. This is an area where road research could help. Another example would be road safety, which if increased has the potential to save the country a lot of money in health care.

6.4 Private sector funding

Some funding might also be generated directly from the private sector. One example of such funding would be the commercial provision of testing facilities via the research laboratory. It is not clear at this stage how a research laboratory would be set up but provision should be made to allow for private companies and other individuals to use it on a commercial basis. If the LEM laboratory is involved, it already has the facility to charge for its services privately.

6.5 Donor funding

During the establishment of the RRC, donor funding should be sought as it is likely to require substantial consultant inputs to advise on the various aspects of setting up a research centre. However, the centre cannot rely on donor funding in the long term and must seek a locally sustainable solution in order to effectively build capacity.

There is a history of donor support for road research in Mozambique. In addition to DFID, Sida, Norad and others have all funded research projects and would presumably be obvious places to start in seeking funds for the establishment of a road research centre.

7 Institutional Structure

7.1 Options for location of an RRC

Following interviews with the main stakeholders there was a lot of interest from virtually all, with some being interesting in hosting the research centre, both from departments within ANE and from organisations outside of ANE such as LEM and the Universities.

From the discussions held, there are three main options for the institutional location of the Road Research Centre. They are:

- 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.

7.2 LEM based

LEM were interested in hosting the proposed research centre. They were not aware of the proposal and had no prior knowledge of the proposal before the interview. The consultants provided the LEM with a copy of the terms of reference and LEM agreed to review this and prepare some feedback.

Although a laboratory will be central to the operation of a road research centre, the LEM is not best positioned to host the centre. It will undoubtedly be able to undertake all of the testing necessary for research projects but it does not have experience in planning and managing research projects and it is not best placed to implement or mainstream the results as it has no implementation role.

However, the LEM can play a very important role in the establishment of a research centre, especially as it has the capacity to charge the private sector for its services.

7.3 ANE based

ANE has been driving the proposal for a road research centre and is very interested in 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 implement and mainstream the results of any research undertaken.

If the road research centre is located within ANE, the main issue will be how it is integrated within the ANE institutional structure. This is an issue that will be presented and discussed at the forthcoming workshop but some information is provided below to allow the participants to think about the options and come to the workshop prepared to discuss this issue.

There are four different departments in ANE. A future research centre would have links with all technical departments. In the short term it would be sensible to locate the research centre under one of the ANE technical departments, as it will not be large enough to warrant its own department and will need to start small and grow as it produces results and gains credibility. Ideally, in the future the RRC would be a separate

department that acts as a cross-cutting support to all of the other departments. In this way it will not be beholden to one department and can offer its services on an equal basis.

Also relevant to this discussion is the new institutional structure for ANE, which indicates that ANE should become involved in research, seemingly through DIPRO. The following has been informally translated from the Boletim do Republica, 1 Serie – Numero 7, 15th February, 2012:

Article 28

Functions of the Department of studies and projects

- g) Follow the investigation of materials and their application in experimental sections;
- h) Promote actions to ensure the preservation and environmental conservation;
- i) Develop survey and research work on roads and bridges issues;
- j) Promote the investigation of materials and new products for chemical stabilizing force and improving the quality of the materials;
- l) Producing standards and technical specifications on site design, maintenance, rehabilitation and preservation of roads;
- m) Create and update the database on the location and quality of the materials existing in the borrow pit and quarries along the country;

Article 29

Functions of the Road Division

- d) Create and manage the database of roads as well as the prices of construction and services.

From the articles above it seems clear that ANE has a mandate to carry out research into roads. It is understood that the institutional structure of ANE is still to be 100% confirmed, so this will be a key issue to discuss at the workshop. In preparation for the workshop, the consultants will ascertain the most recent situation with regards to institutional change within ANE and time will be allocated to discuss this in detail.

Also relevant to the discussion is the ANE Mission and Vision that need to be considered when establishing a Road Research Centre, as the RRC will need to be consistent with the goals of ANE:

7.3.1 ANE Mission and Vision

The Mission and Vision for ANE are:

Mission

Ensure the link between roads and movement of persons, property services and safety, economic and contributing to sustainable economic, social and cultural development.

Vision

Have a network of roads of good quality and safe with high level of satisfaction of users, becoming a reference in southern Africa

(ANE website - translated)

Some further information is shown below on the different departments within ANE:

7.3.2 Directorate of Planning (DIPLA)

The Planning Board is responsible for:

- Planning the needs and requirements of the road network in terms of construction, rehabilitation, repair and maintenance in the short, medium and long terms defining the respective plans;
- Ensuring the strategic planning of the road network;
- Proceeding the collection and analysis of statistical data on inventories of roads, road conditions, traffic and axle weights;
- Updating the register of roads and issue regular information on the classified road network;
- Preparing annual plans and budgets in coordination with other directions;
- Organise international cooperation processes;
- Updating the registration of projects;
- Proposing new classifications of roads according to the importance and interaction in the socio economic of the country;
- Managing team of expert services to the Board, ensuring its transfer technologies, propose the plan of training of personnel management.

7.3.3 Directorate of Maintenance (DIMAN)

The maintenance department has managed the majority of the road research in Mozambique to date, and has staff experienced in all aspects of road research. Also the use of appropriate materials and road maintenance are priority issues for ANE at present, and these subjects come under DIMAN.

The Maintenance Department is responsible for:

- Ensuring the protection of investments in the road network classified;
- Ensuring the implementation of maintenance programmes;
- Ensuring maintenance of roads classified according to the standards set by ANE;
- Liaising with Provincial delegations annually;
- Ensuring compliance functions;
- Managing the team of expert services to the Board;
- Ensuring technology transfer;
- Proposing staff training programmes.

7.3.4 Directorate of Projects (DIPRO)

The Projects Directorate is responsible for:

- Developing and executing construction projects, improvement, rehabilitation and periodic maintenance of roads and bridges defined in the annual plan, develop and disseminate technical standards;
- Monitoring inspection of works of roads and bridges;
- Administering contracts works and services;
- Ensuring the implementation of road improvement programmes;
- Managing a team of expert services to the Board,
- Ensuring its technology transfer;
- Proposing the training plan for personnel management.

The projects department has carried out some small aspects of research, but has also prepared ten concept notes for possible areas of research. At present these are just concepts but DIPRO is actively promoting them to try and develop research projects. The concept notes are:

- Estimating road transitability
- Measuring VOCs
- Cement stabilised layers
- Prioritisation, bridges and accessibility
- Permeability of seals
- Marginal aggregates, where ACV is not achievable
- Resilient modulus after pre-cracking, with high cement content – is it necessary to pre-crack?
- Triaxial cell, finding true parameters
- Interim research towards a realistic design method for Mozambique

DIPRO suggested that LEM should be involved, but that ANE should lead the road research centre as it has the ability to implement the results. Also University students could be involved in some way.

7.3.5 Directorate of Administration and Finance (DIAFI)

The Directorate of Administration and Finance is responsible for:

- Developing budgets and related reports and accounts ANE;
- Providing financial management;
- Ensuring asset management;
- Managing a team of expert services to the Board, ensuring its technology transfer;
- Organising the process of human resources management;
- Developing, proposing and implementing the annual plan of training ANE;
- Developing effective mechanisms for technology transfer specialists serving the ANE, either central or provincial level;
- Ensuring the expedient and flow filing documents.

DIAFA suggested that the institutional structure of ANE is going to change soon so it may be appropriate for a Road Research Centre to become a dedicated department, specifically for research.

7.4 Third Party based

Although there was some interest from the UEM to host the road research centre, from the interviews and assessment of the situation it is unlikely that this is a practical solution. Universities do have experience in research and capable managers but they do not have the specific roads experience and resources to host a fully-fledged road research centre. They are also not involved in road construction or maintenance so they have no opportunity to implement the results of their research. They will be able to promote the results, but in terms of mainstreaming of the research results they are at a disadvantage because they do not have a budget for practical implementation. In roads research this is an essential part of the research process.

7.5 Staffing

Everyone who was interviewed was positive about the potential ability of a Road Research Centre to recruit and retain staff. 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. Maintaining a highly qualified and experienced workforce has been an issue in other countries who are attempting to establish road research centres. Apparently employment conditions within ANE are good and ANE are even able to recruit staff from the private sector due to higher job security; also subsidies are given for additional qualifications, working outside of home station, etc. Overall 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 would want to look at employing a wide range of skills and expertise in order to achieve the same goal.

There were also comments that a number of new graduates have been recruited country-wide and they should be utilised to help focus the research in the areas where it is most needed and ensure it is sustainable.

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.

7.6 Chimoio

There is a lot of interest within ANE to use Chimoio Training Centre as a centre for the road research centre. At present it is a training centre but is understood that it is not in the organogram of ANE and is autonomous, but under the MoPW. It is expected that Chimoio will be restructured soon so no staff want to move positions until this is finalised. The European Union are providing training to local contractors at Chimoio.

On the positive side, Chimoio seems to be in a good location to be an RRC in terms of being central in the country, with good access to Zimbabwe, and reasonable transport links. There is already existing accommodation and resources sufficient to host a research centre.

On the negative side there may be issues in getting staff to work there due to the distance from the capital and remoteness, despite the good transport links. An argument was also proposed during the interviews that it is located near sources of good road building materials. However, it could be more of an advantage to be closer to poor materials as these are the ones more likely to be involved in research.

The issue of using Chimoio will be discussed at the forthcoming workshop.

7.7 Institutional Structure Summary

From the interviews and subsequent discussions it is clear that any road research centre should be based within ANE. The reasons for this are:

- ANE have the most extensive experience in carrying out practical research into roads in Mozambique.
- ANE is in an ideal position to transform the research into practice, in the form of new design, specifications etc.

- ANE have the potential for gaining resources to fund research. In particular a small amount can be included in construction contracts to fund research sections.
- ANE are in a prime position to receive funds for research from the Road Fund.

The issue of the road research centre being located in ANE will be presented at the forthcoming workshop but the main question for the workshop is likely to be how and where should the RRC be located within ANE.

8 Road Research Strategy

This strategy has been developed based on the assumption that a Road Research Centre will be established in Mozambique. The need and desire for such a research centre came across very strongly in the initial meeting and interviews and it is the consultant's view that it is both possible and desirable to establish such a centre. Therefore the establishment of an RRC has been designed to be central to this strategy.

TRL has experience in supporting countries to develop their own research centres as well as experience in establishing and developing TRL itself in the UK. This experience has been drawn on to recommend a strategy for the proposed research centre in Mozambique. Establishing an indigenous research centre from scratch is both an ambitious and challenging project but it is one that could be very rewarding and beneficial to Mozambique in the long term.

A draft Strategy has been produced below but it is inevitable that this Strategy will have to be changed following the workshop on 5th February 2013. In that respect the draft Strategy below should be read as an outline of the detailed strategy that will follow.

8.1 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. It is proposed that this is discussed and initiated at the initial workshop on 5th February 2013.

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 – it was obvious from the initial investigations that 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 and 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 twice per year (once is preferable) and should be limited to seven or 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)

It is also likely that Brazil and Portugal have road research capability, either through government organisations or local universities. Clearly it would facilitate exchange of information if links could be made to such organisations in these countries due to the language and the colonial history of Mozambique. This will be investigated and determined before the workshop on 5th February.

Planning for the future – If the establishment of the RRC goes ahead it 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 – this should be done 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 just 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 gets '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 be 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. 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 sectors funding, either through the provision of testing facilities for materials or from product testing.

Capacity building and training – In order to have a high quality and respected research centre it will be necessary to build the capacity of the staff to a high level. This will be in the form of additional qualifications at MSc or PhD level and by the development 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 gained.

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. 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, etc.

Mainstreaming results – Research is not complete until it has been institutionalised. 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.

9 Programme

9.1 Steps to establish an RRC

At the present time it is not possible to make a programme for the establishment of a road research centre but the steps anticipated for this, which could be incorporated into a future project to assist with the establishment of the centre, are shown below:

- Confirm the institutional structure and location for the RRC. Determine which laboratories will be used and how. Make any legislative adjustments necessary to allow it to function as planned.
- Confirm 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. 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 with roads. 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 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 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.

9.2 Project Programme

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

10 Workshop

The forthcoming workshop planned for the 5th February 2013 is essential to the successful planning and initiation of a Road Research Centre as well as for confirming the Road Research Strategy. ANE will make invitations for the workshop and ensure that the important stakeholders are present for the whole time. An outline of the workshop is provided below:

Presentations

The workshop will include presentations on the following subjects:

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

Plenary session

It is then anticipated that a plenary session will be held to give the audience a chance to raise any questions of clarity and to discuss the issues and determine which issues should be dealt with and decided during the following breakout sessions.

Breakout sessions:

It is a tentative proposal that the workshop participants are split into two groups for the breakout session. The subjects for the breakout sessions will be determined during the plenary session but it is expected that the main issues will be similar to those below:

Group 1:

- Location of RRC (LEM, ANE, other)
- Location of RRC within ANE and how it will work
- How to involve other bodies such as LEM, UEM, etc. – MoUs?
- ANE control other labs in the country, what is the best solution/arrangement?

- How to secure funding and from where?

Group 2:

Exercise: The essential criteria for a successful RRC

11 Conclusions

From the discussions and interviews the following conclusions have been drawn. These conclusions are based on the majority of responses in each subject but should be challenged if necessary at the workshop on 5th February 2013.

- Previous road research has been carried out in Mozambique successfully. Most research is demand driven in response to problems identified by ANE and uptake rates have been good. Almost all research has been carried out by expatriates working with local counterparts and funded by international donors.
- There is a clear need for road research in Mozambique, plus a good argument for developing indigenous capacity to achieve this. Mozambique relies heavily on its road network for development and this is becoming increasingly important with the discovery of extensive valuable natural resources recently. Developing this capacity internally will also help Mozambique to carry out more sustainable research in the future.
- Getting research results is only half way, but mainstreaming them is also a significant challenge. It is essential that any future road research centre is in a position to do this.
- There is political will to make this happen and there are realistic expectations from its outcome. From the interviews and discussions it appears that there is support politically for a road research centre and some appreciation of the benefits it can bring.
- Sustainable funding is essential for any road research centre to progress. Research is, by its nature, a long process. Although some results can be produced quickly it often takes some years to fully carry out research projects and provide robust conclusions. This is also true of road research. A road is a product that is designed to last for 20 or 30 years so any meaningful research into core issues such as deterioration, whole life benefits etc. is bound to take time. This requires patience both on the side of the client as well as on the side of the researcher.
- Staffing for a potential road research centre should not be a problem. ANE is confident it will be able to recruit suitably qualified and experienced staff and retain them for a substantial length of time. The area where experience may be lacking is in research itself and in the management of a research centre.
- Scope of research projects needs to be wider. So far it 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 issues and road safety issues.
- 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.

12 Recommendations

The following recommendations have been made based on the initial meeting and interviews. They should be reviewed and adjusted at the workshop.

- Agree institutional structure and funding options – An institutional structure has been proposed above. This should be thoroughly discussed so that it is appropriate and
- Develop a draft Vision and Mission for the research centre – this should be in line with the vision and mission of ANE. At this stage it can be a draft vision and mission that can be refined during any establishment stage.
- Raise the profile of research – In order to secure the future of the RRC it will be necessary to raise the profile of research through awareness campaigns to senior government officials, and others, which will inform of the activities that the road research centre undertakes and the benefits that road research can bring to the country. In this way sustainable support and funding can be achieved. This awareness drive needs to be led by people who are enthusiastic about research and committed to it. Some 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 required 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, etc.) 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, etc. Although materials seem to be the most important at present, it is advisable to be active in all areas in order to be able to react quickly should the need 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.
- Get 'Quick Wins' – Because politicians are often in power for a short time and road research does not often bring quick results, it would be good for some of the initial research projects undertaken to be short projects that can demonstrate results within a few months and show some substantive results at that time. This will raise the profile of the RRC and generate wider interest.
- Political buy-in – This is linked to the previous two recommendations. Political support will be 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 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, CSIR or ARRB.

- Repository for road research data and knowledge – There is a need to provide a repository for road research 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 it will be necessary to determine the capacity building measures necessary. This will involve identifying the human resources, logistics, equipment, accommodation, etc. 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 will be an essential aspect of 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 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, statistical analysis, etc.
- Invest in equipment – Depending on the agreed methodology for working with LEM, it may be necessary to invest in new testing and laboratory equipment. A scoping study should be carried out to determine the possibilities for commercial testing and the potential income that could be generated for the RRC. This will determine the equipment that should be procured.
- 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
- Location of the RRC – Institutionally the ideal place for the RRC to be located is as a cross-cutting department directly under the Director General. The feasibility of this will be discussed at the forthcoming workshop but it may be necessary to position the RRC within one of the existing ANE departments until it can be established as recommended.
- 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

Interviews:

10th December 2012

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

11th December 2012

- TRL Research Team
Kenneth Mukura, TRL Researcher
- Roads Fund
Dr. Joao Mutombene, Financial Manager, Road Fund
Carlos Fortes, Civil Engineer, Road Fund

12th December 2012

- LEM
Henrique Vasco Filimore, Director General, LEM
Sr. Altamira, Ex. Director General, LEM
Carlos Combane, Engineer, LEM
- ISUTC
Dr. Fernando Leite, Rector, ISUTC

13th December 2012

- Eduardo Mondlano University
Saturnino Chembeze, Director UEM
- DIPRO
Ishmael Sulemane, Director of Projects, DIPRO
Aderito Gilamba, Assistant Director, DIPRO

14th December 2012

- DIAFA
Aurora Mussa, Director Administration and Finance, DIAFA
Virgilio Luchucha, Training Officer, DIAFA
- DIMAN
Luis Fernandes, Head of Maintenance, DIMAN
- DIMAN
Miguel Coanai, Director of Maintenance, DIMAN

Appendix B

Work Programme