

---

# Technical Assistance to PMO-RALG to Develop Road Research Capacity in Dodoma/

## Final Report

**Mike Head (Cardno IT Transport), Tony Greening (TRL) and Dr John Rolt (TRL)**

May 2014

CONTRACT REF NO. AFCAP/TAN/130



Prepared by:



**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>

#### **Report summary**

AFCAP is providing TA assistance to the Infrastructure Development Unit in PMO-RALG of the Government of Tanzania, to achieve its objective of setting up a District Road Research Centre (DRRC) in Dodoma and to develop a strategic plan for implementation of its research priorities in accordance with the National Transport Policy (Draft Final, 2012). Subsequent to extensive consultations with all relevant stakeholders, this Report is the main deliverable of the project setting out the Research Policy Framework, Strategic Research Plan and an implementation framework.

## Table of Contents

	Page
<b>Executive Summary</b>	<b>8</b>
<b>1. Introduction</b>	<b>13</b>
1.1 Background	13
1.2 Building local research capacity	13
1.3 Project Terms of Reference	13
1.4 Scope, key tasks and research activities	14
1.5 Establishment of the DRRC	14
1.6 Purpose of Report	14
<b>2. National policy framework</b>	<b>14</b>
<b>3. Local Government Transport Programme</b>	<b>18</b>
3.1 LGTP 2 outputs	18
3.2 National LV road upgrade targets	19
3.3 Maintenance targets	20
3.4 Quality control	20
3.5 LGTP budgets	20
<b>4. Institutional setting</b>	<b>21</b>
4.1 PMO-RALG	21
4.2 Other Stakeholders	25
4.3 Funders	25
<b>5. Current position</b>	<b>27</b>
5.1 Main constraints facing the road sector	27
5.2 How road research is currently undertaken, which subject areas, which institutions are involved and the funding sources	28
5.3 Current projects/programmes	30
5.4 Relevant existing literature	31
5.5 The case for research	33
5.6 International Perspective	34
5.7 Success factors for establishment of a DRRC	34
5.8 Typical Activities and Costs	35
5.9 The benefits of research	36
<b>6. DRRC policy framework to guide future road research activities</b>	<b>37</b>
6.1 Needs assessment and priorities for research	38
6.2 Key issues to be addressed	39
6.3 Research Policy framework	39
6.4 Mandate and functions of DRRC	40
<b>7. Draft Strategic Plan for the identification and implementation of priority research activities</b>	<b>41</b>
7.1 The nature of research and the selection of suitable projects.	42

---

7.2	Long term strategy	43
7.3	Priorities	43
7.4	Strategic research programme	43
7.5	Knowledge, education and dissemination	47
<b>8.</b>	<b>Establishment of the Road Research Centre</b>	<b>48</b>
8.1	Overview	48
8.2	Short term	49
8.3	Medium term activities	55
8.4	Long term plans	59
	<b>Appendices/</b>	<b>60</b>
	<b>Appendix 1: Bibliography</b>	<b>60</b>
	<b>Appendix 2: List of Consultees</b>	<b>61</b>
	<b>Appendix 3: Examples of Road and Transport Research Centres</b>	<b>69</b>
	<b>Appendix 4: Final Workshop Report</b>	<b>71</b>

It should be noted that the BSI Symbol and UKAS Accreditation mark signify that Crown Agents operate a documented Quality Management System registered with the British Standards Institution to the international quality standard BS EN ISO 9001:2008. The provision of consultancy services in revenue enhancement and expenditure and debt management including: customs, taxation and trade, human institutional and organisational development, engineering, procurement management advice and reform, health logistics and procurement services. The management of third party quality assurance and inspection services related to the supply of manufactured and processed products. International freight forwarding services utilising in house sub-contract warehousing. Verification of service as follows: Air Import – Clearance UK airport; Exports – Airport of departure; Sea Imports – Clearance UK port; Sea Exports – Port of loading.



FS3324

## List of Abbreviations/

ACET	Association of Consulting Engineers of Tanzania
ADRICS	Annual District Roads Inventory and Condition Survey
ADT	Average Daily Traffic
AFCAP	Africa Community Access Programme
ATTI	Appropriate Technology Training Institute
bn	billion
CE	Council Engineer
CRB	Contractors Registration Board
D-by-D	Decentralisation by Devolution
DC	District Council
DE	District Engineer
DP	Development Partner
DRDP	District Roads Development Programme
DROMAS	District Roads Management System
DUF	District, Urban and Feeder
EIA	Environmental Impact Assessment
ERB	Engineers' Registration Board
FY	Financial Year
GOT	Government of Tanzania
HDM	Highway Development and Management System
IDU	Infrastructure Development Unit
JICA	Japanese International Cooperation Agency
JISR	Joint Infrastructure Sector Review
JTC	Joint Technical Committee
LBM	Labour-based methods
LGA	Local Government Authority
LGRICS	Local Government Road Inventory and Condition Survey
LGTP	Local Government Transport Programme
LVR	Low Volume Roads
LRDF	Local Road Development Fund
MDG	Millennium Development Goals
MLYDS	Ministry of Labour, Youth Development and Sports
MOF	Ministry of Finance
MOT	Ministry of Transport
MOH	Ministry of Health
MOW	Ministry of Works
Mkukuta	"Mkakati wa Kukuza Uchumi na Kupunguza Umaskini Tanzania": the National Strategy for Growth and Reduction of Poverty (NSGRP)
MTEF	Medium Term Expenditure Framework
NCC	National Construction Council
NEMC	National Environmental Management Council
NGO	Non-Government Organisation
NMT	Non-Motorised Transport
NRTP	National Rural Transport Programme
NSGRP	National Strategy for Growth and Reduction of Poverty (Mkukuta)
NTP	National Transport Policy
PMO-RALG	Prime Minister's Office -Regional Administration and Local Government
PMU	Procurement Management Unit

---

PPRA	Public Procurement Regulatory Authority
PS	Permanent Secretary
RAS	Regional Administrative Secretary
RF	Road Fund
RFB	Road Fund Board
RRC	Road Research Centre
RS	Regional Secretariat
RTD	Roads and Transport Division
SSATP	Sub-Saharan Africa Transport Programme
SUMATRA	Surface and Marine Transport Regulatory Authority
TACA	Tanzania Contractor Association
TACECA	Tanzania Civil Engineering Contractors Association
TANROADS	Tanzania National Roads Agency
TAROTA	Tanzania Truck Operators Association
TASAF	Tanzania Social Action Fund
TATOA	Tanzania Tanker Operators Association
TIU	Transport Infrastructure Unit
TSH	Tanzanian Shilling
TSIP	Transport Sector Investment Programme

## Abstract/

AFCAP is providing support to the District Road Research Centre (DRRC) Project in Tanzania and has received a request to purchase various laboratory and testing equipment from the Prime Minister's Office Regional Administration and Local Government (PMO-RALG) Infrastructure Development Unit (IDU), Tanzania. This project is to assist PMO-RALG to achieve its objective of setting up a DRRC in Dodoma and to develop a strategic plan for implementation of its research priorities in accordance with the Draft National Transport Policy (2012).

This assignment:

- Conducts a needs assessment study, based on the mandate of PMO-RALG in general, and the IDU in particular, for the establishment of road research capacity in Tanzania. The study is carried out in-country and in consultation with the Road Fund Board, the Director of IDU and her team and with other stakeholders.
- Prepares a policy framework to guide future road research activities.
- Prepares a strategic plan for the identification and implementation of priority research activities under the ambit of PMO-RALG in the short, medium and long term.
- Sets out the next steps.

PMO-RALG requires the DRRC to specifically cover District, Urban and Feeder roads as per its mandate. It also supports the DRRC's wider contribution to all Tanzania roads and encourages its participation in the development of a national Transport Research Centre.

## Executive Summary

AFCAP is providing support for the establishment of a District Road Research Centre (DRRC) and laboratory in Dodoma. The overall objective is to assist the Prime Ministers' Office Regional Administration and Local Government (PMO-RALG) to achieve its objective of setting up a DRRC and to develop a strategic plan for implementation of its research priorities in accordance with the Draft National Transport Policy (NTP, 2012).

Following a needs assessment and the preparation of a policy framework to guide future road transport research activities, the assignment covers the following objectives:

- |    |  |
|----|--|
| a) | The case for road research                                   |
| b) | The case for urban roads research                            |
| c) | The funding of research                                      |
| d) | An appropriate institutional structure to undertake research |
| e) | Development of a Road Research Strategy                      |

It is expected that this Phase 1 (Development of a Road Research Strategic Plan) will be followed by Phase 2 (Establishment of the DRRC). **Over time, it is planned that its activities will broaden to collaborate in research in all roads and eventually to participate in the implementation of a National Transport Research Centre.**

**The Case for a National Transport Research Centre** is based on international evidence. Research and Development has underpinned all major technology innovations and continues to help translate ideas into practical solutions. It will continue to assist in generating income, better returns on investments, cost savings and a reduction of risks for travellers. Most major international research centres were established initially to help facilitate national infrastructure construction, maintenance and operational programmes. In Africa, National Governments have tended to use adaptations of international developments and Standards and used international organisations to assist in discreet projects or Technical Assistance programmes. Building permanent national capacity will enable technology development and innovation in a sustainable manner.

**Typical Activities and Costs depend on national priorities.** Primary research activities are usually Standards and specifications, testing, data analysis and modelling, technology development and quality control and management, monitoring and evaluation and training. The cost of research and the timeframe for returns-on-investment varies with the type of activity. From a perspective of the 'adaptation' of current knowledge, costs are relatively low and therefore are a high priority for the DRRC.

**Benefits** normally expected from research outputs should have far reaching outcomes for the national economy and contribute both to GDP and competitiveness. Objectives for improvements normally cover road construction, upgrading, low volume road seals, maintenance benefits, time savings, accident-related savings and have both social and environmental benefits.

**Consultation with Stakeholders**, including all major Government Ministries, Agencies, Commissions, Authorities and Institutions, provided the following views and recommendations on research needs, funding and institutional frameworks. The main findings were:

- Unanimous support for establishing a DRRC
- Tanzania would benefit from the implementation of a coordinated and prioritised road research programme aimed at achieving 'more for less' in terms of construction and maintenance
- In the short term, a research programme should preferably be aimed at the implementation of existing knowledge and experience

- There is an acute need for appropriate and well maintained data - to be used for analysis and research
- Capacity building and training in research is a priority. Furthermore, there is a lack of research capacity within the existing institutions
- Appropriate level of funding is seen as a constraint. Sustainable funding is essential.

Despite the moderate progress made since 2003 when the National Transport Plan came into force, the transport sector is still characterized by the following **constraints**:

- High costs, both for infrastructure and operations
- Low quality services with high backlog of infrastructure maintenance and rehabilitation requirements
- Insufficient investment
- Low level of enforcement of safety, laws, regulations and procedures
- Low capacity for monitoring, and evaluation
- High traffic congestion in major cities, especially Dar es Salaam;
- High post-harvest losses in many remote parts the country ( an average of 35% of total production) due in large part to unreliable and or inadequate transport services and facilities;
- Difficulties in exporting products such as cement to neighbouring countries due to poor infrastructure;
- High passenger and freight costs due to inadequate competition and poor roads

Key issues to be addressed from a review of previous studies and from results of meetings held in connection with the current project, the following issues and priorities have been identified that will need to be addressed:

- Necessity for **long term** financial and technical support to build permanent research capacity
- Improved **coordination** of DP's funding both for underpinning of the DRRC and for specific projects
- Economic benefits of **outcomes of research to be closely linked to improvements in national GDP** and to potential for reduced costs of construction and maintenance (more for less)
- Need for **improved data** on the road network and its performance, including traffic
- Establishment and management of **more effective road mapping, road condition and asset database**, including structures
- Understanding of links with DROMAS and integration with future development of the software package
- Establishment of **national road material/aggregate inventory and database** for use in construction and maintenance
- More accessible field and laboratory testing, monitoring and quality control
- More **economic** design, upgrading and rehabilitation of roads using whole life cost approaches
- Use of low cost seals, including design, life cycle costs and economics
- Need for improved design manuals, incorporating latest developments in LVR technology, and related training
- Better understanding of causes of road and structural failure and remediation
- **Improved performance of contractors** for both labour-based and equipment based road works, including capacity building
- **Improved management** of maintenance backlog, programming and prioritisation
- **Climate change** effects mitigation to create better network resilience.
- **Training needs and capacity building** on research, laboratory and field testing
- **Urban roads capacity improvement**

**Research Policy framework objectives are:**

- Reducing costs of both construction and maintenance by 30%
- Methods of reducing maintenance backlogs by 33% to address current shortfalls in funds
- Reduce transport costs by improving journey time for rural and urban environments
- More effective investment strategy based on cost-benefit analysis and whole life costing
- Develop more robust delivery strategies based on the application of the Environmentally-Optimised Design (EOD) concept - including use of locally-available resources and materials, contractors, appropriate design and maintenance methodologies.
- Use evidence-based research to develop continual improvement in outputs and outcomes
- Knowledge management and information dissemination
- Building permanent capacity.

**Mandate and functions of DRRC should principally be:**

**Testing and research on roads and construction materials, road pavement design and construction specifications, construction quality control and assurance, and post construction evaluation of roads and other infrastructure.**

**Long term strategy to achieve government policies and programmes are:**

- **To reduce transport costs and travel time** by improving the condition, planning and management of DUR roads;
- **To optimize use of available resources** in the development, rehabilitation and maintenance of roads
- **To enhance capacity** for local contractors
- **To find new ways to construct and maintain roads** at significantly reduced rates
- **To maximise effective use of existing natural material resources**
- **To build research capacity** and speed up implementation of research outputs.

**Short term actions for the establishment of a DRRC covering both urban and rural roads include:**

- A budget allocation for the DRRC
- Commissioning of Regional Laboratories
- An organisational structure
- Identification of priority projects
- Definition of activities in short and longer term
- Project funding, including short and long term TA
- Six month Business Plan

**Short term priority projects identified:**

- Review of outcomes of AFCAP-supported surfacing demonstrations and trials in Bagamoyo and Siha Districts
- Scoping studies for 5 strategic research programmes covering:
  - Road trials, demonstrations and monitoring
  - Road asset inventory, condition and data
  - National road material and aggregates database and inventory
  - Climate resilience
  - Urban congestion

- Initiate cost/benefit studies (e.g. LCA of gravelling verses LV Seals)
- Embedment of new AFCAP LV roads design manuals
- Develop data management systems for research projects being undertaken throughout the country
- Initiate International Best Practice programme on demonstrations/trials, standards, specifications, manuals
- Establish a knowledge management facility for cataloguing, storage and dissemination of knowledge

**Medium term activities relevant to the strategic plan comprise:**

- Improved technologies and methodologies for investigation, surveys, testing, modeling, monitoring and evaluating performance of roads
- Improved pavement designs for road upgrading, reconstruction, rehabilitation and strengthening works by roads authorities for prolonged life
- Construction and maintenance quality control systems including post construction evaluation
- Maintenance of pavement construction and maintenance data base
- Research on more economic road development, maintenance, and operations including research on new construction materials, construction methods and road safety studies
- Development and review of materials testing standards, road design manuals and standard specifications for construction and maintenance of roads in conjunction with stakeholders
- Database development and research management covering national materials inventory, properties of soils and rocks, roads condition and traffic flows
- Identify and implement urban interventions to reduce traffic congestion
- Training and capacity building in research and innovation
- Publication and dissemination of research findings.

**Medium term research programmes proposed include:**

- Road trials, demonstrations and monitoring
- Road asset inventory, condition and data
- National road material and aggregates database and inventory
- Climate resilience
- Urban congestion

**Long term plans**, looking forward say 10 years, are to establish a fully functioning DRRC with its own buildings and facilities and a staff compliment in Dodoma of about 30, covering research and laboratories. The actual size and range of activities will be partly a function of the national targets and policies and also of the scale of available funding from the RFB and from Development Partners. The DRRC will have a number of Regional Laboratories spread across Tanzania for quality control and support activities.

It is anticipated that the DRRC will collaborate with other national organisations and also with international institutions. These plans will be set out and detailed during Phase 2, Implementation, and will cover how the DRRC will evolve with time and its role relating to wider 'roads and transport'.

**The funding for the DRRC and its activities** will be by a combination of PMO-RALG, RFB and Development Partners. DFID will establish a new Rural Roads and Transport Services Research Programme. The programme is valued at £17m, will be for 6 years and is for the second phase of the Africa Community Access Project (AFCAP2). It will operate in up to 12 African countries (including Tanzania). It is hoped that AFCAP 2 will fund both the underpinning of the DRRC and will also provide funds for research and development projects. Through the Wealth Creation Fund, DFID has set aside £25m for both rural road access interventions (£22.2m) and for TA support (£2.8m). The Fund will be disbursed to PMO-RALG through the RFB and it is expected that a portion of the monies will be available for DRRC related activities. DFID has also established an International Climate Fund and will consider funding any applications made by PMO-RALG for research projects relating to climate change and

---

infrastructure resilience. USAID is proposing to set aside \$20m for use by the RFB for distribution to specific PMO-RALG activities and has expressed its interest in supporting the DRRC.

The World Bank, EU and JICA have indicated their willingness to support DRRC activities and it is expected others will follow.

**It is recommended that future policy and targets for upgrading and maintenance of District, Urban and Feeder Roads be modified to encourage substantial increases, otherwise economic development will be impeded. A more appropriate target for upgrading would be at least 400km per year at an estimated cost of \$25m annually. For comparison purposes, the Government of Kenya has recently set a target for upgrading of 8,000km of LVR to sealed standards in 5 years.**

Funds should be sought to provide long term TA support to both the Director of IDU and also the Head of Research to assist with the challenges of increased administration and also with funding and implementing DP programmes and RF activities.

## 1. Introduction

### 1.1 Background

Reliable access is essential for rural communities in Africa. Access is required to reach basic services and all kinds of economic and social opportunities. Unreliable and difficult access reduces growth opportunities and negates the benefits from investments in other sectors designed to improve the livelihoods of poor communities.

The Africa Community Access Programme (AFCAP) is a research programme funded by the UK Government's Department for International Development (DFID). AFCAP is promoting safe and sustainable rural access in Africa. AFCAP supports knowledge sharing between participating countries in order to enhance the uptake of low cost, proven solutions for rural access that maximise the use of local resources.

### 1.2 Building local research capacity

Building local research capacity in African countries is a long term objective of AFCAP. Regional research projects funded by DFID and other donors in the 1980s and 1990s produced important outputs, but they relied heavily on foreign expertise. There was limited transfer of capacity to local partners. AFCAP has created an awareness of the value of research in the participating countries and has provided some of the tools needed by governments to establish their own research programmes. Funding for research is now available from government budgets and from road user charges collected by road funds; but the establishment of research institutions with suitably qualified and experienced staff remains a considerable challenge.

**This project follows on from a report on 'The Case for Transport Research in Tanzania, its Funding and Institutional Location (2012)', DFID Transport Policy Support Programme, Ministry of Transport (MoT).** Although not yet implemented, the findings and recommendations are still supported by the key stakeholders and have been used to inform the needs assessment. This study specifically focusses on research for rural and urban Low Volume Road (LVR) access, a key part of the wider transport spectrum, but recognises that outputs are valuable for all categories of roads.

**PMO-RALG requires the DRRC to specifically cover District, Urban and Feeder roads as per its mandate. It also supports the DRRC's wider contribution to all Tanzania roads and encourages its participation in the development of a National Transport Research Centre.**

### 1.3 Project Terms of Reference

AFCAP has agreed to provide support to this District Road Research Centre (DRRC) Project and to the establishment of a laboratory in Dodoma. It has also agreed to a request to purchase various laboratory and testing equipment, from the Prime Minister Office Regional Administration and Local Government (PMO-RALG). The list of equipment has been put together based on the recommendations of the Tanzania National Roads Agency - Central Materials Laboratory (TANROADS-CML) in Dar es Salaam. This laboratory is intended to serve as a pilot for setting up PMO-RALG regional laboratories, servicing Districts that currently rely on Ministry of Works (MOW) TANROADS Regional Laboratories for quality control testing on projects, as well as the first step towards establishing roads research capacity in Dodoma.

#### 1.3.1 Objective

The overall objective of this assignment is to assist the Infrastructure Development Unit (IDU) in PMO-RALG to achieve its objective of setting up a DRRC in Dodoma and to develop a strategic plan for implementation of its research priorities in accordance with the Draft National Transport Policy (NTP, 2012).

This assignment seeks to:

- Conduct a needs assessment study, based on the mandate of PMO-RALG in general, and the IDU in particular, for the establishment of road research capacity in Tanzania. The study is carried out in-

country and in consultation with the Road Fund Board, the Director of IDU and her team, and with other stakeholders.

- Prepare a policy framework to guide future road transport research activities.
- Prepare a strategic plan for the identification and implementation of priority research activities under the ambit of PMO-RALG in the short, medium and long term.

## 1.4 Scope, key tasks and research activities

### 1.4.1 Description of services

To achieve the objective of the assignment, a four-fold approach is required covering:

- |    |  |
|----|--|
| a) | The case for road research                                   |
| b) | The case for urban roads research                            |
| c) | The funding of research                                      |
| d) | An appropriate institutional structure to undertake research |
| e) | Development of a Road Research Strategy                      |

It is expected that Phase 1 (Development of a Road Research Strategic Plan – object of current ToR) will be followed by Phase 2 (Establishment of the DRRC).

## 1.5 Establishment of the DRRC

At the Inception Workshop held on 16<sup>th</sup> January at PMO-RALG offices the Ag Permanent Secretary Dr D. Mtasiwa, PMO-RALG, decided to accelerate the implementation proposals and instructed that the DRRC be established immediately. Dr Mtasiwa has recommended the close involvement of all regions and councils, as well as cooperation with relevant stakeholders, and recognised the key importance of relevant data analysis, knowledge and innovation - aimed at delivering improved transport access and associated national economic benefits.

At the Final Workshop held at the Protea Courtyard Hotel, Dar es Salaam on 13<sup>th</sup> May, all Stakeholders approved the Strategic Plan and the Final Report subject to the agreements documented in the Workshop Summary in Appendix 2.

## 1.6 Purpose of Report

This Final Report addresses all aspects of the ToR for the establishment of a DRRC and associated research strategy. It sets out relevant Government Policy, plans, programmes and targets to inform the identification, funding and implementation of research programmes. The Report is based on relevant published documents and on discussions with over 50 consultees and stakeholders (see Appendix 2). It includes the Policy Framework and the detailed Strategic Plan. It also contains details of recommended research programmes, priority implementation activities and a short term Action Plan.

## 2. National policy framework

Tanzania aspires to become a medium developed country by 2025. The Tanzania Development Vision 2025 accords high priority to infrastructure development because of its importance to social and economic development.

**The Government considers that no sustainable and meaningful socio-economic development can take place in rural areas while the condition of the roads is poor.**

The overarching goal of Tanzania's immediate development agenda is the reduction of poverty. The strategy to achieve this is described in Tanzania's National Strategy for Growth and Reduction of Poverty II (NSGRP II, July 2010), more commonly known as Mkukuta II. The Mkukuta II strategy reaffirms that infrastructure development

is at the centre stage of the economic development process. **Mkukuta puts the improvement of rural roads first in the order of priority for transport infrastructure.** Priority areas are:

- Primary infrastructure in rural areas (feeder, collector, community roads);
- Labour-based methods in rural roads construction and maintenance;
- Transit traffic facilitation (port and maritime);
- Trunk and regional roads;
- Rail and air transport and sea ports;
- Urban transport.

The Ministry of Transport (MOT) has prepared a Draft National Transport Policy (NTP, 2012). Its Vision and Mission are:

### **National Transport Policy**

#### **The Vision:**

“To have an efficient and cost-effective domestic and international transport services to all segments of the population and sectors of the national economy, with maximum safety and minimum environmental degradation.”

#### **The Mission:**

“To develop safe, reliable, effective, efficient and fully integrated transport infrastructure and operations which will best meet the needs of travel and transport at improving levels of service at lower costs in a manner, which supports government strategies for socio-economic development, whilst being economically sustainable”.

Despite the moderate progress made since 2003 when the NTP came into force, the transport sector is still characterized by the following **constraints**:

- High costs, both for infrastructure and operations;
- Low quality services with high backlog of infrastructure maintenance and rehabilitation requirements;
- Outdated institutional arrangements, laws, regulations and procedures;
- Insufficient investment;
- Low level of enforcement of safety, laws, regulations and procedures; and
- Low capacity for monitoring, and evaluation.

#### **2.1.1 Transport demand**

The population of Tanzania has been growing at an estimated rate of 2.8% for the last two decades and the total is now estimated to be more than 45 million; while in the next decade, over 30 % of the total population will be living in the urban areas. Projections show that by 2030 Dar es Salaam alone will have nearly 6 million people. The strong growth in the economy has been reflected in a strong and growing transport demand, demonstrated by the following **constraints**:

- High traffic congestion in major cities, especially Dar es Salaam;
- High post-harvest losses in many remote parts of the country ( an average of 35% of total production) due in large part to unreliable and or inadequate transport services and facilities;
- Impeded development of tourism, due to inadequate transport services in all transport modes;
- Difficulties in exporting products such as cement to neighbouring countries due to poor infrastructure;
- A rapidly growing construction industry, which exerts pressure on demand for transport services for the production and delivery of construction materials; and
- High passenger and freight costs due to inadequate competition and poor roads.

In the coming decade economic growth is projected to grow at an average rate of around 8% which implies that investment in transport infrastructure and services will have to increase swiftly to enable transport to cope with increased production.

### 2.1.2 Transport policy

The policy for rural transport states how improvements will be addressed through:

- Improving rural transport infrastructure
- Improving rural mobility
- Building of capacity at the district level to manage rural infrastructure
- Employment creation and the adoption of labour-based work.

The policy for urban transport states how improvements to urban transport will be addressed through:

- Improving and managing the urban road network
- Establishment of a rapid transit system in large cities such as Dar es salaam
- Improvement of traffic management and parking control
- Improvement of institutional arrangements and funding of urban transport.

### 2.1.3 Road Infrastructure

Roads provide local, regional, national and international connectivity. During the last 20 years national road infrastructure has taken the lion's share of the transport sector's investment resources. Although large programmes were undertaken during the 1960s and 1970s, the network deteriorated quickly in the subsequent years due a lack of maintenance. A new approach was later adopted in the 1990's giving first priority to **maintenance** (routine and periodic) of the infrastructure, and secondly to **rehabilitation**. More recently, significant investment has also been put into upgrading roads to a higher class in order to meet traffic demand.

The rehabilitation process started with the formulation of the 10 year multi-million Dollar Integrated Road Project (IRP) funded by a group of donors under the leadership of the World Bank. The implementation of the IRP, which started in 1990, put in place a maintenance programme supported by the Road Fund.

The following categories or classification are distinguished:

**Trunk Roads:** Constitute the principal network providing international connections and joining regional centres. Most of such roads are under the administrative control of the government through the Ministry of Works (MOW).

**Regional Roads:** These roads provide for transport along routes within the regions and connect districts within the region, while some of them forming part of the trunk roads and cross to the next regional centres. These are also under the care of the Central Government through MOW.

**District Roads:** Such roads ply within a district connecting villages and townships and subsequently with the regional headquarters. These are under the jurisdiction of the District councils, and the therefore, the Prime Ministers' office (PMO).

**Urban Roads:** These roads transverse within busy urban centres and connect various locations of the town or municipal or city wards. They are under the preserve of the respective town, municipal or city councils, and hence, the PMO.

**Feeder Roads:** These are minor roads most of which are unclassified. They are collector roads or even important tracks into the district roads. They connect one ward and another or sub-ward into the district or even one a trunk road. The main overseer is the village government or times the District Council.

It is recognised that much of this document and its recommendations are also relevant to Regional and even Trunk Roads and so it is intended to cover all roads, not just LVR.



**PMO-RALG Road Network (LGTP 2)**

In 2011, the total road network was 86,472 km, of which only 6,876 km (8%) is paved. The Trunk Road network was 12,786 km of which 43% was paved. The Regional Road network was 21,105 km of which only 4% was paved.

**The District, Urban, and Feeder Road network was 52,581 km of which only 1% was paved. This is considered insufficient to support the level of all-weather access needed for full economic development.**

TANROADS manages Trunk and Regional Roads (33,891 km); while PMO-RALG manages the remaining part of the network. The Road Fund (which is managed by the Road Fund Board (RFB)) provides most maintenance financing for the road network.

In June 2010, the percentage of roads in good to fair condition for various categories was 98% for Trunk paved, 99% for Regional paved, 91% Trunk unpaved, 87% for Regional unpaved, and 56% for Local roads. Although maintenance funding increased substantially through the Road Fund, expenditure (particularly for periodic maintenance) is still below actual needs.

Unless directly addressed, the socio-economic consequences of insufficient maintenance funds will be severe. These will include a growing of backlog of maintenance, declining road asset value, increased vehicle operating costs resulting in higher travel fares and freight tariffs, and a reduction of transport corridor competitiveness.

#### 2.1.4 Investment programme

The Government adopted a ten year (FY2007/8 to 2016/17) Transport Sector Investment Program (TSIP) implemented in two consecutive five year plans. **Phase 2 sets out transport sector strategic goals but fails to set any measurable annual targets for improved rural and urban access:**

- All the trunk roads are paved by 2018;
- All regional centres are linked with paved roads, and all district headquarters with all-weather roads of at least gravel standard by 2018;
- Urban mobility and accessibility as well as rural transport and travel are improved;
- Transport safety & security are enhanced; and
- Private sector participation in infrastructure investment is enhanced.

#### 2.1.5 National Environmental Policy (1997)

The Environmental Policy calls for the need to undertake climate change studies with a view to identify mitigation options. The policy also lays emphasis on the need to develop ways for encouraging a holistic multi-sectoral approach to environmental management by integrating environmental concerns in sectoral policies, strategies and decisions. It creates the context for cross-sectoral planning and coordination.

### 3. Local Government Transport Programme

PMO-RALG has developed the Local Government Transport Programme (LGTP) which forms the framework for all transport projects within the local government system. It constitutes a comprehensive sector-wide approach and is part of the overall transport investment framework, which addresses rural and urban transport infrastructure and services. The first phase of the LGTP was implemented from July 2007 to June 2012 having a budget of USD 430 million over 5 years. The second phase of LGTP started in 2012 and is due to end in 2017.

The main long-term goal of LGTP 2 is **to bring all roads under the responsibility of local government authorities up to a standard that permits traffic to pass throughout the year.** This means carrying out works on roads in poor condition to improve passability. Infrastructure connecting areas of high economic potential or social importance are planned to be steadily upgraded to permit smoother and faster travel and all-weather access.

#### 3.1 LGTP 2 outputs

The main objective for LGTP 2 is **accessibility on the LG road network significantly improved on a sustainable basis.**

Six main outputs have been identified as necessary for the achievement of this immediate objective:

1. Bottlenecks removed to make roads passable
2. Economically important roads rehabilitated or upgraded
3. Community roads improved
4. Comprehensive system of maintenance established
5. Institution strengthened; and
6. Capacity increased.

Associated targets for Phase 2 are:

- Bottleneck improvements carried out on 9,000km of roads currently in poor condition
- At least 5,000km of economically important roads improved or upgraded
- At least 500km of community roads improved or maintained

The research programme devised for the DRRC addresses these required outputs.

### 3.2 National LV road upgrade targets

The lengths of National and LGA Classified roads are given in the following table which shows the total length of LGA roads as 58,037 km. However, there is general agreement that the actual length of the LGA road network is much greater than that given in the table and a figure of over 100,000 km is anticipated.

**Further work on verification and reclassification is urgently needed.**

Type	Lengths(Km)	%
District Roads	29,340	31.9
Feeder Roads	22,703	24.7
Urban Roads	5,994	6.5
<b>Total Classified LGA roads</b>	<b>58,037*</b>	<b>63.1</b>
<b>Total Classified National roads</b>	<b>33,891</b>	<b>36.9</b>
<b>Total Classified Roads</b>	<b>91,928</b>	<b>100.0</b>

Source: Local Government Transport Programme (LGTP) Phase 2 (2012/13 -2016/17)

\*Includes 5,800km of currently Unclassified Community Roads

Most roads falling under the responsibility of PMO-RALG are unsealed earth or gravel. Sealed roads in this network are for the most part restricted to towns. Very few are sealed and the current target for sealing under LGTP2 is 663 km by the year 2016/17 as shown below.

	JISR	LGTP 2					Total LGTP 2
	11/12	12/13	13/14	14/15	15/16	16/17	
<b>A: ROADWORKS ACTIVITY DURING YEAR (KM)</b>							
Upgrade - earth to gravel	187	85	641	1,258	1,679	1,980	<b>5,643</b>
Upgrade - gravel to bitumen	56	45	71	140	187	220	<b>663</b>
<b>Upgrade - total</b>	<b>243</b>	<b>130</b>	<b>712</b>	<b>1,398</b>	<b>1,866</b>	<b>2,200</b>	<b>6,306</b>

Source: Local Government Transport Programme (LGTP) Phase 2 (2012/13 -2016/17)

**The target for upgrading gravel roads to a bituminous standard given in the table is extremely low and will not contribute substantially to Tanzania’s target for economic development.** Furthermore, the current annual target for upgrading for subsequent years up to 2025/26 remains at the 2016/17 level of 220 km. These targets should be revisited by PMO-RALG to determine how they can be increased. The targets for upgrading to an all-weather gravel surface are equally low. If it is assumed that a gravel road will require re-gravelling about every 7 years, the re-gravelling target for the currently classified LGA roads is about 8000 km per year. If there are another 40,000 km unclassified rural roads that need to be of all-weather standard, the true need for re-gravelling each year is very much higher than the current target of 1258 km (earth to gravel) and the increased target of about 2000 km for 2016/2017.

The classification of the roads based on function (i.e. feeder, district, urban, unclassified) rather than task (i.e. traffic level including non-motorised, motor cycles and bicycles) is useful but misleading when calculating some measure of the economic benefits of the investments. Such calculations will be required to set priorities for which roads to include hence an assessment of traffic is important.

**Essentially LGTP 2 plans two actions (i) the upgrading of selected roads from poor to fair condition through the removal of bottlenecks; and (ii) the improvement of selected roads from fair to good condition through appropriate upgrading. Appropriate ranking and selection procedures need to be defined for the two cases.**

### 3.3 Maintenance targets

One recent worrying trend has been the gradually decreasing value of the Road Fund in real terms due to increasing prices such that only 66% of the maintenance needs of the road network are being met.

The estimates in Annex 2 of LGTP 2 show the budget required based on the network increasing in length from around 58,000 km in 2012 to over 65,000 by 2025/26. However, if the budgets are not realised, the expansion of the network will have to be postponed or curtailed. In addition, this does not take into account the likely more realistic network length of around 100,000 km. **The research programme for the DRRC addresses the need to reduce whole life costs of maintenance substantially.**

### 3.4 Quality control

Improved quality control of works is a priority for implementation under LGTP 2. Monitoring by PMO-RALG Engineers and the Road Fund Board identified the low standard of some of the improvement and maintenance work carried out under LGTP 1 as a major problem. This has a number of contributory factors including poor design, low capacity of local contractors, inadequate supervision and lack of quality control procedures. Therefore, LGTP 2 introduces a system of quality control that effectively enforces standards whilst being appropriate to the local roads environment and the Council Engineers’ capacity.

### 3.5 LGTP budgets

The following table sets out budget requirements for key activities:

**Overall LGTP 2 Budget Requirements (USD million)**

Activity	2012/13	2013/14	2014/15	2015/16	2016/17	Total
Maintenance	65.6	89.9	113.4	128.7	148.0	<b>545.6</b>
Development	8.0	53.8	88.6	115.0	142.9	<b>408.2</b>
M&E, Consultants, Studies	5.2	7.5	9.7	10.1	10.6	<b>43.1</b>
<b>Total LGTP budget</b>	<b>78.7</b>	<b>151.2</b>	<b>211.7</b>	<b>253.8</b>	<b>301.5</b>	<b>996.9</b>

Based on the overall LGTP 2 Budget, routine maintenance will be carried out over five years on about 30,000 km of local roads. In addition, there will be the periodic maintenance of over 21,000 km; the bottleneck removal on over 90,000 km; the rehabilitation of over 3,000 km; and the upgrading of over 6,000 km of LGA roads.

## 4. Institutional setting

### 4.1 PMO-RALG

The Prime Minister's Office Regional Administration and Local Government (PMO-RALG) is led by Minister Hon G Mkuchika (MP), two Deputy Ministers, a PS and 2 DPS. In order to move towards the realisation of the vision within the short, medium and long term; PMO-RALG, in collaboration stakeholders will:-

- Champion decentralization by devolution and create a capable Regional Administration and autonomous Local Government Authorities.
- Promote Urban and Rural development Policies.
- Improve systems and deliver equitable quality services effectively and efficiently, and equitably in order to eradicate poverty.

Administratively, Tanzania Mainland is divided into 25 regions, 133 districts and 168 Local Government Authorities (LGAs). Urban Authorities (UAs) include the 5 Cities of Dar es Salaam, Mwanza, Mbeya, Arusha and Tanga; as well as 19 Municipalities and 9 Town Councils. The District Councils or Authorities are 135 in number.

Urban centres are key engines of economic growth, contributing more than half of the national GDP. Most urban centres in the country, especially cities and municipalities, are under immense pressure, particularly arising from traffic congestion, unregulated land use development; unsustainable urban forms and settlement structures; increasing environmental degradation; and inadequate and poor basic infrastructure services.

Road congestion is now becoming very severe and PMO-RALG is responsible for implementation of Urban Transportation policies and strategies covering public and private transport, urban access, traffic management, non-motorised transport and road safety. Although not part of the primary objectives of the establishment of the DRRC, it is expected that these issues and activities will be addressed as its scope progressively broadens to cover road transportation.

The following diagrammatic structure chart shows the organisation of PMO-RALG Eight Divisions report to a Board of Directors, the PS and the Minister.

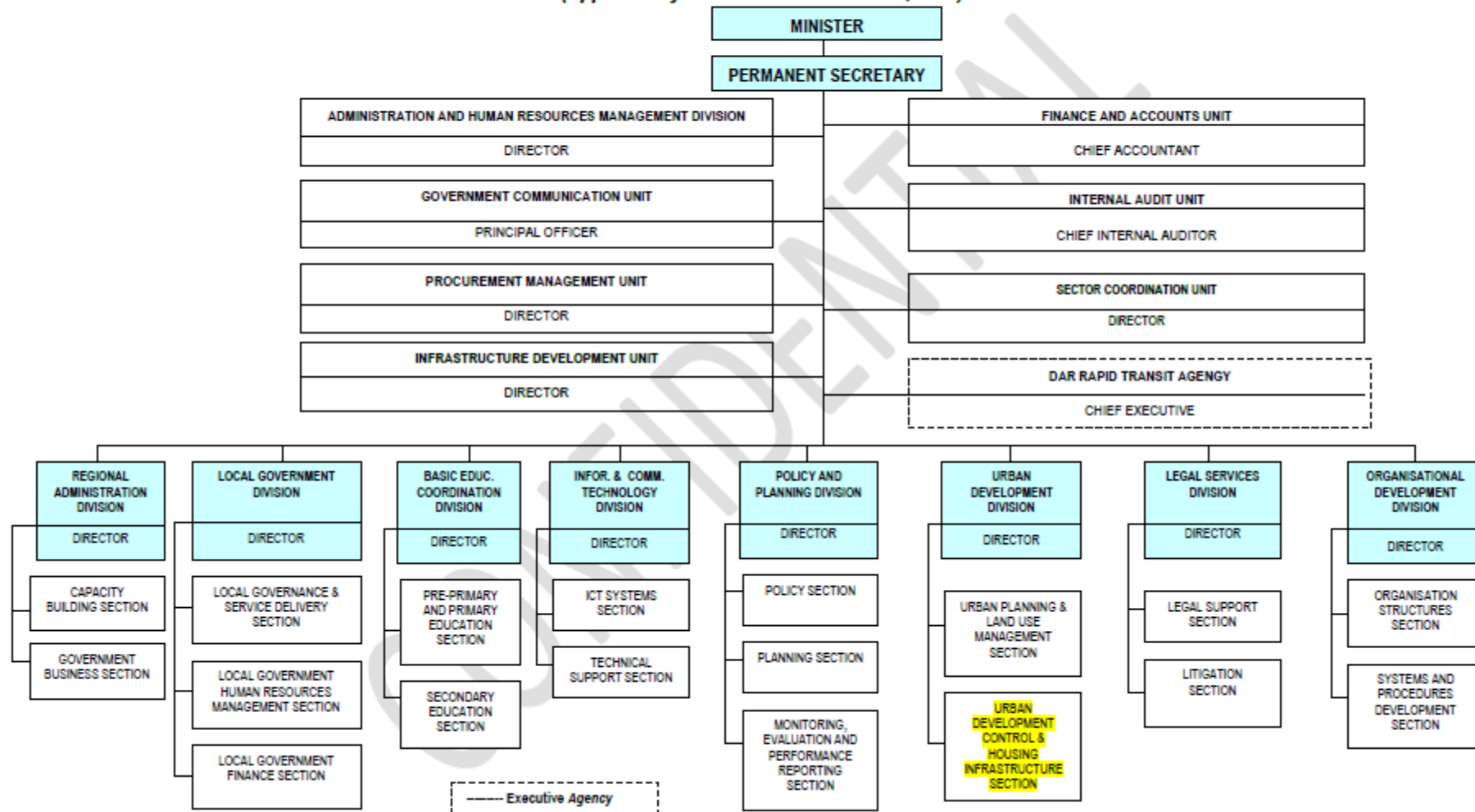
The following Divisions have particular relevance to this study:

- **Urban Development Division:** The Infrastructure Development Unit (IDU) is contained within the Urban Development Control, Housing and Infrastructure Section, led by Eng Elina Kayanda, who is also a PMO-RALG Board Director. The Division provides services and technical advice on fundamental principles of land use and guide Urban Planning and Land Development. Relevant functions include:-
  - To coordinate, advise, supervise and monitor the implementation of Urban Development Policy;
  - To provide technical backstopping and advise on land use planning to Urban Councils and monitor their implementation;
  - To put in place and operationalise a mechanism for protecting developed public infrastructure;
  - To oversee the establishment and implementation of Disaster Management and Preparedness plans in all Urban Councils;

- To coordinate and facilitate capacity building on relevant skills and expertise in urban development; and
- To provide input for reviewing urban development policies.

Chart II

**THE ORGANISATION STRUCTURE OF PRIME MINISTER'S OFFICE – REGIONAL ADMINISTRATION AND LOCAL GOVERNMENT**  
*(Approved by the President on 3<sup>rd</sup> June, 2011)*



The IDU's objective is to facilitate infrastructure development and maintenance in LGAs. Relevant activities include:

- Prepare road inventories;
- Review and update District Roads Management System (DROMAS) and Local Government Road Inventory and Condition Survey (LG-RICS);
- Facilitate LGAs to prepare and implement action plans on transport, urban water supply, waste water and infrastructure development;
- Undertake study on appropriate technologies on rural roads, water and housing and provide technical guidance to LGAs;
- Identify and solicit resource requirements for development, rehabilitation and maintenance of infrastructure in LGAs;
- Monitor, evaluate and take corrective measures on the implementation of infrastructure programs in LGAs;
- Prepare and disseminate operational guidelines and methodologies on management and construction of District Roads;
- Build technical capacity to LGAs on infrastructure development;
- Facilitate and coordinate feasibility studies and impact assessments of infrastructure development projects in LGAs.
- Coordinate Urban and Rural Infrastructure issues (solid waste, sewerage, drainage systems, storm water drainage, roads, electricity, and water supply);
- Advise and coordinate and facilitate availability and use of low cost building materials;
- **Information and Communication Technology Division:** designs ICT systems for data collection, processing, analysis, storage and retrieval; and maintains ICT backup systems.
- **Policy and Planning Division:** provides expertise and services in policy formulation, implementation, monitoring and evaluation. Relevant functions include:
  - To coordinate preparation of ministerial policies and monitor their implementation and carry out their impact assessments;
  - To analyse policies from other sectors and advise accordingly;
  - To coordinate preparations and implementations of ministerial plans and budgets;
  - To carry out monitoring and evaluation of the PMO-RALG's plans and budgets and prepare performance reports;
  - To conduct studies, assessments and evaluation of ministerial plans and provide a basis for making informed decisions.
- **Administration & Human Resources Management Division:** provide expertise and services on human resources management and administrative matters to the PMO-RALG. Relevant Functions include:
  - To advice on administrative and human resources matters;
  - To provide strategic inputs on Administration and Human Resources Management issues such as recruitment, human resources development and training, promotion, discipline, retention, motivation, performance management and welfare;
  - To manage utilization of human resources in the Office;
  - To collect, analyse, store and disseminate data and information related to human resource development plans;
  - To provide data support and up-date records on various human resources information;

- To provide all organization development services in areas such as restructuring, job listing and job evaluation;

## **4.2 Other Stakeholders**

### **4.2.1 MOT**

Ministry of Transport is the government body, with primary responsibility for Transport Policy, Planning and Coordination functions as well as oversight of Infrastructure delivery and asset management. Established in December, 2010, the Ministry of Transport is mandated for formulation of Transport and Transportation policies and monitor their implementation, Transport Licensing, Civil Aviation, Air Transport and Transportation, Meteorology, Railway, Harbours/Ports and ensure Safety and Security of Transport.

### **4.2.2 MOW/TANROADS**

TANROADS was established on 1st July 2000 as an Executive Agency of the MOW to take over the responsibilities for the management, development and maintenance of the trunk and regional roads networks.

Relevant aspects of the Planning Directorate of TANROADS responsibilities include:

- Ensuring that engineering designs and economic feasibility studies for road and bridge projects comply with specified technical standards and economic viability.
- Undertaking data collection for the purpose of planning the road network, engineering designs, budgeting for maintenance works, investment in road development projects and monitoring of progress of road works against set targets.
- Implementing road safety, environmental and social measures for road works.
- Undertaking testing of construction materials and civil works and commissioning research on construction materials and construction technologies for road works.

TANROADS carries out a programme of internal and external training and development, including MSc's and occasional PhD's and World Bank/ADB/JICA have funded Technical Assistance (TA) programmes for capacity building.

### **4.2.3 TANROADS CML**

The CML is part of the Department of Materials and Research, under the Directorate of Planning, TANROADS. It carries out testing and quality control, geotechnics and pavements/materials. CML has developed standards, specifications and manuals including a Pavement and Materials Design Manual, Standard Specification for Road Works and Field Testing Manuals. It provides consulting services to both Government and the private sector and research.

## **4.3 Funders**

Initial discussions have taken place with DP's and their representatives (See Appendix 2). Funding for the DRRC is expected to come from several sources, including Roads Fund and Development Partners, as follows:

### **4.3.1 Roads Fund/LRDF**

The Road Fund is fully autonomous, with 90% of its revenue for maintenance and emergency repairs, with a Road Fund Board (RFB) to manage and control the Road Fund's financial resources. The purpose of the Roads Fund is to provide an adequate and stable flow of funds for road maintenance and rehabilitation and to enhance the transparency between the revenues collected from road users and spending on the road network. It receives funding from the following sources:

- fuel levies on diesel and petrol (90%);

- transit fees;
- vehicle overloading fees; and
- monies from any other source at the rate to be determined by Parliament from time to time.

The Fund is mandated to use:

- At least 90% of its funds for maintenance and emergency repair of classified roads and related administrative costs in Mainland Tanzania.
- Not more than 10% of its funds for roads development and related administrative costs in Mainland Tanzania.
- All administrative costs with regard to the Roads Fund Board shall be defrayed from the Roads Fund.

Revenue from the fuel levies accounts to more than 90% of total revenue. In FY 2011/12 that Tshs.316.6 billion was collected. The Roads Fund Board disburses funds to three implementing agencies:

- The Tanzanian National Roads Agency - TANROADS;
- The Local Authorities under the Prime Minister's Office for Regional Administration and Local Government - PMORALG; and
- The Ministry of Infrastructure Development – MOID.

TANROADS currently receives 63% of the distributable amount after the Roads Fund Board has covered its own administration costs, PMORALG receives 30% and the Ministry of Infrastructure Development (MOID) receives 7%. It is proposed to put in place a **Local Road Development Fund** (LRDF) that would function like a basket fund and that may, if well designed, attract the majority of the DPs that have shown interest in the sub-sector. The funders expected to contribute to the LRDF would be the RF (the 10% portion meant for development), GOT (a budget line under LGTP 2), and some of the DPs.

#### 4.3.2 Development funders

Official development assistance increased from US\$1.6 billion in 2000 to US\$3 billion in 2009, accounting for about 9.2 percent of GDP and 34 percent of actual government expenditures. More than 40 development partners support Tanzania, with five accounting for about 53 percent. IDA is the largest accounting for about 20 percent of the US,?? followed by the United Kingdom with 10 percent, Japan at 9 percent, and the European Union (EU) institutions and the United States (US) at 8 percent.

Coordination of the transport sector is done through the Infrastructure Working Group, currently led by the JICA on the DP side, comprising EU, AfDB, Denmark, DFID, Japan, Korea, and the World Bank. The main funders that are expected to fund the DRRC and its activities are as follows:

- DFID and AFCAP

The DFID Operational Plan 2011-2015 focusses on Wealth Creation, Water, Education, Health and Governance. However, regionally, DFID are funding several projects (Trademark East Africa and Crossroads, Uganda) to improve trade and wealth creation linked to better transport infrastructure and roads access. DFID are not generally funding directly to the roads sector, but are supporting several initiatives including AFCAP.

DFID will establish a Programme Management Unit to deliver its new **Rural Roads and Transport Services Research Programme**. The programme is valued at £24m, will be for 6 years and comprise two components: a second phase of the Africa Community Access Project (AFCAP2); and a new Asia Community Access Project (ASCAP). AFCAP2 will work in up to 12 African countries (including Tanzania) and ASCAP in up to five Asian countries. The programme will focus on high quality, applied research to rural transport problems, communicate the research outcomes to stakeholders, support the mainstreaming of the research results into practice and build research capacity in Africa and Asia. They will identify and support the uptake of low cost, proven solutions for rural transport that maximise the use of local resources (labour, materials, enterprise and ingenuity). The programmes will develop both a knowledge management and capacity building strategy focusing on low volume rural transport within the first 9 months of the research programme. **It is hoped that**

**the AFCAP 2 funding of approximately £17m will support both the underpinning of the DRRC and will also provide funds for research and development projects.**

Through the Wealth Creation Fund, DFID has set aside £25m for both rural road access interventions (£22.2m) and for TA support (£2.8m). **The Fund will be disbursed to PMO-RALG through the RFB and it is expected that a portion of the monies will be available for DRRC related activities.**

DFID has established an International Climate Fund and will consider funding any applications made by PMO-RALG for research projects relating to climate change and infrastructure resilience.

- World Bank

The Country Assistance Strategy for the period 2012-2015 sets out 'Build Infrastructure and Deliver Services' as one of its four objectives. Its primary funding is for corridor infrastructure, including the Central Transport Corridor Project II (CTCP II, US\$190 million, FY08) and Transport Sector Support Project (TSSP, US\$270 million, FY10) for rehabilitating trunk roads and airports.

The World Bank will continue to support the national Transport Sector Investment Program. The technical assistance provided under ongoing IDA operations and Public-Private Infrastructure Advisory Facility (PPIAF) are building sector plans in rural roads.

The World Bank wishes to follow the progress of the DRRC and may contribute to its activities sometime in the future.

- JICA

JICA is funding a four-year TA programme for Rural Road Maintenance Systems Development, to 2016, in 2 Districts - Dodoma and Iringa. It wishes to contribute to the development of the DRRC and its activities.

- EU

EU is funding several capacity building projects with potential direct and indirect applications for this project. It expects to contribute towards capacity building aspects of the DRRC.

- USAID

Is funding roads through its Feed the Future programme relating to agriculture and access to markets. It is currently operating in 4 Districts and will be rehabilitating upwards of 1000km of LVR. If approved by Congress it will contribute \$20m to RFB for a 4 year programme starting 2015.

## 5. Current position

This Section sets out the existing constraints faced by the road sector, how research is currently being undertaken, what types of projects are being carried out and what literature is available.

### 5.1 Main constraints facing the road sector

The main economic constraint in Tanzania, like many other East African countries, is the limited funding for the development of the road network in the form of the provision of essential maintenance and upgrading. These activities are constrained by limited government resources and competition for the available funds by other sectors such as health and education. These constraints have resulted in limitations in the length of paved trunk roads, with a consequential impact on the economy through high vehicle operating costs and the poor condition of some rural roads, which results in restrictions to all-weather access in rural areas.

The technical constraints in the sector include a scarcity of road-building materials in some areas that meet the existing standard for road construction.

Urban transport challenges revolve around motorised private traffic, public transport, non-motorised transport, service vehicle traffic and freight traffic. Urban travel in Cities and Towns predominantly happens through walking, cycling and public transport, including intermediate public transport (IPT) or paratransit. The urban transport system in Tanzania is characterised by the congested central areas of the cities, poor quality of service from public transport operators, inadequate infrastructure (including underutilisation of existing capacity), lack of consideration for all users especially people with disability and non-motorised traffic (NMT), high exposure to road accidents and poor environmental standards.

The main constraints can be summarised as follows:

- Many roads in poor condition (inhibiting socio-economic development in rural areas – negative impacts on agriculture, tourism, construction and general investment).
- High vehicle operating costs (increased costs for passengers and freight)
- High cost of maintenance and operations (inadequate budget for maintenance)
- Decreasing value of the Road Fund in real terms (Insufficient funding allocation for maintenance)
- Level and targets for sealed rural roads are low (high costs of re-gravelling)
- Classification (inventory) of rural roads inaccurate (impacts for planning and budget allocation)
- Limited funding available for monitoring and evaluation (important for assessing impacts and implementation of research findings)
- Outdated institutional arrangements (delays and inhibits investment).
- Urban congestion
- Poor transport services

## **5.2 How road research is currently undertaken, which subject areas, which institutions are involved and the funding sources**

Most research in the road sector in Tanzania has been done by, or in collaboration with, the CML and most projects have been sponsored, at least in part, by the international development community. This includes two programmes being undertaken under AFCAP. Other related projects are being carried out both under AFCAP and in direct collaboration between organisations in Tanzania and international consultants. The main focus of the current AFCAP research in Tanzania is on the use of local materials (EOD approach), various surfacing techniques and road safety.

A desk study has been carried out to collect and review the relevant documents and a list is presented in Appendix 1. The team has undertaken an initial review of the existing research roles, responsibilities and capabilities of the stakeholders, including work carried out by TanT2 and universities. Monitoring of the trials initiated through the collaborative AFCAP programme in Tanzania is being undertaken by PMO-RALG and supported by TANROADS Central Materials Laboratory (TANROADS – CML).

### **5.2.1 CML TANROADS**

The scope of CML work covers soils, aggregates, bitumen and concrete. Regional centres only cover the quality control of soils and aggregates. Thus CML is the only government institution that can fully cover the range of testing and quality control for road building activities in Tanzania. This work is done at CML's headquarters in Dar es Salaam and at the network of 25 regionally-based laboratories. It also carries out research and is responsible for monitoring trials that have been constructed under AFCAP. Their operational delivery requirements and budget restrictions currently constrains their ability to participate in studies and research.

In addition to carrying out laboratory testing for the national roads and the districts, CML also plays an important capacity-building and training role for technicians by holding regular courses at their headquarters in Dar es Salaam where they have a well-stocked library, a dedicated classroom and adequate laboratory equipment for training (although some of this equipment is rather old and needs replacing).

Whilst much of the current research is being undertaken on roads that fall under the responsibility of PMO-RALG, monitoring of the trials sections is being undertaken by CML on behalf of PMO-RALG. Therefore, it is clear that current research is very much a collaborative effort between these organisations. In the current situation, where research expertise in government is limited, the assistance of CML will need to continue, certainly in the short-term, to maximise the benefits of the resources available and until DRRC has built its own capacity and expertise to carry out research with minimal assistance.

TANROADS CML has agreed to assist PMO-RALG establish the Laboratory in Dodoma, including training.

### 5.2.2 Relevant collaborative institutions

There are several existing institutions that carry our road research and dissemination. The characteristics of research carried out by academic institutions are often different from the applied research required by government. The main objectives of academic research are to fulfil the requirements to achieve the necessary qualification (e.g. BEng, MSc, PhD). However, components of DRRC projects could be suitable for these student projects, particularly those studying for higher degrees. These sub-projects have a double benefit in that they reduce the costs to Universities of having to find and fund student projects, whilst aiding the delivery of DRRC projects.

- **University of Dar es Salaam (CoET)**

The College of Engineering and Technology (CoET) is a semi-autonomous campus College of the University. It provides degrees in civil engineering and structures and provides a range of post graduate Diplomas and Masters' degrees in highways, geotechnics, civil engineering and construction. The Department of Transport and Geotechnical Engineering carries out teaching, consulting and research. It does not have students from government currently – the majority are funded by government loans or private donors. PhD's tend to be funded privately.

Research and studies are carried out by staff through projects derived from competitive bidding. Examples include consultancy studies for Bureau for Industrial Cooperation, Volvo Foundation and SIDA. Research is carried out for MSc and PhD courses but is not presently aligned to national priorities.

- **Tan T2 Centre**

Dissemination and uptake of the outcomes of research is always a challenge. T<sup>2</sup> centres have been established in a number of countries in Africa with the role of creating a repository of information on technological developments and documents on research projects and outcomes and assisting/encouraging the implementation of these results, together with recent technological innovation in the transport/road sector. The T<sup>2</sup> centre in Tanzania is one of the earliest and most successful in Africa and it can play an important role in (a) providing relevant local and international documentation for the researches in the DRRC (b) as a conduit for raising awareness of the research outcomes and (c) facilitating the implementation of research findings.

The MOW established the Transportation Technology Transfer (TanT2) Centre in August 1997 in collaboration with the University of Dar Es Salaam, supported by the United States Federal Highway Administration. The Centre is attached to TANROADS and although their remit is transport they work predominantly in roads. It is a Centre for transport technology information, best practise, professional training programmes, technology transfer, technical assistance and applied research and development and library services. It specialises in organising and facilitating training courses, seminars, workshops,

conferences and exhibitions. It is funded by the Road Fund and other Central Government budgets and via Conference fees.

- **Other Relevant institutions**
  - Appropriate Technology Training Institute (ATTI)
  - Tanzania Bureau of Standards
  - Dar es Salaam Institute of Technology (DIT)
  - Arusha Technical College

### 5.3 Current projects/programmes

- **AFCAP LVR Manuals**

The purpose of this project is to prepare a design manual for low volume roads in Tanzania as a basis for promoting rational, appropriate and affordable implementation of projects in a manner that makes appropriate use of local resources in a cost-effective and sustainable manner. It is expected that the new manual will be based on similar documents prepared previously under AFCAP in other African countries though other relevant local and regional experience will also be incorporated.

- **DFID Improving Rural Access in Tanzania (IRAT)  
Technical Assistance (TA) for Improving Rural Access in Tanzania**

DFID Tanzania is providing £25 million over the next 4 years to help improve Tanzania's rural road network. £22.2 million will be spent on repairing and improving rural roads and £2.8 million will be spent on helping to improve value for money, manage fiduciary risk and to maximise the impact of rural roads in Tanzania. Funds will be channelled via the National Roads Fund to Local Government Authorities (LGAs). Projects will be implemented by District Engineers. 36 bottlenecks (out of a short list of 406 priority bottlenecks nationwide) in 14 districts have been identified as providing the greatest economic rate of return amounting to an estimated total cost of £6.6 million. These will be the focus of the first year of DFID's funding.

Technical Assistance is provided as part of the programme. This is partly aimed at helping LGAs maximise value for money, manage fiduciary risk and to help strengthen PMO-RALG and the Road Fund Board. It is also expected that TA assistance will be allocated to development of the DRRC.

- **EU Capacity Building for PMO-RALG/SMEC**

The EU is supporting 3 related projects in Tanzania:

1. A Road Rehabilitation Project for the improvement of some 250Km of rural road in 3 regions of Morogoro, Iringa and Ruvuma.
2. A Capacity Building project linked to the road rehabilitation project and aimed at building the capacity of PMO-RALG, LGAs and construction industry in the 3 regions supported by first project.
3. A capacity building project for the transport sector aimed at Ministry of Works and Ministry of Transport staff.

IT Transport UK has a contract for the implementation of project number 2, the capacity building of PMO-RALG and LGAs for support to District roads, to carry out the training implementation and produce manuals and guidelines. The inception phase consisted of a review in the 3 regions and 6 districts receiving support under the road rehabilitation project as well as a review of capacity of the private sector construction industry in those regions. A training needs analysis was carried out that produced

recommendations for physical support in terms of monitoring equipment (materials testing kits) and other items as well as a programme of manual production and training courses. Over the period from March 2014 to December 2015 a programme of technical management guidelines production and training courses to disseminate the operational procedures and skills will be carried out utilising selected senior experts to conduct the training.

- **UNDP**

The UNDP policy aims at consolidating the achievements from activities and projects undertaken in urban areas such as:

- The urban management project and priorities under the sustainable cities project as implemented in the 1990s in various cities and municipalities in the country;
- The Cities Alliance project, especially the City-Wide Strategy for upgrading unplanned settlements;
- The Community Infrastructure Upgrading Projects (CIUPs); implemented in various urban settlements in the country;
- The Safer Cities Project, implemented in Municipalities such as Dar es Salaam, Moshi, Tanga, Mwanza, Morogoro, Iringa, and Mbeya;
- The Urban Development Environment Management (UDEM) Framework, LGAs capacity building programme promoted by PMO - RALG.

- **JICA Capacity Building for District Engineers**

JICA have dispatched a number of LTE and STE covering, maintenance, planning, construction management and PR. The purpose is to establish Operational Guidelines covering Planning, Budgeting, Procurement, Construction Supervision and Monitoring. JICA have expressed a willingness to support the activities of the DRRC and are considering possible TA assistance.

- **US AID Feed the Future**

This programme involves upgrading of 1000km of gravel roads. It is hoped to use these roads for trials and test sites as part of the performance monitoring programme and to link the associated monitoring with the DRRC.

**Other relevant Programmes:**

- EU Capacity Building for MOW
- US AID Partnership for Growth
- WB Tanzanian Strategic Cities
- WB Dar es Salaam Metropolitan Development Project.

## 5.4 Relevant existing literature

- **Bibliography**

A list of relevant reports and publications is set out as Appendix 1. Some of those reports are described below.

- **AFCAP Reports and Publications**

Reports on AFCAP projects in the transport sector are freely available on the AFCAP website (AFCAP.org). Many of these projects provide important background literature for researchers. They provide information on ongoing and completed research projects commissioned under AFCAP and are essential reading in that they enable researchers to replicate approaches adopted elsewhere and adapt them to local needs and conditions,

whilst avoiding unnecessary duplication of research. The documents also include manuals that aid design and provide advice on the various other aspects of road provision.

Some 26 reports are listed for Tanzania. These include papers and reports on the following topics:

- Alternative approaches to road maintenance
- Alternative surfacings for low volume roads
- Various reports on the Bagamoyo and Siha research & demonstration sites
- Sociology aspects of demonstrations sites
- Improving accessibility for reducing poverty
- Road safety
- Research priorities
- Transport services and links and aging

- **SADC Guidelines**

The 'Guideline for low-volume sealed roads in the SADC region' was produced by TRL for SATTC under SADC and it was jointly funded by DFID, NORAD and SIDA. Its main objective was to raise awareness of the outcomes of research, new approaches and technologies aimed at reducing costs and aiding the delivery of sealed rural roads.

- **National design guides, manuals and handbooks**

The revision of manuals being undertaken under AFCAP has provided the opportunity for research-based evidence to be included in these documents and enhances the likelihood of research outcomes being put into practice for the benefit of road users.

Manuals have already been prepared for some countries under AFCAP (e.g Ethiopia, South Sudan) and are currently being prepared for others, including Tanzania and Mozambique.

Under the auspices of the AFCAP project for preparation of LVR Design Manual for Tanzania, a review of the existing relevant documents in Tanzania and elsewhere has been undertaken by the project team led by IT Transport, and this review has resulted in the development of a provisional framework for the manual as shown below.

Part	Chapter	Focus
A. Introduction	1. General Introduction	Core
B. Planning	2. Rural Accessibility Planning 3. Complementary Interventions	Complementary Complementary
C. Investigations	4. Site Investigations and Route Selection 5. Geotechnical Investigations and Design 6. Construction Materials	Core Core Core
D. Design	7. Environment 8. Traffic 9. Geometric Design 10. Road Safety 11. Hydrology, Drainage and Erosion 12. Drainage Structures 13. Pavement Design 14. Unpaved Roads 15. Surfacing 16. Comparison of Designs and Implementation	Core Core Core Core Core Core Core Core Core Core
E. Contracts	17. Documentation, Tendering and Award	Complementary
F. Construction	18. Construction and Quality Assurance 19. Borrow Pit Management 20. Technical Auditing	Core Core Complementary
G. Maintenance	21. Management, Operations and Procedures	Complementary

The activities of the DRRC will be fundamental to the development of technology, specifications for the use of local materials and other activities aimed at improving the cost-effective delivery of roads. The outcomes from research projects will provide the evidence for revising design manuals and specifications to meet the specific needs of Tanzania.

### 5.5 The case for research

There is a universal acceptance that there is a direct link between level of investment in research and economic development. As an example of the potential benefits, UK government research commissioned in 1995 indicated that for every \$1 million spent on research, society in the UK benefited by over \$20 million annually.

Research is the mechanism for the advancement of knowledge and for social and economic progress. It is the best method for developing and testing new and innovative ideas to assist in generating income, better return on investment, cost savings and reduction of risks. The results of successful road research, combined with demonstration projects, enable practitioners to adopt and apply new and innovative approaches with confidence. However, in many African countries, the funding for research is minimal and research in the transport sector is often absent. Innovative solutions are required to improve the delivery and sustainability of rural road infrastructure but these must be shown to be technically appropriate and cost effective.

African Governments have tended to use adaptations of international developments and Standards and used international organisations to assist in discreet projects or Technical Assistance programmes. Research Organisations providing R & D assistance include TRL (UK), CSIR, VicRoads, ARRB and Sweroads. Other similar functions have been carried out by consultants such as IT Transport and SMEC. More recently, there has been a move to establish national research centres to adapt regional and local experiences, to carry out national priorities and most importantly to build permanent national capacity. A local centre allows permanent retention of knowledge generated by locally employed people rather than expatriates – which has enormous advantages and benefits. The generation and dissemination of research knowledge is an international activity. Most transport

research knowledge applied in Tanzania, as in other African countries, has been generated internationally through programmes, partnerships and Institutes. The main role of research tends to focus upon the local characteristics that will influence key decisions and modify or adapt existing models and procedures. Examples include:

- Local material properties for road building.
- The performance of road pavements in particular climatic zones.
- Appropriate solutions bearing in mind local economic and physical environment, cost structures, institutional set up etc.
- Analysis of traffic demand and forecasting of traffic volumes and modal split.
- Study of different measures on urban congestion.
- Development of different interventions on road accident rates.
- Analysis of transport costs and tariffs and road user charges.
- The impact of transport investment on development and poverty reduction.
- Examination of the rural accessibility and mobility.
- Reduction of urban congestion.

Examples of countries in Africa considering either establishing or enhancing their national research capacity includes Ethiopia, Ghana, Kenya, S Sudan and Mozambique.

## 5.6 International Perspective

Internationally, the national Road and Transport Research function in most countries is usually carried out either through a Government Centre or Institute or carried out through several separate Government Ministries. Some are split into Roads and Transport, others are combined. Examples of these include Australia: ARRB; UK: TRL Ltd; S Africa: CSIR; Ethiopia: ERA; Ghana: BRRI; Kenya: MTRD; Mozambique: ANE.

Descriptions of the main activities of ARRB, TRL and CSIR are given in Appendix 3.

## 5.7 Success factors for establishment of a DRRC

It is generally assumed that for projects to be accepted and sustainable, they need to satisfy the following criteria:

- Politically supported - ideally with Patron at high level in Government
- Socially acceptable - research community and career progression needed
- Institutionally embedded – permanent location with key stakeholders
- Environmentally sustainable – mandate should cover environmental considerations and climate change
- Financially sustainable – line item in Ministry budget with a spectrum of funding sources
- Economically viable – providing benefits to deliver economic growth
- Technically appropriate – sufficient skills, capability, equipment and facilities.

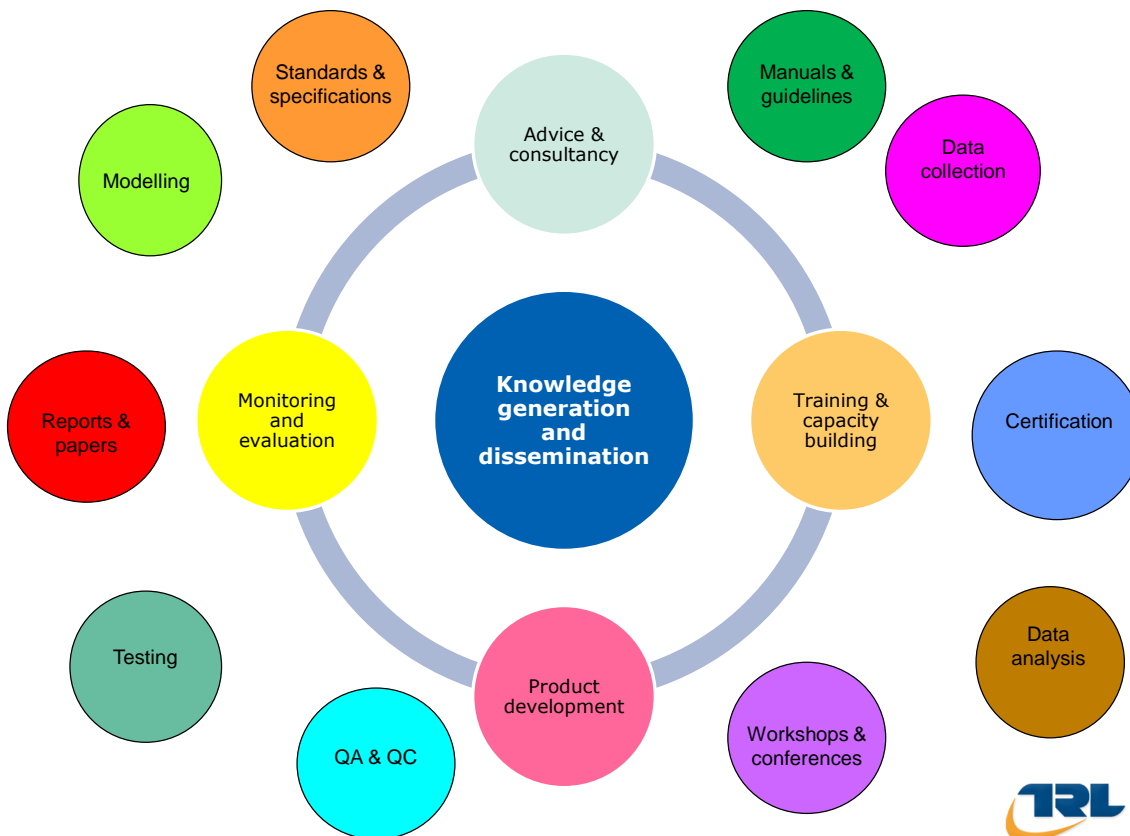
Components for the sustainability of a DRRC and in the retention of good quality staff will also include:

- A strong and respected research institution that is well-managed.
- Assured present and future funding streams that ensure sustainability
- Well-defined career paths with fair advancement channels
- Remuneration/salaries compatible that compare favourably with similar/competitive institutions
- Local and international partnerships with academic organisations and other research institutions
- Interesting and rewarding projects.

These factors will help ensure that motivated professionals are attracted to, and retained, in research, that they have the opportunity to work in an environment conducive to research, have an assured career path within the organisation in which they work and that remuneration is at a level which will attract good professional staff.

### 5.8 Typical Activities and Costs

Typical research activities include:



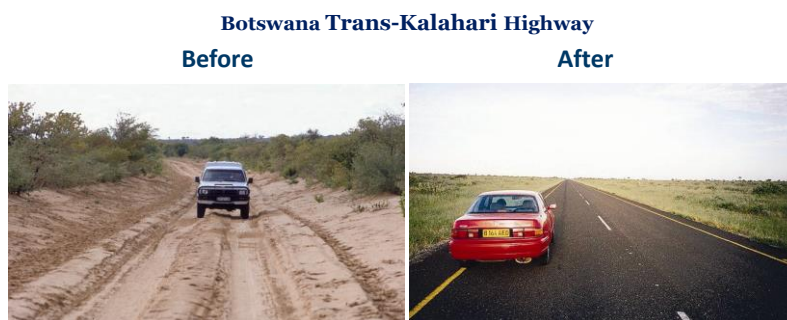
The cost of research and timeframe for return-on-investment are primary issues that underpin investment decisions. The following matrix explains the comparative costs associated with different activities and the different expected returns over the short, medium, and long term. From a perspective of 'adaptation' of current knowledge costs are relatively low.

**Research costs and timescales**

<b>Costs</b>	<b>High</b>	Data Collection Surveys	International courses PhD Courses	Fundamental research Data management Performance studies
	<b>Medium</b>	Laboratory testing Product testing Pavement testing	Applied research Field testing Modelling National graduate/ post graduate programme	Monitoring and evaluation
	<b>Low</b>	Secondments International conferences Publications Workshops Courses	Secondments Collaboration	Capacity building
		<b>Short</b>	<b>Medium</b>	<b>Long</b>
		<b>Time</b>		

**5.9 The benefits of research**

Good information on the direct and indirect benefits of research is not easy to abstract because of the long time lines between investment and return. Projects such as the one carried out by TRL in Botswana in the 1980’s to derive specifications for the use of the locally available (sub-standard) materials for road construction projects in the Kalahari region produced savings conservatively estimated to be in excess of \$20 million on the main road network alone and facilitated investment in the development project shown in the picture below.



**Research outcomes:**  
 New laboratory tests and specifications for sand as sub-base material  
 Use of ‘marginal’ materials for road base  
 Provision of sealed shoulders enabling use of weaker materials  
 Revised specifications and techniques allowing use of weaker aggregates for surfacing  
**SAVINGS > US\$20 million (2000)**

The evaluation of Sida-funded projects in Zimbabwe using the Highways Design and Maintenance Model (HDM) produced some of the first evidence that in whole-life cost terms, gravel roads could be economically upgraded at much lower threshold levels of traffic than was previously thought possible. This has been further substantiated by more recent research. In Tanzania, the trials constructed under AFCAP and being monitored by CML should

produce further evidence on the use of local materials for the low-cost surfacing of roads through towns and villages and for spot improvement works, which have been shown to yield large economic benefits.

### 5.9.1 Economic evaluation

The benefits from research begin with the implementation of the results. These can begin to accrue quite quickly, if implementation follows immediately after the completion of the research. More usually, there is a delay between the time that the outputs of the research become available and implementation. Cost Benefit Analysis (CBA) is the normal method used for economic evaluation of projects and the results are usually quoted as the Benefit/Cost ratio (B/C), Net Present Value (NPV) or Internal Rate of Return (IRR). The NPV can be regarded as profit from the research. The ratio of benefits to cost (NPV/RPV) provides evidence of the profit in relation to the cost of the research. The IRR is the discount rate that reduces the NPV to zero. This measure is sometimes favoured by aid agencies because it does not require disclosure of a country's discount rate. The '1<sup>st</sup> year rate of return' is a measure which is sometimes used for timing the start of projects.

In a study carried out by the California Department of Transportation, it was claimed that 8 projects costing a total of \$6 million achieved annual benefits of \$35 million with a range of B/C ratios of between 2:1 and 44:1.

One of the most comprehensive published studies on the value of research is contained in a document published by the TRL on a project commissioned by the U.K. Department of Transport.

The 12 projects studied were selected from 3 main areas of research having the following aims:

- to reduce road construction and maintenance costs
- to save accidents
- to cut traffic congestion

A standard discount rate of 8% was used in the study although the sensitivity analysis included the effect of a range of discount rates on the results. The NPV was used as the main measure of the return on the research. The effect on NPV of using three different base years was examined for each project; the start year of the research, the base year of 1992 and the deployment year of the results. On average, altering the base year from the base year of 1992 to the start of the research reduces the NPV on average by a factor of 4. Altering the reference year to the start of deployment of the results decreases the NPV by just 19 percent on average.

**The results showed that all projects in the study would pay for themselves within less than 6 months. The annual benefits for the 12 projects over 20 years was 15 times the annual costs of all TRL projects (over 400) being undertaken in the base year.**

### 5.9.2 Benefits and Outcomes

By providing an improved understanding of travel and transport trends over time, research can support evidence-based decision-making and hence better/ more robust decisions. Transport research should form the basis for the building blocks of policy development. Ideally, it should be both independent and impartial, gathering primary information, such as new data and statistics, for use by policy makers and others.

## 6. DRRC policy framework to guide future road research activities

It has been recognised that research has an increased role in the development and management of the infrastructure. It is expected that more focussed activities will provide the basis for improving the long term capacity to undertake relevant, high quality, research that will assist Government develop evidence-based policy and programmes and also assist in the process of evaluation and monitoring to provide continual improvement in the transport sector.

The long term outcomes of implementation of research findings is expected to deliver more durable infrastructure, lower vehicle and stock operating costs, shorter travel times, lower accident and fatality levels, improved designs and standards for construction and maintenance, and more efficient and cost effective operations.

## 6.1 Needs assessment and priorities for research

The following is a summary of **relevant** research needs identified in the 2012 DFID funded study 'The Case for Transport Research in Tanzania, its Funding and Institutional Location (2012), Transport Policy Support Programme, MOT'.

### 6.1.1 Ministry of Transport

- Information on passenger and freight transport: costs per km; O/D data; types of commodities transported; actual weights of lorries
- Data on Non-Motorised Transport (NMT).
- Causes of and means of addressing congestion in urban areas
- The impact of new developments on transport demand.

### 6.1.2 Ministry of Works

- Behaviour and design of road pavements
- Urban congestion
- Road safety implementation programmes
- Ground improvement and stabilisation technologies
- Low cost seals and surfacing
- Quality Control and Assurance methods and procedures
- Data collection and management

### 6.1.3 TANROADS

- Costs and cost savings of road construction
- Premature failure of road pavements
- Rutting and deformation of road pavements
- Properties and improvement of road construction materials
- Use of marginal materials/improvement of material properties
- Mapping of material resources
- Need for a national road pavement deterioration model to fit into their Road Maintenance Management System
- Traffic surveys, although adequate for the network, are not adequate for research purposes
- Combined index to classify overall road condition
- Monitoring and evaluation of road investments

### 6.1.4 CML (TANLAB)

- Updated Standards and manuals
- Equipment to undertake research
- Material properties and use of marginal materials
- Mapping of material resources
- Capacity building

### 6.1.5 Roads Fund Board

- More comprehensive traffic data
- Comparative transport costs and pricing
- Road maintenance/materials/management
- Audit as a service
- Capacity building and institutional strengthening

### 6.1.6 TanT2 Centre

- Optimisation and utilisation of local materials

- Labour based and community based road construction and maintenance
- Traffic flow and incident management
- Investigation into construction cost reductions
- Improvement of marginal soils

## 6.2 Key issues to be addressed

From a review of previous studies and from results of meetings held in connection with the current project, the following issues and priorities have been identified that will need to be addressed:

- Necessity for **long term** financial and technical support to build permanent research capacity
- Improved **coordination** of DP's funding both for underpinning of the DRRC and for specific projects
- Economic benefits of **outcomes of research to be closely linked to improvements in national GDP** and to potential for reduced costs of construction and maintenance (more for less)
- Need for **improved data** on the road network and its performance, including traffic
- Establishment and management of **more effective road mapping, road condition and asset database**
- Understanding of links with DROMAS and integration with future development of the software package
- Establishment of **national road material/aggregate inventory and database** for use in construction and maintenance
- More accessible field and laboratory testing, monitoring and quality control
- More **economic** design, upgrading and rehabilitation of roads using whole life cost approaches
- Use of low cost seals, including design, life cycle costs and economics
- Need for improved design manuals and related training
- Better understanding of causes of road and structural failure and remediation
- **Improved performance of contractors** for both labour-based and equipment based
- **Improved management** of maintenance backlog, programming and prioritisation
- **Climate change** effects mitigation to create better network resilience.
- **Training needs and capacity building** on research, laboratory and field testing
- **Urban roads capacity and reduction of congestion**
- **Road safety research, education, training and capacity building**

## 6.3 Research Policy framework

The policy framework is a translation of existing national policy, objectives, aims, targets and programmes into research activity outputs that will help deliver outcomes at less cost and more sustainably.

Objectives and targets of the **policy framework** comprise:

- Reducing costs of both construction and maintenance by 30%
- Methods of reducing maintenance backlogs by 33% to address current shortfalls in funds
- Reduce transport costs by improving journey time for rural and urban environments
- More effective investment strategy based on cost-benefit analysis and whole life costing
- Develop more robust delivery strategies based on the application of the Environmentally-Optimised Design (EOD) concept - including use of locally-available resources and materials, contractors, appropriate design and maintenance methodologies.
- Use evidence-based research to develop continual improvement in outputs and outcomes
- Knowledge management and information dissemination
- Building permanent capacity.

#### 6.4 Mandate and functions of DRRC

The DRRC vision and mandate should be developed in line with Government's Vision, Millennium Development Goals, and the Strategic Plans of PMO-RALG. The DRRC will be charged with the responsibility of research and testing materials for quality and standard compliance both for Government and private sector construction and Industry. Specifically, the DRRC's mandate should be:

**Testing and research on roads and construction materials, road pavement design and construction specifications, construction quality control and assurance, and post construction evaluation of roads and other infrastructure.**

It is proposed that the mandate would be delivered through the following core functions:

- Provision of laboratory and testing facilities for:
  - Geological and geotechnical investigations;
  - Geospatial surveys;
  - Hydrological surveys and hydraulic studies;
  - Traffic surveys and studies;
  - Prospecting, examination and testing of construction materials;
  - Construction quality control; and
  - Post-construction monitoring and evaluation of roads, bridges and buildings
- Testing, calibration, and verification of precision instruments, gauges, scientific apparatus, and other laboratory and field measurement equipment to ensure compliance;
- Certifying civil engineering laboratory technicians;
- Vetting of pavement designs for road upgrading, reconstruction, rehabilitation and strengthening works;
- Construction quality control including post construction evaluation of completed works;
- Monitoring functional and structural performance of road pavements including axle load and pavement condition surveys;
- Maintenance of pavement construction and maintenance data base for public roads;
- Research on road development, maintenance, and operations including research on new construction materials, construction methods and road safety studies;
- Undertake collaborative research activities in liaison with other local and international organizations;
- Disseminate research undertakings and findings;
- Development and review of materials testing standards, road design manuals and standard specifications for construction and maintenance of roads in conjunction with other stakeholders;
- Provide materials testing and consultancy services at nominal charges to other government Departments, roads authorities and the public; and
- Advise the government on road construction, maintenance and operation standards, on physical, chemical and engineering characteristics of materials and on materials usage.

Proposed **strategic goals** are:

- Quality assurance
- Research and consultancy
- Institutional capacity
- Financial stability

Proposed **functional objectives** are:

- Ensure prolonged road pavement/wearing course life
- Ensure structural integrity of structures and bridges
- Enforce value for money in construction of roads and bridges
- Identify areas of research and innovation
- Establish a resource centre for technical knowledge.
- Provide consultancy services
- Expand and upgrade ICT systems
- Attain and retain optimum HR levels

**The following research and testing functions are considered to be constituent parts to build capacity:**

Provide modern and comprehensive materials laboratory for the testing of materials used in road works
Provide in-house capacity for materials investigations and geotechnical investigations required for road works, road condition investigations and analysis of pavement and surfacing failures
Become a Centre dedicated to research on matters related to roads in Tanzania, including road policy, road transport, road asset management, road design, construction, maintenance and operation. Such research will be carried out in a number of ways, including: <ul style="list-style-type: none"> <li>○ Outsourced to academic institutions</li> <li>○ Through local and international consultants</li> <li>○ In collaboration with other national, regional and international research centres</li> <li>○ In-house</li> </ul>
Provide services for quality control of construction projects
Undertake independent Technical Audits of selected road projects where quality is suspected to have been compromised
Develop and verify new design and operational standards for the use of materials, maintenance systems, road transport sector regulations etc.

## **7. Draft Strategic Plan for the identification and implementation of priority research activities**

Initially, the DRRC will be established within PMO-RALG and will concentrate on addressing problems associated with the construction, maintenance, upgrading and rehabilitation of District, Urban and Feeder (DUF) Roads. With the fullness of time it is envisaged that its remit will broaden to all roads and may eventually encompass all transport modes or that it will be part of a broader National Transport Research Centre that is yet to be established.

Key National policy objectives and plans are set out in Section 2, National Policy Framework. Section 3 sets out the Local government Transport Programme, including targets and objectives. Key national transport and road issues to be addressed are set out in Section 6.2. These have all been used to identify road research strategies to help deliver those plans, programmes and targets. The research strategies are used as a basis to set out priority programmes and activities for the short and long term with the aim of reducing costs of construction and maintenance and improving access for sustainable economic development.

**It is recommended that future policy and targets for upgrading and maintenance of District, Urban and Feeder Roads be modified to encourage substantial increases, otherwise economic development will be impeded. A**

more appropriate target for upgrading would be at least 400km per year at an estimated cost of \$25m annually. For comparison purposes, the Government of Kenya has recently set a target for upgrading of 8,000km of LVR to sealed standards in 5 years.

Examples of the types of activities currently being used in other East African countries include:

- **Local material properties for road building.**

This is an area of research that has produced significant benefits through changes in specifications that have enabled increased use to be made of locally available materials in different environments.

- **The performance of road pavements**

Research on paved roads with natural gravel bases in southern Africa showed that environmental factors (i.e. climate and drainage) are highly influential on pavement performance. Research is required to be able to both exploit and mitigate designs as appropriate for variations in the climatic conditions.

- **Analysis of traffic demand and modal split**

Regular classified traffic counts give important information on changes in traffic patterns on the network to plan for maintenance and upgrading. They are also an essential component in monitoring trials as the results enable design recommendations to be made on the basis of expected traffic loading.

- **Road inventory and management systems**

Without a proper road inventory and management system, it is difficult to plan and prioritise interventions such as maintenance activities. The revised version of DROMAS will help but there is some uncertainty being expressed about the accuracy of the current inventory.

- **Interventions on road accident rates**

The rural road network is predominantly unpaved. Accidents on unpaved roads are often different to those on paved roads. Road condition tends to have a more important influence as high levels of roughness and corrugations often result in a loss of control of vehicles by drivers whilst the impacts of dust also have an impact on road safety together with impacts on health, agriculture and the environment.

- **Rural accessibility and mobility**

Many engineering solutions that are sustainable are less expensive in the long term (in whole life cost terms) but can be perceived as being expensive to construct initially. Recent AFCAP research has shown that this doesn't have to be the case, especially if the EOD approach is applied. The overall investment and cost-benefits of road improvement schemes is an area of research that is needed to help justify these interventions.

- **Impacts of climate change**

Changes in climate are undoubtedly leading to more extreme weather. Rural roads with low cost drainage structures are particularly vulnerable. The risk factors to which they are designed are based on historic rainfall records and should be revised.

## 7.1 The nature of research and the selection of suitable projects.

Whilst the overall objective of the research is straightforward there are several key issues concerning the selection of projects and topics for research and the way that they are tackled that need to be addressed. Once the problem has been identified there are then several possible actions for the research centre to take.

1. The solution may be well known and can be 'looked up' in reference documents.
2. The solution may be well known outside Tanzania and therefore an assessment needs to be made as to whether it can be used without modification or whether it needs to be 'developed' for Tanzania. This will involve research comprising demonstration and modification.
3. The solution is not known and fundamental research is needed to find a solution.

Thus projects in category 2 are more likely to be suitable for inclusion in the research programme. The next step is to evaluate them in a logical manner. The factors that affect this include the following:

- a) Does it address the current objectives and priorities defined by PMO-RALG?
- b) How important is the problem or what will be the impact (benefits) of solving it (in broad terms only at this stage).
- c) Evaluate the risk. For example, how difficult is it likely to be? At what point do we close the project because it is proving too difficult and a solution is not guaranteed?
- d) What resources are needed to solve the problem? In other words define the research method, experimental matrix, equipment required, staff and skill levels required and cost. Also think about collaborators who could provide additional resources and expertise.
- e) Define the time frame (short (1 year), medium (3 years), long-term (5 years plus). If the latter, will there be any useable intermediate outputs?
- f) Identify possible sources of funding.
- g) Define the deliverables.
- h) Define an implementation strategy

Structured guidelines will need to be developed, say in the format of a generic proposal, providing information that would be needed to enable stakeholders (Research Committee) to make rational decisions on the value and benefits of proposed projects, in supporting the strategic plan.

## 7.2 Long term strategy

Proposed long term strategic priorities, therefore, to achieve government policies and programmes are:

- **To reduce transport costs and travel time** by improving the condition, planning and management of DUR roads;
- **To optimize use of available resources** in the development, rehabilitation and maintenance of roads
- **To enhance capacity** for local contractors
- **To find new ways to construct and maintain roads** at significantly reduced rates
- **To maximise effective use of existing natural material resources**
- **To build research capacity** and speed up implementation of research outputs.

## 7.3 Priorities

The following Research and Development (R&D) **themes** are proposed to support development of the long term strategy:

- Establishment of an improved (provisional) inventory of classified roads and assets
- Priority programme of sealing, upgrading and rehabilitation based on accessibility needs
- Road bottleneck programme
- Increased LVR upgrade programme based on new road classification and traffic priorities
- Location of construction materials, aggregates and marginal materials for short term programmes
- Improved QA/QC programme
- Review of cost savings opportunities to be achieved through full cycle of construction and maintenance
- Establishment of more rigorous monitoring and evaluation programmes
- Road safety programme

## 7.4 Strategic research programme

From an assessment of the themes, the following priority programmes have been identified. Each programme will require a scoping phase so that a detailed programme of sub-projects can be prepared.

### 7.4.1 Road trials, demonstrations and monitoring

There are already a number of trial sections of road constructed under several programmes, including the PMO-RALG and AFCAP programmes, which are designed to demonstrate and verify successful surfacing options for LVRs. The benefits of these are only revealed by their durability and low maintenance costs and therefore whole life costing principles must be used. To quantify this, the trials need to be monitored for a number of years.

Successful specifications for road building materials for LVRs that do not meet the specifications for high volume roads, have been, and are being, developed in several neighbouring countries thereby reducing the costs of provision of LVRs substantially. Similar studies need to be carried out in Tanzania because the properties of such materials can differ significantly across the continent.

Not only is some relaxation of material specifications possible for LVRs but the design thickness is being researched and revised. Conventional design methods have a lower thickness cut off point for LVRs but it is possible to sub-divide this LVR class and achieve material cost savings for the lower classes. The results of such research needs to be demonstrated and possibly extended in Tanzania. The first step is to identify all the trials that have already been built in Tanzania and to assemble all the data that are available. Some trials may be quite old and may have already produced useful data but some may have been abandoned. It will be necessary to evaluate the existing trials and decide which are worth monitoring for a further period of time and which should not.

The second step is to evaluate the monitoring data. Monitoring is not always done correctly. There are several important principles that need to be adhered to and therefore a short manual needs to be prepared outlining how monitoring should be done. This is vital because monitoring data can prove to be almost worthless unless certain rules are followed.

The third step is to devise a programme schedule for the continued monitoring of the trials. Simple analysis of the data should be carried out after each monitoring activity but the main analysis will take place when the trials have been monitored for long enough for the durability and long term performance of the trials to be assessed reasonably accurately. This can be a relatively complex task and it is likely that in the early stages of the development of the DRRC expert technical assistance may be required.

In the longer term, additional trials will be constructed to demonstrate and investigate the relaxation of specifications for some of the more abundant road building materials in Tanzania that do not meet the specifications for high volume roads. A review of the likely candidate materials needs to be carried out and suitable materials identified. A programme of laboratory testing and evaluation is then carried out and material sources that are deemed most suitable are selected for trials. Trials are normally constructed on existing, or soon to be awarded, road building contracts by simply changing the materials for a trial length. DRRC staff will need to be present during construction and to sample and test the trial section. Monitoring can begin soon after construction.

Road trials are usually of one of two types, namely 'demonstration' or 'research'. A demonstration trial is used to show the application of innovation/research developed elsewhere which should be applicable in Tanzania, maybe with minor modifications. A 'research' trial is aimed at resolving local problems specific to the host country (e.g. those related to the use of local materials that have not been studied elsewhere).

### 7.4.2 Road asset inventory, condition and data

The current inventory of district roads (i.e. those classified) does not accurately represent the length of roads in the network and there are suggestions that the actual figure could be nearly twice the current stated value of approximately 58,000km. An accurate road inventory is vital for managing the road network efficiently and effectively. Therefore one of the priorities is to ensure that the roads are properly identified and that the additional information required for prioritisation of maintenance and upgrading, such as road condition and traffic data, can be collected and analysed with accuracy.

The first step is to review the current inventory and, on the basis of a sample, determine how incomplete it is. Identifying and obtaining copies of any maps that have been compiled anywhere in Tanzania will help greatly, if such maps exist.

Methods of identifying roads and tracks need to be reviewed. The use of a GPS location system appears to be essential for visiting roads and collecting road condition data but an initial step might be to see what data is available from Google Earth and from commercial satellite imagery to identify roads that are not in the classified inventory. Specialist advice from professional map-makers should be sought as a matter of urgency.

Assuming that satellite imagery at a suitable scale permits roads to be identified, then the basis of a complete inventory can be obtained. However, populating the inventory with vital information about each road can only be done through site visits. At present, site visits are used to obtain a relatively subjective view of the condition of the road and to identify 'bottlenecks' where problems of passability occur. This process must be reviewed and may need to be modified to make it more objective. Pilot trials will be needed to improve the survey method.

Traffic data is also vital for economic analysis and setting priorities. Ways of estimating this need to be researched. It is impracticable for traffic counts to be carried out on all roads by DRRC staff and so harnessing local resources in some way is required. The use of shop owners, local schools, any transport services that are found to be using the roads, are all potential 'helpers' for assessing traffic levels. Again, a pilot scheme needs to be devised and tested.

Once acceptable methods have been developed, a programme for covering the whole country must be devised. An initial estimate is that five or six teams might take 6 months to cover the whole network, collecting only visual data and classifying traffic level into a limited number of categories.

Once the inventory is complete, keeping it up to date should be somewhat easier. A second round of site visits could obtain additional data if required and feedback following interventions to solve 'bottleneck' problems will be vital for a process of continuous improvement.

The most useful form for the inventory are maps at a suitable scale and resources to produce these should be sought.

#### **7.4.3 National road material and aggregates database and inventory**

A database containing information about the location, properties and volume of road building materials is invaluable for effective planning and costing of road maintenance and road construction especially when sources of good material are being depleted and the use of materials of lower quality are being identified as suitable for LVRs in many circumstances. . This project will identify the most appropriate methodologies to use for a Tanzanian Materials Database by undertaking pilot studies in representative areas. Following on from this the pilot studies will be expanded into initially a Tanzanian National construction materials database and eventually into a national materials management system that includes information not only on existing materials sources but also on potential sources and post-construction performance.

This project is essentially a long term project because the eventual goal is a National Database and this cannot be achieved quickly. The first step is to find and review the information that is already available. The CML has a great deal of information that could form the initial data set but there should also be numerous consultants' reports where material properties from different quarry sources have been measured and recorded. Such a search need not be restricted to LVRs only because all material sources need to be included.

A key element of the database is the range of information that it contains. A survey needs to be carried out amongst potential users of the database to determine what information they would ideally require. Bearing in mind that the cost of data acquisition depends largely on the amount of data about any specific material source that is required, it will be important to also determine the minimum data requirements that will be acceptable.

The next step is to review material databases that have been set up elsewhere and to evaluate their success and their pros and cons. A desk-based pilot trial then needs to be carried out using existing data. This needs to be evaluated and modified if necessary prior to carrying out a full field based pilot trial. This needs to include new

data from ongoing road projects plus an exploratory study in a 'virgin' area. Usually local people will know of potential sources and simple field testing can be used to obtain basic material properties although some laboratory testing will probably be required.

The success of the pilot trials will signal the beginning of a systematic programme of data collection. How this is organised and managed needs to be discussed and agreed when the pilot trials have been completed because only then will the difficulties and constraints be known.

These programmes, coupled with information documenting and cataloguing through EDMS, will form both short and long term programmes and efforts will be made to fast track existing and new research programme implementation during this Phase.

Sources of funding will be explored for both the Establishment of the DRRC and its research programme. The RFB are considering allocating a sum in the next budget for staff and facilities. Discussions will take place to seek funding for Long Term and Short Term Technical Assistance support from DFID, JICA, USAID, EU and AFCAP II as well as specific funded studies and research projects.

#### **7.4.4 Climate resilience**

Tanzania is vulnerable to climate change given that a large proportion of GDP is associated with climate sensitive activities, particularly agriculture. As described in box 5, current climate variability already results in significant costs in Tanzania, with regularly occurring annual events costing in excess of 1 percent of GDP, which could grow to 3 percent of GDP by 2030. Recent studies have concluded that Tanzania is not adequately adapted to the current climate, resulting in a large existing adaptation deficit, which future climate change can only exacerbate. Such vulnerability could prevent Tanzania from achieving key economic growth and poverty reduction targets.

Climate Change in the Transport Sector is not well understood and the associated actions not well known. There are reasonably well developed international adaptation and mitigation practices that can be applied to improve the situation. These include:

- Creation of awareness, understanding and knowledge
- Improved integration of climate data and projections into transport and road planning
- Need for modelling impacts leading to cost-benefit analysis
- Need for risk assessments and vulnerability maps
- Implementation of emergency response programmes for extreme events
- Develop adaptation frameworks
- Produce guidance on mitigation measures

#### **7.4.5 Urban congestion**

Urban centres are key engines of economic growth, contributing more than half of the national GDP. Most urban centres in the country, especially cities and municipalities, are under immense pressure, particularly arising from traffic congestion, unregulated land use development; unsustainable urban forms and settlement structures; increasing environmental degradation; and inadequate and poor basic infrastructure services.

Road congestion is now becoming very severe and PMO-RALG is responsible for implementation of Urban Transportation policies and strategies covering public and private transport, urban access, traffic management, Non-motorised transport and road safety. Further scoping is required to develop a research support programme with a view to identifying best practice and to trailing appropriate interventions and improvements.

A scoping and implementation programme will need to be developed with relevant stakeholders, including funders, in the implementation phase.

## 7.5 Knowledge, education and dissemination

In order to ensure that the DRRC is sustainable in the long term it is essential to develop comprehensive knowledge management, capacity building and training programmes.

### 7.5.1 Knowledge management and EDMS

The knowledge generated from research is valuable and should be well managed in order to contribute to national development goals. It is therefore important to establish databases and maintain knowledge generated through research activities, both from national and international sources. Similarly, access is also needed to a wide range of Standards, guides, manuals, data and reports. Accessing this information and disseminating it, is, however, particularly challenging.

The primary purpose of good knowledge management is to:

- Create awareness of information through systematic, secure, storage and sharing of data and information
- Ensuring sufficient capacity and management strategies
- Adherence to intellectual property requirements
- To provide guidance on the emerging technologies and applications for ICT.

There are three elements, as follows:

- Data  
The acquisition of knowledge is a process that commences with collection of data. Data is a collection of facts, figures and statistics related to an object or event, out of which conclusions may be drawn. It may consist of numbers, words, or images, particularly as measurements or observations of a set of variables.
- Information  
Information is data that has been processed and organized in such a way that it achieves meaning in a generalized way and can be used for decision making. Information relates to description, definition, or perspectives (what, who, when, where) and entails an understanding of the relations between data and events.
- Knowledge  
Knowledge is defined as the meaningful links people make in their minds between information and its application in action in a specific setting. Knowledge comprises strategy, practice, method, or approach.

A central digital archive will be needed as a focal point for storage, receiving and sending reports, publications, correspondences and other data. It will also be necessary to install and commission a Document Management System (EDMS). This system will improve the management of all records and publications both electronically and hard copy. A standard classification, indexing, cataloguing will need to be adopted.

It will be necessary to establish a library and Information system for Low Volume Sealed Roads to be managed under the Electronic Document Management System. Collection of Publications and CDs will need to be initiated under a filing system.

An EDMS normally contains contain the following characteristics:

- Tools that allow the capture and loading of information into the system
- Storage and archiving methods for files and documents
- The ability to support and administer any compliance or legal requirements
- Organization of documents via an indexing system
- Search tools that enable the finding and retrieval of information
- Security and access controls to stop unauthorised access to data
- An audit system to enable the tracking of the life-cycle of a document

- A workflow system that allows the automatic routing of documents to people or departments.

### 7.5.2 Training and capacity building

Training of team members of the Research Centre in the specific skills required to undertake the activities associated with research projects is a high priority task if the DRRC is quickly to build the capacity needed to become an effective organisation conducting research and producing outcomes that aid development. The engineers and other professionals in the team will require training in the design and execution of research projects so that they are carried out effectively and efficiently and deliver the project objectives on time and within budget. Assistance with this training can be provided by established research organisations such as TRL and CSIR who have access to mature researchers with long experience in conducting research and in training researchers in Africa.

The outcome of engineering and other research projects is highly dependent on the quality of the data collected from surveys, trials and laboratory testing. This information is normally collected by technical support staff under the supervision of an engineer or a person of similar standing in the DRRC. These support staff, (technicians, technical assistants, etc) will also need training in laboratory testing, in the techniques used to monitor research trials and other activities used in conducting transport research. Local organisations such as CML can meet the laboratory training needs and training in monitoring. This training together with training in any other skills required can be supplemented through external technical assistance.

It is important that these training needs are identified at an early stage and adequate funding secured for the anticipated training needs.

### 7.5.3 Information capture and dissemination

- Determine requirements with regards copyright and other governing legal instruments
- Determine type, location and relevance of existing knowledge (Manuals, books, reports, electronic media, maps, relevant regulatory, legal and policy documents etc) relevant to thematic sub-sectors
- Capture and catalogue this knowledge (or links) to enable easy interrogation, location and access (in hard copy and electronic)
- Identify opportunities to become recipient of information generated through commissioned on-going and planned DUF road projects
- Identify relevant statistical sources and where necessary establish database and record holding facilities
- Develop a knowledge dissemination strategy, including dissemination opportunities provided by electronic and other media
- Provide visibility by maximising attendance at national and regional events, representation at workshops, seminars and the like
- Provide updated information to stakeholders base through publication of regular newsletters
- Establishment of web site.

## 8. Establishment of the Road Research Centre

### 8.1 Overview

It is envisaged that this Phase 1: Development of a Road Research Strategic Plan, would be followed by an Implementation Phase. In fact, implementation has already started, a DRRC has been established and related activities are underway. This Section sets out progress made and plans for the Short Term (1 year), Medium Term (3 years) and Long Term (up to 10 years). It also sets out frameworks for establishment of a Steering Committee, priority projects and potential funding arrangements.

## 8.2 Short term

### 8.2.1 Establishment Road Research Centre covering both urban and rural road

The Director of IDU, PMO-RALG Eng E Kayanda has established the District Road Research Centre at its Head Office in Dodoma. At some stage in the future she has confirmed an intention to broaden its remit to cover all roads and even eventually, all transport. The DRRC offices are housed within the PMO-RALG Dodoma HQ and the Laboratory will be located in Dodoma Municipal Council buildings close by.

Dr Eng F F Magafu, the Head of the DRRC, based in Dodoma, is tasked with establishing the Centre and its laboratory and with developing its operations in line with the strategic plan.

Immediate actions are:

- A budget allocation for the DRRC
- An organisational structure
- Commissioning of Laboratories
- Identification of priority projects
- Activities in short and longer term.

Some of these actions are considered to be 'quick wins' which will demonstrate the value and effectiveness of the centre and will encourage early wider support.

### 8.2.2 Start-up budget

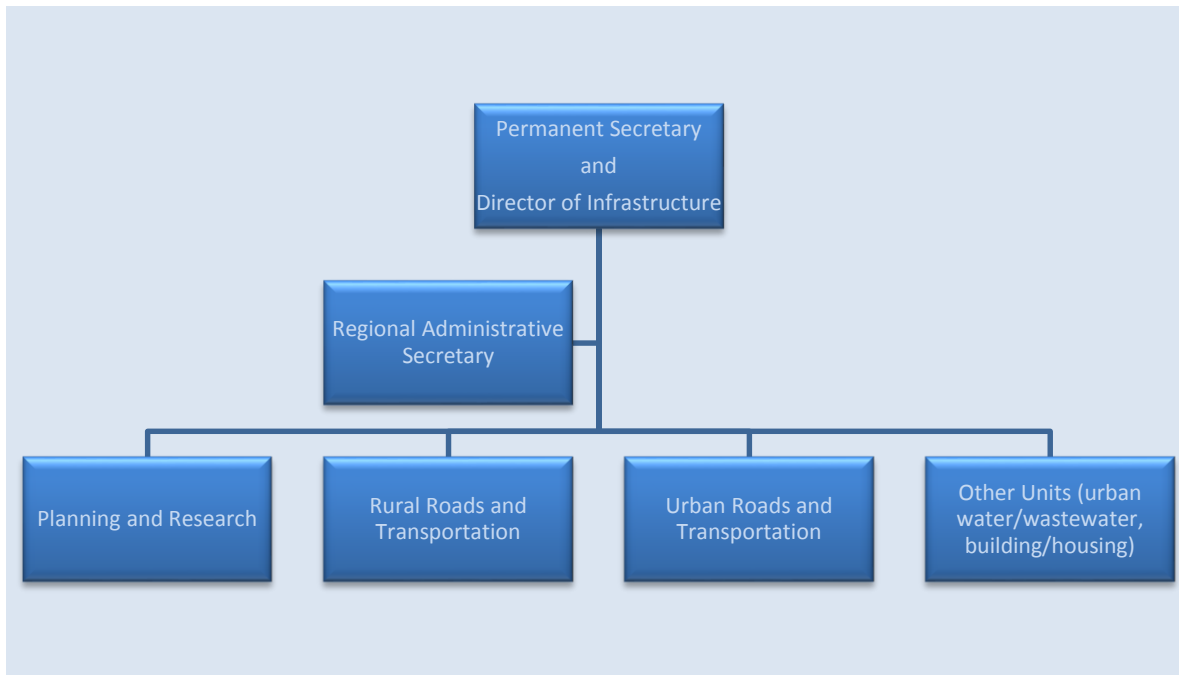
An initial budget application has been submitted to cover costs of:

- Additional staffing requirements, including training and other associated capacity building costs
- Fit out of Dodoma laboratory buildings/ facilities, established and operational within 6 months
- Vehicles, operational running costs and expenses
- ITT/ICT costs, including software for EDMS
- Land purchase for a future dedicated centre and laboratories

### 8.2.3 Organisational structure

It is intended to set up a new Directorate of Roads and Transportation, covering roads and transportation, urban water supply/wastewater and building/housing. The relevant part of that new Directorate structure, showing a Planning and Research unit, is set out below:

*Directorate of Roads and Transportation*



The IDU currently has 10 staff with 5 additional staff proposed.

It is recommended that funds should be sought to provide long term TA support to both the Director of Infrastructure and also the Head of Research to assist with the challenges of funding and implementing increases in both DP programme and RF activities.

**8.2.4 Establishment of the Road Research Technical Committee**

Key challenges for the successful development of the DRRC will be agreeing a communication research policy, priority projects and progress with the various stakeholders, monitoring progress and ensuring outputs achieve maximum economic outcomes. It is therefore planned to establish a Road Research Technical Committee (RRTC).

Its purpose will be to:

- Assist in development of research strategy to address government policies
- Review annual research plan
- Review outputs and outcomes of research programmes
- Assist in securing funds for both DRRC and its research activities
- Provide technical advice and support to Head of Research
- Help promote the work and development of the DRRC.

The RRTC should be comprised of representatives from PMO-RALG, TANROADS-CML, RFB, MOW, T2 Centre and from Development Partners. International technical experts would be invited to attend specific meetings to provide advice or make presentations on specific matters. This would be the case for LTE’s and STE’s. Its Chairman should be rotated on an annual basis and the Secretariat should be provided by the Head of Research.

**8.2.5 Establish a modern and comprehensive materials laboratory for testing of materials used in road works and quality control on projects, as well as training of laboratory personnel**

Establishment of the DRRC will require the provision of a materials laboratory to support its activities. The laboratory will be located initially at the Municipal Council offices in Dodoma. A suitable portion of the building has been identified for renovation as a laboratory together with associated offices. A budget has been established

---

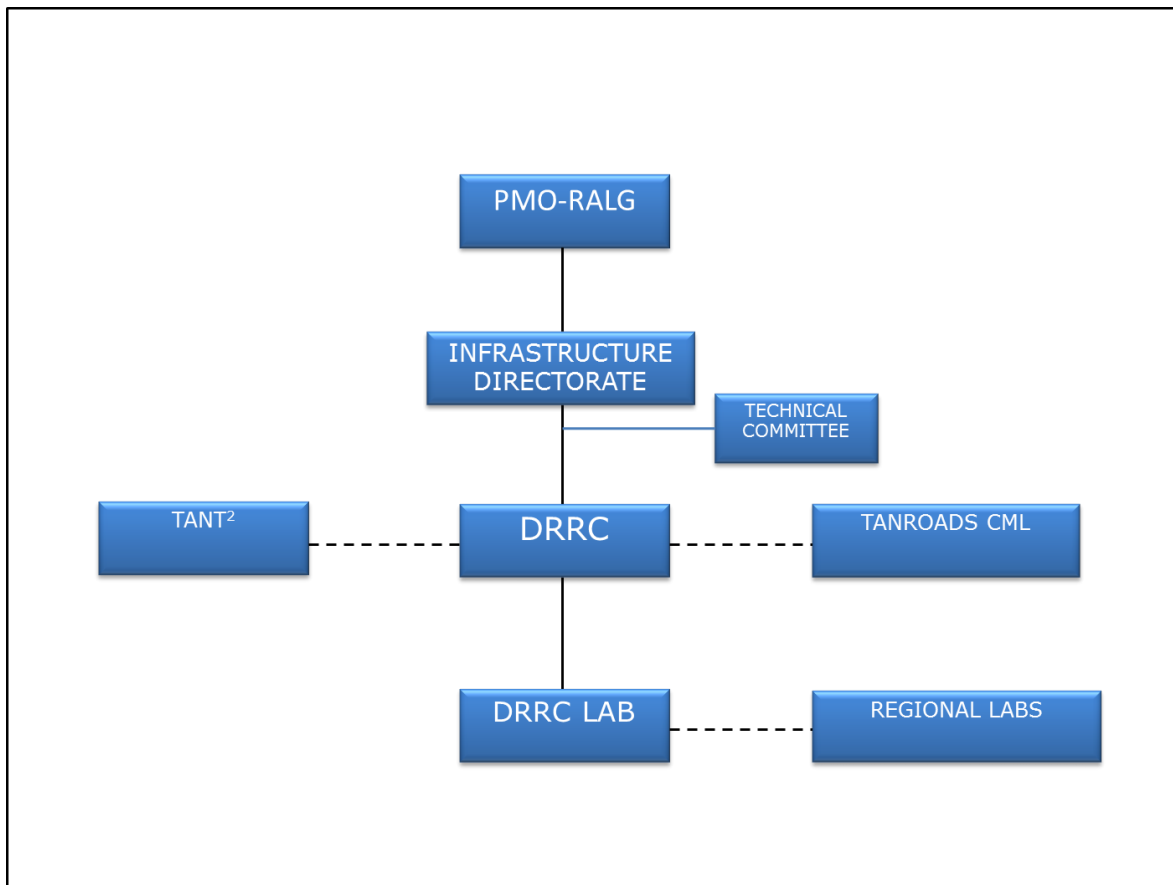
for staffing and other costs required for commissioning and running the laboratory. The initial batch of laboratory equipment has been procured by AFCAP and delivered. Additional equipment may also be required to carry out the monitoring of trial sections.

The immediate tasks to be undertaken in setting up the laboratory are:

- Visit and review current status of the building
- Commission structural building works
- Prepare outline internal plan including location of lab furnishings, equipment, plinths, etc. (Liaise with CML together with external support as required)
- Commission water supply and drainage works
- Commission electrical works
- Install laboratory furnishings (benches, cupboards etc), construct plinths
- Check equipment supplied meets requirements and prepare a list of any 'missing' items
- Arrange storage of equipment pending installation
- Commission and arrange for calibration of laboratory testing apparatus
- Recruit laboratory staff
- Prepare and begin training programme (Liaise with CML for local component: Identify additional training needs that require external support)
- Plan for district Laboratory network to be commissioned in 2015/16.

### **8.2.6 DRRC structure**

After consultations with stakeholders a conceptual structure has been developed. It reflects the need for a separate identity, as part of the Planning and Research Unit of the Infrastructure Directorate, shown above. The structure shows the two main centres – research and laboratory, the interfaces with the Steering Committee and the future Regional Laboratories and finally, the linkages with other organisations that it will cooperate with, such as TANROADS CML and TANT<sup>2</sup>.



### 8.2.7 Short term priority projects

The following projects have been identified;

- **Review of outcomes of road trials**

Research sections on the road network are usually designed to trial new, cost-effective and durable approaches to road provision. They usually take a long time to yield significant results and data, unless they fail prematurely or unless the research objective is in the construction process itself. However, useful indications to prospective long term performance and other important results often materialise during the first few years of the monitoring period.

The outcomes from the monitoring of the current PMO-RALG AFCAP road trials (and any other research projects carried out recently in Tanzania) should be reviewed by the DRRC with the objective of determining whether they provide ‘quick-wins’ in terms of demonstrating good performance. Even if the outputs are only preliminary, in terms of the anticipated technical benefits, it should be possible to calculate the economic benefits to date and the projected economic benefits. The purpose would be to use the information to fast track promising trials into the road network.

A review of similar projects undertaken in other countries, either through AFCAP or other initiatives, should also be carried out to help support the analysis and the projections for anticipated benefits from ongoing research projects.

**Cost of review and outcomes, with implementation programme for changes and detailing: £100k**

- **Best practice for use of block paving for roads and footways**

There is substantial international experience on the design, construction and maintenance of stone cobbles, setts and blockwork, for both roads and footways. These are particularly valuable in urban environments and can be taken up and relaid very economically. They have the added advantage that they can use marginal and recycled materials, local stone and are ideal for labour based activities.

**Cost of review and production of best practice guide: £100k**

- **Scoping studies for 4 strategic research programmes**

Section 8.4 sets out the four core programmes that address a large proportion of the research needs of PMO-RALG for the next 10 years. It is envisaged that these will be linked to national targets and objectives through a series of activities and research projects carried out over the short, medium and long term. These programmes will be continually reassessed and improved through a logical framework approach. It is proposed that each programme is studied in detail and analysed to set out an implementation roadmap through a scoping study. Each scoping study can be carried out either as separate studies or as one complete study. The outputs of this scoping exercise will guide the form and sequencing of a series of related projects to be implemented in the medium and long term.

**Scoping Study cost, including discussions with DP's and applications: £100k**

- **Initiate cost/benefit studies (e.g. LCA of gravelling verses LV Seals)**

The evaluation of economic benefits from research projects in Tanzania is covered to some extent in the potential benefits from undertaking the short-term activity 'reviewing the outcomes of the AFCAP road trials' but it has special significance in making the case for upgrading gravel roads. Research-based evidence for lowering the traffic threshold at which upgrading to a sealed road is economically viable has proved to be influential in increasing sealed road provision elsewhere.

With approximately 80% of the road network in Tanzania reported as being unpaved, this incurs a high cost in the maintenance required to keep these roads in sufficiently good condition that ensures that access and mobility are not impaired. Research to study the performance of unpaved roads with the objective of providing evidence for upgrading at lower levels of traffic have already been identified in this report as a priority area for the DRRC. Collection of data to provide specific evidence will depend on factors such as location, material, terrain etc and are likely to be at least medium term in duration. However, by using existing information coupled with proxy data, and by the application of expert engineering judgement, it should be possible to produce a provisional case for upgrading from which a revised set of national targets could be developed.

Studies have already been carried out in various countries in this area of research (e.g. country projects by TRL/ILO), a methodology for evaluating life-cycle costs and benefits has already been developed. Therefore, a review of this research with comparative evaluation between Tanzania and other countries of the circumstances in which the results favour upgrading could be highly beneficial and provide a 'quick win' in terms of the potential economic benefits for the country.

**Cost of CBA study, reporting and dissemination programme: £150k**

- **Embedment of new AFCAP LV roads design manuals**

A project is currently being undertaken under AFCAP, on behalf of PMO-RALG, to develop a Low Volume Roads Manual for Tanzania. The manual is expected to contain a comprehensive cover of the components of road design as indicated in the table in Section 5.4. The DRRC can play an important role in training and capacity building, perhaps in collaboration with organisations such as Tanzania T2, promoting the acceptance of the manuals and their implementation by practitioners. This activity to aid embedment in road provision practice could serve as an early demonstration of the influence and effectiveness of the DRRC.

(The subsequent revision of the manuals, as they are modified on the basis of research outcomes, to better reflect the needs of Tanzania, will be a longer term activity).

**Cost of dissemination and training programme: £150k**

- **Review of gravel roads maintenance manuals and procedures with a view to updating:**

PMO-RALG currently use maintenance manuals for gravel roads produced by ILO in the 1980's. TANROADS CML use their own document produced in 1990's. Both are considered to be out of date. A review is needed of their content, what modifications can be applied to bring a new document in line with best international practice and production of a revised manual.

**Cost of production of manual: £200k**

- **Develop data management systems for research projects being undertaken throughout the country**  
Data is the lifeblood of research but, in general, it is expensive to obtain. Data must be checked properly for accuracy/correctness and stored in a safe and retrievable manner for use whenever it is needed. The same is true of research reports. Electronic systems are now available to enable this to be done relatively easily and the services of an IT specialist will be required.

**Cost of stage 1: Establish database £50k**

- **Initiate International Best Practice programme on demonstrations/trials, standards, specifications, manuals**

The DRRC role in promoting and assisting in the implementation of the new design manuals has been mentioned above. However, this DRRC role applies to all relevant documentation either in its present form, if directly applicable for Tanzania, or in providing opportunities for planning and designing research projects to produce the outputs required to modify these documents so that they fully meet the country's needs.

A 'quick win' project would be a review of the current documents available (the most recent of which will include AFCAP manuals, standards and specifications) with recommendations for their adoption, modification or rejection as appropriate.

Similarly, experience reported from other countries (see AFCAP reports on the website) on the problems incurred and the benefits obtained from setting up specific trials could also be of considerable benefit to the DRRC in compiling its research programme. This would also reduce the need for repeating some of the work whilst also reducing the lead time for the establishment of similar trials where these are deemed necessary.

**Review of best practice and case studies: £75k**

- **Establish a knowledge management facility for cataloguing, storage and dissemination of knowledge**  
There is a need to establish linkages between this facility and others such as CML, as well similar facilities in the region and internationally. Access to knowledge in the form of research papers, conference reports, manuals and guidelines, enable researchers to avoid duplicating research whilst accessing projects which provide ideas for new research and the local calibration of relevant research conducted elsewhere.

**Establish facility: £20k****8.2.8 First year business plan**

The following activities will be carried out in the first 12 months.

### 8.2.8.1 Short term planning

A concept plan for a DRRC Cost Centre for the first year has been established. Job descriptions, roles and responsibilities and recruitment will be implemented within 6 months. The key elements are:

- **Research Centre at Dodoma**
  - 1No Head of Research
  - 2No Researchers
  - 1No Librarian/Administrator
  - 1No ICT/software technician
- **DRRC Laboratory at Dodoma**
  - 1No Laboratory Manager
  - 2No Technicians
  - 2No Support Staff
- **Planning for Zonal Laboratories for medium term**
- **Short term and longer term TA**

In order to create long term sustainable capacity it will be necessary to use Technical Assistance support, funded by DP's and the RFB. Initially, this should be 1No Long Term Research Expert for up to 3 years and 3No Short Term Experts (12man-months initially). In addition, a long term TA support is needed for the Director of Infrastructure to assist her increase the effectiveness of the next years programme.

Priorities for the TA Team would be to assist and advise the Head of Research including:

- Assist with short term 'quick win' activities
  - Plan and detail long term programmes and projects
  - Programme manage funded studies
  - Capacity building and training
- **Liaison with DP/RFB for long term programming**

### 8.2.8.2 Professional career progression:

Definition of senior status and remit of the newly appointed Head of Research is needed, including first year targets. In addition, a programme of training, capacity building, study tour and overseas visits should be agreed.

In the long term career progression, remuneration and training will need to be developed for all DRRC staff in order to strengthen retention and to improve qualifications and experience. A relevant HR and training plan will be required.

### 8.2.8.3 Development of funded research programme

In conjunction with the RRTC, develop a series of research briefs to be carried out under contract and managed by TA support initially.

## 8.3 Medium term activities

Priority Research & Development, information and dissemination of programmes relevant to the strategic plan comprise:

- Improved technologies and methodologies for investigation, surveys, testing, modeling, monitoring and evaluating performance of roads
- Improved pavement designs for road upgrading, reconstruction, rehabilitation and strengthening works by roads authorities for prolonged life

- Construction and maintenance quality control systems including post construction evaluation
- Maintenance of pavement construction and maintenance data base
- Research on more economic road development, maintenance, and operations including research on new construction materials, construction methods and road safety studies
- Development and review of materials testing standards, road design manuals and standard specifications for construction and maintenance of roads in conjunction with stakeholders
- Database development and research management covering national materials inventory, properties of soils and rocks, roads condition and traffic flows
- Training and capacity building in research and innovation
- Publication and dissemination of research findings.

### 8.3.1 DRRC

Activities to help development of the DRRC in the medium term are:

- **Progressively establish research representatives in all Regions and Councils and a research forum.** Consideration will be given to how the DRRC interfaces with the Regions and Councils, as well as the various stakeholders. In order to engage more effectively, the Acting PS, PMO-RALG is seeking to establish Research Representatives across Tanzania. The practicality of this, along with the possibility of setting up a Research Forum, will be assessed.
- **Become a leading institution dedicated to research on all matters related to district road asset management, road design, construction, maintenance and operation.** Such research will be carried out in a number of ways, including:
  - Outsourced to academic institutions (e.g., graduate and post-graduate programmes at Universities of Dar es Salaam & other tertiary institutions
  - Through local and international consultants
  - Through International research organisations.

Research carried out by academic institutions has the main objective of satisfying the requirements for the qualification at the appropriate level. Nevertheless many research projects will have sub-components that are ideally suited for projects for students, for establishing partnerships with academic institutions and provide opportunities for students to be exposed to, and participate in, research which directly benefit to local people.

- **Provide services for quality control of construction projects being undertaken on the District and Urban road network** It is one of the tasks of the DRRC to help improve the quality of construction. Specifications normally spell out the quality control testing required on road projects but these are often not followed. It is suggested that each year a sample of projects is visited and advice and help provided to the District Engineer and the consultants and contractors as well as checking the quality control. The DRRC laboratories will also be able to provide testing services to the District Engineers.
- **Undertake independent Technical Audits of selected road projects where quality is suspected to have been compromised** In addition to the general audit, training and testing role described above, DRRC will also have responsibility for investigating problems with quality that have been reported. This may involve more comprehensive testing than normal and may involve road failure investigations.
- **Develop and verify new design and operational standards and specifications for the use of materials in road construction and maintenance systems** This is a key role for the DRRC and one which is essentially an ongoing programme. There are already a number of trial sections of road constructed under several programmes. The benefits of these are only revealed by their durability and low maintenance costs and therefore whole life costing principles must

be used. To quantify this, the trials need to be monitored for a number of years. Not only is some relaxation of material specifications possible but the thickness design is being researched and revised.

- **Periodically review existing manuals for appropriateness, and develop new standards and specifications as may be required**

Research carried out elsewhere in Eastern and Southern Africa is leading to revised specifications and design methods. It is not necessary for Tanzania to repeat this research but it is essential that DRRC reviews it to allow decisions to be made about potential adoption.

### 8.3.2 Medium term programmes and projects

Medium term research programmes will continue to concentrate on the four strategic research programme areas set out in Section 8. Initially, the DRRC is unlikely to be staffed by people with sufficient research experience to enable it operate at optimum capacity. TA support is likely to be required in the short to medium term to help develop the research programme, implement research activities build capacity and enable medium-term projects, such as those listed below, to achieve their objectives. Possible support funding for TA activities could be available through partner development programmes such as those funded by DFID, JICA, EU, World Bank, etc.

- **Road trials, demonstrations and monitoring**

Road performance trials are usually constructed to provide whole-life evidence on performance and cover a wide range of design, materials and construction aspects. The final outcomes, in terms of recommendations, in respect of changes in design and specifications are often long term. However, experiences from adopting different construction techniques can provide short to medium-term benefits, whilst results from the pavement performance monitoring programme can provide impacts that can be described as medium-term (e.g. which sections are failing prematurely, which are showing signs of enhanced durability, etc). These are important medium-term outcomes from the monitoring of existing trials, which could indicate an immediate change in design/specifications for the materials used in the trials, a need to modify the direction of the research or the need for additional supplementary research.

The current trials constructed under AFCAP are intended to investigate various surfacing techniques using a selection of materials and these are expected to produce useful results but new trials will also need to be established to meet the needs of the road sector in Tanzania. These trials can build on existing research but should be extended, for example, to cover the wide range of materials and investigate new construction techniques.

AFCAP's aim is to help deliver safe and sustainable access and under this programme and others, new approaches to the delivery of roads are constantly being developed. An important medium –term activity will be to liaise with other researchers in AFCAP, review research being undertaken elsewhere to assess the possible benefits of the outcomes of the research to Tanzania and establish similar research projects, where necessary, to calibrate their application in Tanzania.

Tasks to be undertaken by the DRRC in the medium term include:

- Continue to monitor current trials
- Construct new trials to demonstrate economic benefits of improved design approaches
- Construct new trials on the use of local materials in road projects, including Otta seals, cobble stones, etc
- Examine opportunities to exploit climatic variations/change on road designs for Tanzania
- Review performance of bottleneck interventions

- **Road asset inventory, condition and data**

There is uncertainty about the accuracy of the inventory, condition and trafficking data of the rural road network in Tanzania. From a research perspective, it is of paramount importance that the network is comprehensively

defined in terms of the location, condition and the function of the various network links. The responsibility for ensuring an accurate inventory of the network lies with PMO-RALG but the DRRC will need to be involved in the definition and performance requirements and will liaise closely with the contractors undertaking the different road inventory assignments. The management of data and research, from a perspective of monitoring and evaluation, will be part of the policy evaluation responsibility of the DRRC.

A series of projects are envisaged, carried out by contractors and researchers, to define spatial location and condition of the road network and associated assets, current uses and trafficking and forward planning and maintenance. The collection and analysis of data will be particularly valuable for the activities of the DRRC.

- **National road material and aggregates database and inventory**

The benefits of establishing a comprehensive inventory of road-building materials, including location, volume, condition and properties are set out in Section 8.4.3. Knowledge of the location and use of the available materials will be of particular importance to the activities of the DRRC, especially for selecting the location and sites on project roads for research and for providing evidence for making the case of upgrading to bituminous surfacing.

The DRRC needs to be closely involved in the development of a materials inventory as a medium-term activity and the information obtained during its compilation for research purposes. The main tasks in setting up the inventory are likely to include:

- Transfer existing locational data held on files to geographical coordinates
- Link the data to a GIS of the road network
- Undertake prospecting and laboratory materials testing (DRRC)
- Interrogate the data to select research projects on road building materials (DRRC)
- Determine the location for prospective sites for research (DRRC)

- **Climate resilience**

Climate change effects result in more extreme events such as rainfall of longer duration and higher intensity, storms and thunderstorms, high winds, drought and more extreme temperatures. Roads and structures on rural roads are particularly vulnerable to changes in rainfall and runoff and to flooding, erosion and instability.

Projects for consideration include:

- Education and dissemination of current practice
- High level infrastructure vulnerability assessment based on current climatological data
- Production of guidance on design and construction interventions and adaptation activities
- Interventions programming and implementation
- Regional vulnerability assessment with intervention plans

- **Urban congestion**

A range of interventions can be applied to urban congestion and these would normally be linked with a Transportation Masterplan and with Transport Policy. Typically, this would also involve an integrated transport approach and multi-modal solutions. Within this programme options would be investigated, designed and trialled such as:

- Orbital and ring roads
- Urban motorways
- Park and ride
- Bus Rapid Transit
- Interchanges, crossroads, roundabouts with integrated signalling
- Re-routing and one-way systems

- Traffic control systems
- Light rail and metro
- Congestion charging

Research can play a lead role in investigating best practise, international experience and in data analysis, monitoring and evaluation. A separately funded project is needed to define a roadmap.

- **Other areas of research for consideration include:**

- Road safety implementation programmes
- Ground improvement and stabilisation technologies
- Use of marginal materials/improvement of material properties
- Labour based and community based road construction and maintenance
- Traffic flow and incident management
- Investigation into construction cost reductions
- Best practice for bottlenecks
- Case Studies
- Alternatives for dealing with traffic congestion in Dar es Salaam
- To enhance capacity for local contractors
- To find new ways to construct and maintain roads at significantly reduced rates.

#### **8.4 Long term plans**

The long term plans, looking forward say 10 years, are to establish a fully functioning DRRC with its own buildings and facilities and a staff compliment of about 30, covering research and laboratories. Additional laboratory staff will be needed if more than 3 zonal laboratories are established and if field testing comes under the responsibility of the DRRC.

The actual size and range of activities will be partly a function of the national targets and policies and also of the scale of available funding from the RFB and from Development Partners.

It is anticipated that the DRRC will collaborate with other national organisations and also with international institutions. These plans will be set out and detailed during Phase 2, Implementation.

Plans should cover how the DRRC will evolve with time and its role relating to wider 'roads and transport'.

## Appendices/

### Appendix 1: Bibliography

- National Vision 2025, Tanzania (1999)
- National Transport Policy, Revised 2012. Draft Final Report.
- 10-Year Transport Sector Investment Programme (TSIP), Phase 2 (FY2012/13 – FY2016/17)
- Local Government Transport Programme (LGTP), Phase 2 (2012/13-2016/17)
- Urban Development Management Policy (2013)
- National Environmental Policy (1997)
- The Case for Transport Research in Tanzania, its Funding and Institutional Location (2012), Transport Policy Support Programme, MOT
- Tanzanian Standard Specification for Road and Bridge works
- Tanzania Laboratory Testing Manual
- Tanzanian Environmental Code of Practice for Road Works
- Tanzanian Field Testing Manual
- Tanzanian Road Sector Environmental Assessment and Management Guidelines
- Tanzania Improved Maintenance Systems
- Tanzania Stone pavement Manual
- Ethiopian Design Manual for Low Volume Roads Part C
- Ethiopian Design Manual for Low Volume Roads Part E
- Ethiopia Best Practice Manual for Thin Surfacing
- Ethiopian Site Investigation and Route Selection Manual
- Botswana Guideline on the Use of Marginal Surfacing Aggregates (2008)
- Zimbabwe Guideline on Quality Control Testing on Labour-based Gravel roads – for ILO in Zimbabwe.
- Zimbabwe: Min. of Works: Pocket Guideline on the Design of Low Volume Roads
- Guidelines on Materials and Borrow Pit Management for Low Cost Roads (2000), Roughton.
- ARRB Sealed Local Roads Manual
- ARRB Unsealed Roads manual
- S. Africa-Western cape Provincial Admin., Dept. of Public Works: materials Manual (2004/2005).
- S. Africa. TRH4 1966-Structural Design of Flexible Pavements for Inter-Urban and Rural Roads.
- Southern Africa Transport and Communications Commission (SATCC): Guideline for Low Volume Sealed Roads (2003)
- AFCAP Reports and Publications
- National design guides, manuals and handbooks
- The Functions and Organisation Structure of the Prime Minister's Office, Regional Administration and Local Government, President's Office (June 2011)

## Appendix 2: List of Consultees

The following is a list of those attending Workshops. These include:

- Dr Deo M Mtasiwa Ag PS PMO-RALG
- Eng Elina Kayanda Director PMO-RALG
- Members of PMO-RALG IDU
- Members of PMO-RALG DUD
- Eng. Rehema Myeya, MOW
- Yumiko Takeda, Project Coordinator, JICA
- Salimu Kijaka, Coordinator, RMSD/JICA
- Richard Mwakasitu, TA to USAID, Feed the Future
- District Engineers
- Municipal Engineers
- Eng. E. W. Raphael ATTI-MBEYA
- Emanuel E. Tarimo TANROADS-Dodoma
- Nkululeko Leta, Technical Manager – AFCAP
- Hagai K S Bishanga – TANT<sup>2</sup> Centre
- Eng M Mataka – TANROADS CML
- Rashid S Kalimbaga - RFB
- Boniphace Marwa – USAID
- Prof Donath Mrawira – University of New Brunswick
- Dr John Rolt – TRL
- Tony Greening – TRL
- Mike Head – Cardno IT Transport

Others consulted include:

- Dick Komakech, TA to DFID
- Jan Bijl, TA to EU
- Dave Jennings, TA to EU
- Eng Salimu Kisaka, TA to JICA
- Tatsumi Tokunaga, TA to JICA
- Sion McGeever, DFID
- Mike Pinard, AFCAP Consultant
- John Malisa, TANROADS-CML
- Joseph O Haule, RFB
- Ronald Lwakatara, RFB
- Prof Phil Paige-Green, AFCAP Consultant
- OZEKI Yuzuru, Transport Policy Advisor, JICA
- KIMATA Yoichiro, Senior Representative on Local Governance, JICA
- KOBE Nobuyuki, JICA
- Jonathan Saiger, MCC DCO/EASA
- Jozefina Cutura, MCC DCO/TSD
- Stacy Alboher, MCC DCO/EASA
- Tomas Kaluzny, USAID
- Yonas Nchomvu, WB
- Moroni Fabrizio (EEAS-DAR ES SALAAM)
- Negedi Lewi, WB

## Workshop Attendees

### Inception Meeting in Dodoma

Sr. No.	Name	Position / Function	Address (P.O Box, Town)	Tel. (Office ) & Mobile	E-mail address
1	Dr Deo .M.Mtasiwa	DPS (H)	PMORALG	0754-474346	<a href="mailto:dmtasiwa@hotmail.com">dmtasiwa@hotmail.com</a>
2	Eng Elina Kayanda	DID	PMORALG	0713 -448835/ 0752-448835	<a href="mailto:elikayanda@yahoo.co.uk">elikayanda@yahoo.co.uk</a>
3	Eng Chacha Mwita	Civil Engineer	IDU/PMORALG	0784-706763	<a href="mailto:pechsam@hotmail.com">pechsam@hotmail.com</a>
4	Faustine Barayata	QS	IDU/PMORALG	0756-529898	<a href="mailto:barayataf@yahoo.com">barayataf@yahoo.com</a>
5	Justin .M. Lyatuu	Economist	IDU/PMORALG	0713-565274	<a href="mailto:j2000lyatuu@gmail.com">j2000lyatuu@gmail.com</a>
6	Girbert Mfinanga	Civil Engineer	IDU/PMORALG	0754-096433	<a href="mailto:mfinangagwk@yahoo.com">mfinangagwk@yahoo.com</a>
7	Eng Jackson Masaka	Civil Engineer	IDU/PMORALG	0782-877054	<a href="mailto:smasakas@yahoo.com">smasakas@yahoo.com</a>
8	Dick Komakech	TA-DFID	IDU	0686-573951	<a href="mailto:dick.komakech@ittransport.com">dick.komakech@ittransport.com</a>
9	Nkululeko Leta	Technical Manager	AFCAP	0753-733204	<a href="mailto:Nkululeko.leta@uk.crownagents.com">Nkululeko.leta@uk.crownagents.com</a>
10	Richard C.Kehengu	PV-DUD	DUD-PMORALG	0752-955500	<a href="mailto:rkehengu@yahoo.com">rkehengu@yahoo.com</a>
12	Eng Godwin Mpinzile	District Engineer - Chamwino	Chamwino District Council	0784-723455	<a href="mailto:mpinzilegs@gmail.com">mpinzilegs@gmail.com</a>
13	Ally Kassinge	SHRO	DLG-PMOLAG	0767-984876	<a href="mailto:amakassing@yahoo.com">amakassing@yahoo.com</a>

## Workshop Attendees

14	Eng Hamidu Mataka	Civil Engineer	IDU-PMOLAG	0713-563645	<a href="mailto:hamidumataka@yahoo.com">hamidumataka@yahoo.com</a>
15	Eng.E. W. Raphael	Principal	ATTI-MBEYA BOX 1957 MBEYA	0754-635533	<a href="mailto:ewansirap@yahoo.co.uk">ewansirap@yahoo.co.uk</a>
16	Eng Girbert Mwoga	Engineer	IDU-PMOLAG	0754-872131	<a href="mailto:gmwoga@yahoo.com">gmwoga@yahoo.com</a>
17	Eng Mkwata MM	RSE	Dodoma Regional	0715-586521	<a href="mailto:m-mkwata@yahoo.com">m-mkwata@yahoo.com</a>
18	Geofrey P.Mkinga	District Engineer Bahi	Bahi District Council	0754-398621	<a href="mailto:g-mkinga@yahoo.com">g-mkinga@yahoo.com</a>
19	T .Bagandanshwa	ADPP	PMOLAG	0754-696243	<a href="mailto:tbagandanshwa@yahoo.com">tbagandanshwa@yahoo.com</a>
20	Edina Mwaipopo	Ag.DRA	PMOLAG	0754-749145	<a href="mailto:edinamwa@yahoo.com">edinamwa@yahoo.com</a>
21	Ainekisha M.John	Architect	PMOLAG	0757-610176	<a href="mailto:johnainekisha@yahoo.com">johnainekisha@yahoo.com</a>
22	James E. Mapunda	Town Planner	PMOLAG	0765-817972	<a href="mailto:jampson44@yahoo.com">jampson44@yahoo.com</a>
23	Adam J.Mbeyela	Economist	PMOLAG	754-418102	<a href="mailto:mbeyela2006@yahoo.co.uk">mbeyela2006@yahoo.co.uk</a>
24	Eliurd L. Mwaiteleke	Economist	PMOLAG	0763-686106	<a href="mailto:mwekindu@gmail.com">mwekindu@gmail.com</a>
25	Edwin Mgendera	Ag.DLS	PMOLAG	0715-430222	<a href="mailto:edwin.mgendera@yahoo.com">edwin.mgendera@yahoo.com</a>
26	Kedmon L. Malima	District Engineer -	Dodoma Municipal Council	0755-540535	<a href="mailto:eng.malima@yahoo.com">eng.malima@yahoo.com</a>
27	Emanuel E. Tarimo	Civil Engineer	TANROAD-Dodoma	0754-285037	<a href="mailto:emmanuelelizana@yahoo.com">emmanuelelizana@yahoo.com</a>

## Workshop Attendees

First Workshop in Morogoro					
S/N	NAME	POSITION/FUNCTION	ADDRESS (P.O. BOX TOWN)	TEL. (OFFICE & MOBILE)	E-MAIL ADDRESS
1	GODWIN MPINZILE	DISTRICT ENGINEER CHAMWINO DC	P.O. BOX 598, DODOMA	026 2390194, 0784 723455	<a href="mailto:mpunzilegs@gmail.com">mpunzilegs@gmail.com</a>
2	SASOCHE MATENYA	FOR: MUNICIPAL ENGINEER - DODOMA	P.O. BOX 1249, DODOMA	0716 515105, 0767 515105	<a href="mailto:sam.ek2011@gmail.com">sam.ek2011@gmail.com</a>
3	GILBERT MWOGA	PRINCIPAL ENGINEER - PMO - RALG	P.O. BOX 1923, DODOMA	026 2322051, 0754 872131	<a href="mailto:gmwoga@yahoo.com">gmwoga@yahoo.com</a>
4	AMBARI IDABAGA	MATERIALS ENGINEER - CML TANIZOAD	P.O. BOX 9452, DSM	022 2866068, 0754 372424	<a href="mailto:idabaga@yahoo.com">idabaga@yahoo.com</a>
5	MKWATA M.M.	RSE - DODOMA	P.O. BOX 914, DODOMA	0715 586521	<a href="mailto:m_mkwata@yahoo.com">m_mkwata@yahoo.com</a>
6	ENG. DR. MAGAFU, FF	DISTRICT ENGINEER - RUFUJI	P.O. BOX 28, UTETE - RUFUJI	0756 494079	<a href="mailto:fikirimagafu@yahoo.co.uk">fikirimagafu@yahoo.co.uk</a>
7	ENG. HAMIDU MATAKA	ENGINEER - PMO - RALG	PMO - RALG	0713 563645	<a href="mailto:hamidumataka@yahoo.com">hamidumataka@yahoo.com</a>
8	DR TASUMI TOKUNASA	PROJECT LEADER/RMSD	JICA/EJEC	0787 710257	<a href="mailto:takunaza-ta@ej-hds.co.jp">takunaza-ta@ej-hds.co.jp</a>

## Workshop Attendees

9	YUMIKO TAKEDA	RMZA/JICA AS A PROJECT COORDINATOR		0768 464188	<a href="mailto:yumiko_takeda@cdc-kobe.com">yumiko_takeda@cdc-kobe.com</a>
10	SALIMU KIJAKA	RMSD/JICA	COORDINATOR	0755 497864	<a href="mailto:salimukisaka@yahoo.com">salimukisaka@yahoo.com</a>
11	ENG. DIGAGA, ABDULR	MUNICIPAL ENGINEER - MOROGORO	P.O. BOX 166, MOROGORO	0715 488896	<a href="mailto:a_digaga@yahoo.com">a_digaga@yahoo.com</a>
12	NKULULEKO LETA	TECHNICAL MANAGER - AFCAP	AFCAP		<a href="mailto:nkululeko.leta@gmail.com">nkululeko.leta@gmail.com</a>
13	ENG. REHEMA MYOYA	ENGINEER MOW	P.O. BOX 9423, DSM	0766 892944	<a href="mailto:nyayarehem@yahoo.com">nyayarehem@yahoo.com</a>
14	ENG. H.S. KATOTO	ENGINEER - MDC - MOROGORO DC	P.O. BOX 1880, MOROGORO	0654 653441	<a href="mailto:hskatoto@yahoo.com">hskatoto@yahoo.com</a>
15	Tony Greening	LV Roads expert, TRL Ltd	UK		<a href="mailto:tonyk.greening@sky.com">tonyk.greening@sky.com</a>
16	Mike Head	Team Leader, ITT Ltd	UK		<a href="mailto:mikehead7@gmail.com">mikehead7@gmail.com</a>
17	Richard Mwakasitu	Senior roads Engineer, USAID, Feed the Future	P.O. BOX 608, MOROGORO		<a href="mailto:richard.mwakasitu@yahoo.com">richard.mwakasitu@yahoo.com</a>

## Workshop Attendees

---

### Workshop 2, Protea Courtyard Hotel, Dar es Salaam    Tuesday 13 may 2014

S/N	Name	Organisation	Contact
1	Emily Kagaigai	PMO-RALG	<a href="mailto:emily.kagaigai@yahoo.com">emily.kagaigai@yahoo.com</a>
2	Jackson Masaka	PMO-RALG	<a href="mailto:smasakas@yahoo.com">smasakas@yahoo.com</a>
3	Hamisi S Katoto	Morogoro D.C.	<a href="mailto:hskatoto@yahoo.com">hskatoto@yahoo.com</a>
4	Tony Greening	Consultant to AFCAP	<a href="mailto:tonyk.greening@sky.com">tonyk.greening@sky.com</a>
5	Godwin Mpinzile	Chamwino D.C.	<a href="mailto:mpinzilegs@gmail.com">mpinzilegs@gmail.com</a>
6	Eng M M Mkwata	R S Dodoma	<a href="mailto:m_mkwata@yahoo.com">m_mkwata@yahoo.com</a>
7	Hagai K S Bishanga	TANT <sup>2</sup> Centre	<a href="mailto:hbishanga@yahoo.com">hbishanga@yahoo.com</a>
8	Eng M Mataka	TANROADS – CML	<a href="mailto:mussamataka@yahoo.co.uk">mussamataka@yahoo.co.uk</a>
9	Faustine Barayata	PMO-RALG	<a href="mailto:barayataf@yahoo.com">barayataf@yahoo.com</a>
10	Rashid S Kalimbaga	Road Fund Board	<a href="mailto:rkalimbaga@gmail.com">rkalimbaga@gmail.com</a>
11	Nkululeko Leta	AFCAP	<a href="mailto:nkululeko.leta@gmail.com">nkululeko.leta@gmail.com</a>
12	Elina N Kayanda	PMO-RALG	<a href="mailto:elikayanda@yahoo.co.uk">elikayanda@yahoo.co.uk</a>
13	Gilbert Mwoga	PMO-RALG	<a href="mailto:gmwoga@yahoo.com">gmwoga@yahoo.com</a>

## Workshop Attendees

---

14	Boniphace Marwa	USAID	<a href="mailto:mmarwa@usaid.gov">mmarwa@usaid.gov</a>
15	Eng John Mbozu Nchilla	Dodoma Municipality	<a href="mailto:inchilla2003@yahoo.com">inchilla2003@yahoo.com</a>
16	Prof Donath Mrawira	Univ of New Brunswick	<a href="mailto:donath17@gmail.com">donath17@gmail.com</a>
17	Eng Abdul R Digaga	Morogoro M. C.	<a href="mailto:a_digaga@yahoo.com">a_digaga@yahoo.com</a>
18	Eng Fikiri F Magafu	PMO-RALG	<a href="mailto:fikirimagafu@yahoo.co.uk">fikirimagafu@yahoo.co.uk</a>
19	Mike Head	Consultant to AFCAP	<a href="mailto:mikehead7@gmail.com">mikehead7@gmail.com</a>
20	Dr John Rolt	Consultant to AFCAP	<a href="mailto:j.rolt@sky.com">j.rolt@sky.com</a>



## Appendix 3: Examples of Road and Transport Research Centres

- **ARRB, Australia ([www.arrb.com.au](http://www.arrb.com.au))**

ARRB provides research, consulting and information services to the road and transport industry. It applies research outcomes to develop equipment that collects road and traffic information and software that assists with decision making across road networks. ARRB's member agencies include federal, state and local government bodies and is a not-for-profit entity.

Key strategies include:

- conducting multi-disciplinary programs of research on national priorities for Austroads
- consulting services for members and the industry
- creating a hub for road industry knowledge and experience which provides certainty and reliability in information
- expanding knowledge sharing and transfer activities to meet industry needs
- developing and commercialising innovative technology and systems.

### Areas of expertise

ARRB Group's capabilities cover the full spectrum of road transport operations including:

- materials, pavement and concrete design and testing
- transport policy, operations and economics
- infrastructure asset management
- bridge management and evaluation
- equipment manufacture and data collection services
- road safety
- traffic engineering & road design
- heavy vehicle testing and simulation
- parking
- climate change
- land transport resources and information
- knowledge transfer and capacity building.

### Customers include:

- all state and territory road authorities within Australia
- national governments in Australia and New Zealand
- local government including local councils and associations
- state government
- national bodies and associations
- Australian and international aid agencies
- transport and mining companies
- private and engineering consultancies
- major construction firms
- defence, water, parks and wildlife government departments.

ARRB supports the activities and outcomes of its members and other customers across a range of industry sectors by:

- delivering technical expertise in areas of particular importance to Australasian road authorities through the Sustainable Expertise Model (SEM)

- managing a \$10 million research investment portfolio on behalf of road agencies
- sourcing and disseminating to members and customers world-class research and technical information
- operating as a commercially viable and sustainable business.

### **WAPARC**

The Western Australian Pavement Asset Research Centre (WAPARC) is a collaboration between ARRB, Main Roads Western Australia and several WA universities. It has a dual aim of developing pavement research capability in Western Australia and investigating pavement performance. ARRB acted as trusted pavement research advisors to Main Roads before the establishment of WAPARC and is fulfilling the Centre Director role, ensuring its focus on local issues while informing and being informed by the National Austroads program.

### **TSD and ROADCRACK**

ARRB is working collaboratively with an international equipment developer, Austroads and its members to better understand and maximise the potential benefits of new technologies for assessing the structural capacity of the \$200bn road network.

### **TRL, UK ([www.trl.co.uk](http://www.trl.co.uk))**

**TRL provides independent and impartial world-class research, consultancy, testing and certification for all aspects of transport.**

Originally established in 1933 as part of the UK government, TRL privatised in 1996 to become a fully independent private company. TRL is wholly owned by the Transport Research Foundation (TRF), a non-profit-distributing foundation with no shareholders, enabling profits made by TRL to be passed to TRF and re-invested in scientific research. TRF is comprised of over 80 sector members from the transport industry. It has 320 staff, many of whom are world-recognised experts, for customers on a wide range of projects from transportation to safety and environmental issues, from risk and infrastructure management to simulation and testing.

### **Customers**

Its customers include organisations from multiple sectors including:

- governments
  - consultants
  - emergency services
  - IT
  - motor sport
  - security
  - legal
  - software
  - local authorities
  - manufacturers
  - commerce
  - aid agencies
  - regulatory bodies.
- **[Transport Infrastructure Engineering, CSIR, South Africa \(www.csir.co.za\)](http://www.csir.co.za)**

The Council for Scientific and Industrial Research (CSIR) in South Africa is one of the leading scientific and technology, research, development and implementation organisations in Africa. It undertakes directed research

and development for socio-economic growth. Projects are undertaken in collaboration with international, national, provincial and municipal road authorities and agencies, universities, private sector associations, consultants, manufacturers, producers and contractors; while international networks facilitate the transfer of cost-effective technologies to South Africa. Team members also transfer knowledge to build sector capacity locally. Core focus areas are:

- Road engineering and materials
- Rail infrastructure engineering.

### Capabilities, research areas, competences and facilities

<b>Capability</b>	<b>Pavement design and construction</b>
<i>Research areas</i>	Design, construction and maintenance of transport infrastructure assets (roads, streets, airports, railways); and support a sustainable and cost-effective transport network
<i>Competences and facilities</i>	<ul style="list-style-type: none"> <li>• Materials, including traditional, alternative, waste and novel materials, also supporting environmental engineering and climate change mitigation and adaptation</li> <li>• Engineering design, analysis and modelling supporting sustainable construction</li> <li>• Vehicle-pavement and infrastructure-environment interaction</li> <li>• Geotechnical engineering</li> </ul>

<b>Capability</b>	<b>Accelerated pavement testing</b>
<i>Research areas</i>	Data on behavioural characteristics and performance of road pavement materials and structures; accelerated loading testing; and international collaboration in accelerated road pavement testing
<i>Competences and facilities</i>	<ul style="list-style-type: none"> <li>• Performance data capturing techniques and instrumentation</li> <li>• Real field characterisation of material behaviour (as opposed to laboratory models)</li> <li>• Structural capacity determination of existing road structures</li> <li>• Comparative testing of various road pavement structure types</li> </ul>

<b>Capability</b>	<b>Advanced materials testing</b>
<i>Research areas</i>	Standard and special testing services; and development of specific equipment and test methods to meet the transport infrastructure engineering sector SET needs
<i>Competences and facilities</i>	<ul style="list-style-type: none"> <li>• Soils and granular materials laboratory</li> <li>• Asphalt laboratory</li> <li>• Dynamic testing laboratory</li> <li>• Bituminous binders laboratory</li> <li>• Chemical laboratory</li> <li>• Mechanical workshops</li> </ul>

## Appendix 4: Final Workshop Report

### Purpose of Workshop

The workshop was the second of two, which have been held in connection with the project entitled ‘Technical Assistance to PMO-RALG to Develop Road Research Capacity in Dodoma’. This final workshop was held at the

Protea Courtyard Hotel on Thursday 8<sup>th</sup> May to enable stakeholders to discuss and comment on the content of the Draft Final Report prepared for the project and to approve the Research Strategy. MOT, MOW, TANROADS, JICA, EU, WB and DFID were unable to attend. The outcomes from the workshop have subsequently been included and covered in greater detail in the main report but are summarised in this appended workshop report.

## Attendees

Engineer Kayanda, Director of IDU in PMO-RALG opened the workshop to which all stakeholders had been invited. Those in attendance also included the AFCAP technical manager (Nkululeko Leta), one or more representatives from PMO-RALG, TANROADS, district, municipal and urban councils, development partners, the Road Fund Board, TanT2 and academia. The AFCAP project team (Mike Head, Tony Greening and Dr John Rolt) were also in attendance together with the Head of the Research Centre (Dr Fikiri Magafu). A list of participants is provided at the end of the report.

## Presentations

Mike Head (team leader) presented the main components of the draft Final Report, which included an outline of the suggested priority short-term and longer-term actions, programmes and projects. A brief summary of the case for research was presented by Tony Greening. This presentation highlighted the examples of problems in the transport sector and presented evidence of the benefits to countries that invest in research. Engineer Magafu gave a presentation that included a proposed outline structure for the centre and the expected short-term activities, which included the establishment and commissioning of a materials testing laboratory in Dodoma.

## Outcomes of discussions and recommendations

**The Research Strategy and Draft Final Report were approved subject to alterations covered by this Workshop Report.**

Various names for the research facility were proposed and discussed with the favoured option being District Roads Research Centre (DRRC), reflecting the aim of the centre to focus on roads that are within the mandate of PMO-RALG.

An initial structure for the DRRC was discussed and outline structure agreed, in which the head of the DRRC will report to the Director of IDU. The DRRC will also consist of 3 professional staff with a Laboratory Manager and 2 technicians and support staff.

The current AFCAP Steering Committee for Tanzania should be expanded as required to include the required Steering Committee role for the DRRC. This is expected to be discussed and endorsed at the next meeting of the committee on 4 June 2014.

The inclusion of an IT expert at engineer level should be included in the structure of the DRRC, who will have various roles including setting up data analysis and management systems, dissemination of research outputs and development of a knowledge base at the Centre.

Various options for inclusion of projects in the research programme were proposed including further projects involving the use of 'block paving', which is currently being implemented in Mwanza and is proposed for Kigoma.

It was agreed that the outputs from ongoing research projects should be reviewed as a priority activity and monitoring continued under the DRRC. Preliminary outputs/recommendations from this research could provide 'quick-wins' for the DRRC.

Considerable discussion took place on the order of events for the establishment of the DRRC but there was generally agreement that whilst activities such as job descriptions for staff, detailed design and budgets for projects, etc will be required, these will follow once staffing and budget for the DRRC have been formally agreed.

Questions were raised on the possible inclusion of a wider role for the DRRC to include other roads and concerns (e.g. safety). The immediate priority is district roads as specified in the mandate for PMO-RALG and to take this opportunity as a starting point to provide the benefits from an indigenous research capability in the road sector in

Tanzania. It was agreed that the role of the DRRC could be expanded later to cover all roads and cross-cutting issues in the roads/transport sectors such as road safety.

It was agreed that standards and specifications are the mandate of the Ministry of Works (MOW) and research in these areas will need to be carried out with close collaboration and agreement of the MOW.

The existing materials laboratory testing capacity in the sector is considered to be insufficient to meet the needs of the DRRC. Therefore in addition to the DRRC laboratory, the provision of an additional 12 district laboratories is planned in the next year to provide additional testing capacity.

The need for collaboration and assistance from TANROADS-CML in setting up the laboratories and training laboratory personnel was agreed.

There was general agreement on the proposed 4 priority programmes in the draft report (Road Trials (existing and new), Road Asset Inventory, Road building materials (inventory) and Climate Resilience.

PMO-RALG is responsible for urban roads, some of which are experiencing serious congestion. It was agreed that congestion should be added as an additional priority.

The priority projects/activities identified for initial attention by the DRRC were discussed. These are:

- Review of outcomes from existing trials
- Scoping studies for the longer term programmes
- Cost/benefit studies (NB related to upgrading district roads)
- Embedment and dissemination of manuals (TanT2 centre also to play a role)
- Data management systems
- Initiate outcomes best practice procedures
- Establish knowledge management facility

It was proposed and agreed that Maintenance should be added to the list of priority projects (especially maintenance of unpaved roads). The existing manuals might not reflect current practice and should be reviewed. The existing AFCAP manual on maintenance contracting would provide a good starting point for revision of the manuals.

**The next steps** for research activities are those contained in the short-term plan (see main report) but the immediate actions include those required to provide a laboratory:

- Refurbish the building designated for the DRRC laboratory
- Commission additional works for the provision of services (water, electricity, etc)
- Purchase and install a generator
- Purchase and re-fit the building with benches, cupboards, etc
- Install and commission laboratory equipment.
- Recruit laboratory staff

It was agreed that funds should be sought to provide long term TA support to both the Director of IDU and also the Head of Research to assist with the challenges of funding an implementing increases in both DP programme and RF activities.

## STRUCTURE FOR THE TANZANIA DRRC

