

# Development and Support to the Implementation of a Strategy for the Establishment of a Road Research Centre in South Sudan

Preliminary Findings Report



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## Abstract

AfCAP agreed to provide technical assistance to the South Sudan Ministry of Roads and Bridges for the development and support to the implementation of a Strategy for the Establishment of a Road Research Centre in the country. A situational assessment study is necessary in order to develop a strategic plan that is responsive to the country's needs.

Information gathering has been conducted through documentation review and consultative meetings with key stakeholders in the road sector in South Sudan. The results of the documentation review process and consultative meetings established: (i) existing road sector policy and legislative framework, (ii) information on existing institutional arrangements to support and implement road research strategy, (iii) identified priority research areas and (iv) established potential funding mechanism to effectively implement and ensure long term sustainability of road research culture in the country. This report summarises the results from the documentation review and the opinions and suggestions by the stakeholders during the consultative sessions conducted in April 2019. The findings are preliminary, and provide the basis for developing the key objectives and strategy for the establishment of the Road Research Centre (RRC), to ensure sustainable research capacity in the road sector in South Sudan.

## Key words

Capacity building, road research, strategic plan

## Research for Community Access Partnership (ReCAP)

### Safe and sustainable transport for rural communities

ReCAP is a research programme, funded by UK Aid, with the aim of promoting safe and sustainable transport for rural communities in Africa and Asia. ReCAP comprises the Africa Community Access Partnership (AfCAP) and the Asia Community Access Partnership (AsCAP). These partnerships support 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. The ReCAP programme is managed by Cardno Emerging Markets (UK) Ltd.

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## Acronyms, Units and Currencies

AASHTO	American Association of State Highway and Transportation Officials
AfCAP	Africa Community Access Partnership
AfDB	African Development Bank
AsCAP	Asia Community Access Partnership
ASTM	American Society for Testing and Materials
BS	British Standard
CML	Central Materials Laboratory
CSIR	Council for Scientific and Industrial Research
DFID	Department for International Development
DMR	Directorate of Materials and Research
GBP	United Kingdom Pound (1 GBP = 163.07 SSP, as at 15 July 2019)
JICA	Japan International Cooperation Agency
MRB	Ministry of Roads and Bridges
RA	Roads Authority
RRC	Road Research Centre
ReCAP	Research for Community Access Partnership
RRSC	Road Research Steering Committee
RRTC	Road Research Technical Committee
RSP	Road Sector Programme
SSRA	South Sudan Road Agency
TRL	Transport Research Laboratory
UNOPS	United Nations Office for Project Services
UGX	United Kingdom Pound (1 GBP = 4480 UGX, as at 15 July 2019)
USAID	United States Agency for International Development
WFP	World Food Programme

## Executive summary

South Sudan is in the process of establishing a Road Research Centre (RRC). To achieve this, it is necessary to develop and establish a robust strategy for research that will support the development of the new RRC. As part of its applied research and capacity-building objective, the Africa Community Access Partnership (AfCAP) has agreed to provide the necessary technical support to the Ministry of Roads and Bridges (MRB) for implementation of the activities necessary to achieve the key objectives and strategies to establish a research centre in an effort to develop road research capacity in South Sudan.

As part of the process of developing the strategy for research, a consultative approach is necessary, to gather the opinions of stakeholders and their suggestions, in order to ensure that the strategy is responsive to the national needs. The documentation review process and consultative meetings were aimed at establishing existing road sector policy and legislative framework, gathering information on existing institutional arrangements to support and implement road research strategy, identifying priority research areas and establish potential funding mechanism to effectively implement and ensure long term sustainability of road research culture in the country.

Information gathering was conducted through the documentation review and consultative meetings with key stakeholders in the road sector. This report summarizes the results from the documentation review and the opinions and suggestions by the stakeholders during the consultative sessions conducted in April 2019:

- Based on the consultative meetings, the establishment of the Road Research Centre is unanimously supported by the stakeholders, and they are of the opinion that it should be a semi-autonomous broad-based institution. There exists a road sector policy and legislative framework that provide the MRB with the key objectives and strategies to establish a research centre to enable the development of road research capacity in South Sudan. This sets the guidance for the development of the strategic plan for the establishment of sustainable road research capacity in the country to be aligned with the key national policies and strategies.
- The proposed new development to establish a Road Research Centre, requires the appropriate human capital and infrastructure capacity. The situational assessment established the level of laboratory infrastructure capacity and staff at the Central Materials Laboratory (CML), under the Directorate of Materials and Research (DMR) at the Ministry of Roads and Bridges and, also, the College of Engineering at the University of Juba. There are skills and staffing level gaps within the Directorate of Materials and Research (DMR) in the Ministry Roads and Bridges necessary to conduct high level research. Only two (2) out of the 14 staff members hold at least a bachelor's degree qualification. Based on academic qualification profiles of staff at the College of Engineering and Architecture, there is insufficient human capital with the requisite background to undertake research.
- The main laboratory to support research in the interim is the CML, which has four rooms (standard room size, about 15 square metres) for three sections of material testing; (1) foundation/soil testing, (2) aggregate and concrete testing, and (3) asphalt materials testing. The facility requires upgrading to improve the staff's working environment and testing capacity.
- The College of Engineering and Architecture does not have a functional laboratory facility. No functional ICT infrastructure exists within the DMR and the College of Engineering.
- There are various opportunities proposed by stakeholders to address the funding requirements in order to ensure long term financial sustainability of the RRC. These include: increased and ring-fenced funding allocation to the RRC from MRB, as the line Ministry, and from other infrastructure cluster ministries; income generation through testing services to the road industry; requirement for testing to be done at the RRC laboratory during the execution of government projects; provision of a cost item for R&D during the bidding process of road construction projects and fundraising from multilateral agencies. Increased funding sources and the undertaking of research activities in collaboration with private sector and universities will benefit the road industry at large.
- The research priority areas required to address issues in the road sector as identified by the stakeholders. Generally, the stakeholders indicated soil properties analysis, classification and mapping, construction materials identification, fit-for-purpose design, the impact of road projects on the environment, safety, social dynamics and information management systems. The construction



challenges that impact on construction processes, include heavy seasonal rainfall and drought in different regions, large swampy areas, expansive clays (black-cotton soils) in some region, scarcity and high transport costs of construction materials and basis for project costing.

The findings are to be discussed at the first stakeholder workshop scheduled for 20 June 2019. The workshop will assist in identifying the structure and processes required to enable viable, sustainable and high impact road research activities at the RRC. In identifying the research projects for greater impact, due cognisance will be accorded to the contextual challenges of the country to ensure the developed strategic plan will be responsive to the achievement of the Government's long-term goals for the road transport sector development.

# 1 Introduction

## 1.1 Background to the project

South Sudan embarked on a process to establish a Road Research Centre (RRC). The initiative was initially started in 2013, when AfCAP commissioned Transport Research Laboratory (TRL) of UK to provide technical assistance to the South Sudan Ministry of Transport, Roads and Bridges (MTRB) to develop road research capacity in the Directorate of Materials and Research (DMR). The process of this initiative was interrupted due to security concerns in the country. The Government of South Sudan through the Ministry of Roads and Bridges (MRB), now responsible for the construction of roads and bridges throughout the country, requested for support to undertake the next steps to achieve the objective of establishing the RRC. As part of its applied research and capacity-building objective, AfCAP agreed to provide the necessary technical support to the MRB for implementation of the activities necessary to achieve the key objectives and strategies to establish the RRC. The next steps are to define the institutional and organisational structures, vision, missions and goals and research priorities for the RRC.

This assignment requires the development and establishment of a strategy for research that will support the development and implementation of the new RRC, providing the framework for undertaking the next steps. As a process of developing the strategy for research, gathering of information and opinions of stakeholders is necessary, in order to ensure that the strategy is responsive to the national needs and, therefore, aligned to the country's National Development Plan (NDP), policies and long-term Vision 2040 aspirations. The road network in South Sudan was estimated at 12,642 km in 2005, consisting of 7,369 km of interstate roads, 1,451 km of state primary roads and 3,822 km of state secondary roads<sup>1</sup>. Most of these roads are unpaved. The challenge the country faces is the delivery of a road network at a level of service that meets the country's requirements, including upgrading unpaved rural roads to bitumen standard. Innovative solutions through undertaking research are required to address these challenges.

The technical assistance being provided under this project will enable the process of developing and implementing the strategy for the establishment of the RRC.

## 1.2 Rationale for building local research capacity

The 2011-2016 South Sudan Development Plan (SSDP), takes cognisance of the importance of transport infrastructure as a vital driver of the nation's economy. It provides plans to be implemented in order to remove impediments to transport infrastructure development and achieve the country's economic development objectives by initially focusing on renewed rural development and diversifying into broader private sector development.

One of the areas of action prioritised in the SSDP is ***the extending and upgrading transport infrastructure, especially roads. This is critical to connect farmers to markets and includes plans to asphalt 700km of trunk roads and 1000km linking major towns; expand the feeder road network, and strengthen maintenance for all roads.***

The expectation is that MRB, as the line Ministry responsible for the construction of roads and bridges throughout the Republic of South Sudan, should respond to the national priority and do more in improving the country's road network, in order to support government's strategy (Vision 2040, National Development Plan) and policy (Transportation Policy), as well as fulfil its mandate according to the Ministry's own strategic plan (2013 -2018).

One of the key actions in the Ministry's strategic plan (2013-2018), included the recommendation to undertake research on alternative construction methods. The strategic plan, therefore takes cognisance of the importance of research. Research development and innovation in the design and provision of roads is crucial in order to find solutions for the road sector, and provide the rural population the opportunity to

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<sup>1</sup> Draft Strategic Plan 2013 - 2018. Republic of South Sudan, Ministry of Roads and Bridges.

participate in meaningful agricultural activities and to have easier access to markets. There is an urgent need for establishing the appropriate institutional set up and developing sustainable capacity for undertaking research in the country. However, it requires the development of a Strategic Plan to provide a framework for the establishment of a RRC. AfCAP, through this project is providing the necessary technical support to the Ministry of Roads and Bridges (MRB) for implementation of the activities to develop the Strategic Plan.

### 1.3 Objective of the project

As provided in the Terms of Reference, the overall objective of this assignment is to assist the MRB, in collaboration with key stakeholder organisations, with the institutional set up for and to develop a strategic plan for implementation of road research. The project is to be implemented in two phases:

1. Phase 1 – *Development of a Strategic Plan* (current phase).
2. Phase 2 – *Establishment of the RRC*.

### 1.4 Purpose of the report

This report provides insights into key preliminary findings on the basis of documentation review and consultative meetings with key stakeholder. The report identifies key aspects that can influence implementation of the research capacity building programme. The findings will guide the process for developing an effective Strategic Plan that responds to the needs of the country, and is relevant to the road sector and the process of establishing the RRC.

## 2 Methodology

### 2.1 Introduction

The focus at this stage of the project is on establishing and understating the existing situation through information gathering from a variety of sources.

The process of information gathering should provide a better understanding of the road sector and assist in identifying gaps that, if not addressed, can negatively influence implementation of the research capacity building strategy. The information to be gathered is to provide knowledge about a variety of cross-cutting issues relating to the internal and the external environment that the RRC will be part of and operate in. This environment includes: existing national policy plans and strategies; institutional framework and administrative set up in the road sector; training institutions playing a role in capacity building for the road sector; availability and capacity of road construction materials testing facilities; road research capacity and institutional cooperation; level of laboratory staff contingent and equipment to support the research activities of the RRC. The findings are to be used to develop the Strategic Plan and the action plans for the establishment and sustainability of the RRC.

The methodology for gathering information was undertaken through two main tasks:

1. Review of key documents relating to national strategy, policies, research reports and other studies on rural access improvement programmes.
2. Meetings and interviews of key stakeholders to get their perceptions, on the basis of their experience, on a variety of issues related to the establishment of the RRC.

### 2.2 Review of documents

The setting of the objectives and the development of a Strategic Plan for the establishment of sustainable road research capacity must be based on certain considerations that take into account the country's policies and strategy, as these provide the framework and direction to which the road research priority areas should be aligned to, in order to respond to national priorities. The documentation should also

provide a sector institutional framework for the environment within which research capacity building can effectively be implemented.

A number of documents have been reviewed to gather information that assists in establishing the country's vision, the national challenges, policies, legal framework considerations, institutional mandates and responsibilities regarding the design, construction and maintenance of roads and human capital development.

The key strategic and policy documents designed to lead the country towards attainment of the development goals and relevant to this project are highlighted in Table 1. The documents relevant to developments in design and standards in the road sector are presented in Table 2. The documents on aspects of human capital development and relevant to the road sector are presented in Table 3.

**Table 1: National strategies and policies**

No.	Document Title	Source Organisation
1	South Sudan Development Plan 2011-2013. Government of South Sudan	Ministry of Finance and Economic Planning, July 2011
2	South Sudan Interim Country Strategic Plan (2018–2020)	World Food Programme, November 2017.
3	Draft Strategic Plan 2013- 2018. Republic of South Sudan	Ministry of Roads and Bridges, Government of South Sudan, 2012
4	Transport Sector Policy: Ministry of Transport and Roads Government of Southern Sudan	USAID, October 2007
6	The Establishment of the Ministry of Roads and Bridges in the Republic of South Sudan	Ministry of Roads and Bridges, June 2012
7	Presentation on Revised Policy Document	Ministry of Roads and Bridges, April 2018
8	South Sudan Development Initiative: Prioritised Project List Specific section on roads planning: Ministry of Roads and Bridges	SSDP and AfDB

**Table 2: Road sector development**

No.	Document Title	Source Organisation
1	Specification for Highway Work: SERIES 10000: Testing Materials and Workmanship. Government of South Sudan	Ministry of Roads and Transport, 2006
2	South Sudan Low Volume Roads Design Manual: Volume 1, Road Design	Ministry of Roads and Bridges. Government of South Sudan, June 2013
3	Implementation Completion and Results Report: Rural Roads Project to the Republic of South Sudan	The World Bank, June 2017
4	Environmental Management Plan – Feeder Road Construction in South Sudan	United Nations Office for Project Services (UNOPS), September 2017

The assessments in the documents presented in Table 3 were conducted more than 10 years, but they reflect key issues to be assessed in the current environment for incorporation in the Strategic Plan as they relate to institutional capacity in the road sector. Without the appropriate human capital, with sufficient technical skills and strong academic training at tertiary institutions, it will be difficult for the country to develop the critical mass to undertake research and provide the innovative solutions needed to improve road infrastructure.

**Table 3: Human capital development**

No.	Document Title	Source Organisation
1	Training needs analysis Report: Ministry of Transport and Roads. Government of Southern Sudan	USAID, July 2007
2	Human Resource Development In The Transport Sector of Southern Sudan. Ministry of Transport and Roads. Government of Southern Sudan	USAID, October 2007

### 2.3 Meetings with stakeholders

The stakeholder consultation process is achieved through consultative meetings and interviews. During the meetings and interviews, the same specific directed questions are put to the stakeholders to solicit their perception and suggestions on: institutional arrangements for the establishment of the RRC, laboratory and ICT infrastructure, collaborative activities or relationship between key stakeholder organisations in the transport sector with MRB and DMR specifically, research culture in the country, research funding mechanism and priority research areas.

The suggested priority research areas are then subjected to a ranking process in order to shortlist those with the greatest payoff for inclusion in the Strategic Plan for implementation to address the identified national challenges. The national challenges are a combination of those identified in the national strategy documents and those resulting from the key stakeholders consultation if not already identified.

Ideally, consultations should involve broad-based sector representation to ensure that the development of the strategic plan is inclusive and that the unique aspects and realities of the country are considered. Key stakeholder representation should include:

#### 1. Government representatives

- Ministry of Roads and Bridges as the line Ministry and respective Directorates
- State Ministries of Physical Infrastructure
- Ministry of Science and Technology, governing the higher education sector and research
- Ministry of Finance and Economic Planning, for high-level financial support

#### 2. Roads Authority

#### 3. Academic institutions

#### 4. Non-Governmental Organisations

#### 5. Private sector

- Construction companies
- Consultants
- Civil engineering laboratories

#### 6. Professional and regulatory bodies

- Engineering Council

However, meetings have been held with representatives from the following organisations:

- ABMC, a construction company
- College of Engineering and Architecture, Juba University
- Engineering Council of South Sudan

- JICA
- Ministry of Roads and Bridges
- South Sudan Roads Authority
- UNOPS
- USAID
- WFP

### 3 Preliminary findings and considerations for road research Strategic Plan

#### 3.1 Introduction

This section deals with aspects that should be considered in developing the road research Strategic Plan for South Sudan, on the basis of the review of relevant sector documents, and experiences and opinions shared by key stakeholders during the consultative meetings.

The issues identified through the consultative meetings and document review are categorised by key elements considered to be the most common in the implementation process of the strategy. These elements will have an impact on the establishment, effective functionality and sustainability of the Road Research Centre as well as achieving the expected outcomes and benefits of building road research capacity in South Sudan. These components will be aligned with the strategy for establishing a national institution that will build sustainable road research capacity and is responsive to the key challenges of the road transport sector in the Republic of South Sudan.

#### 3.2 Institutional framework

The following sections present the identified issues with respect to required institutional framework and organizational setup that will affect the establishment, effective functionality and sustainability of the RRC, and personnel cultural change to be more responsive to the objectives of a RRC. These objectives include the identification of the challenges that the road transport sector faces in South Sudan and which the RRC can address through research.

##### 3.2.1 National Vision 2040

The longer term aspirations for South Sudan are guided by Vision 2040<sup>2</sup>, which sets out a comprehensive vision and agenda for the country. The outcome of this document review is aimed at integrating and linking the research activities of the RRC to the national aspirations in order to contribute towards achieving effective economic development objectives in alignment with the Vision 2040. This will assist the Project Team to prepare a responsive Strategic Plan. The overall objective in the review is to assess which priorities are already reflected in the National Development Framework and more specifically to:

- Identify which national targets and indicators for road transport are already reflected within the national development documents namely, Vision 2040, South Sudan Development Plan and Road Sector Strategic Plans,
- On the basis of the key consultations to further explore the challenges, gaps, and opportunities to implement the road research agenda, with addition of new areas not found in the available documentation.

The National Vision 2040 identifies the following four pillars that constitute a set of national priority programmes to which government resources will be focused:

1. Governance
2. Economic development
3. Social and human development

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<sup>2</sup> South Sudan Vision 20140

#### 4. Conflict prevention and security.

The Economic Development Pillar, essential to the future prosperity of South Sudan, covers the overarching priority area for road transport infrastructure that is relevant to the project objectives, as identified by the two key excerpts:

- ***Roads transport and infrastructure development that will provide opportunities in isolated regions and create a national market, and on providing social infrastructure development, including particularly water resource management and sanitation services.***
- ***Rural transformation, and developing economic activities that will contribute immediately to the quality of life of most South Sudanese.***

The South Sudan Development Plan (SSDP) builds on the Vision 2040 and sets the framework for national development over the coming years. The strategic objective of the SSDP is to increase mobility of persons and goods and it calls for focused funding for improving and expanding road infrastructure. The expected outcomes of the SSDP with respect to roads transport infrastructure, linked to the Transport Sector Policy, are as follows:

- ***Improved transport reliability, levels of service and efficiency to enhance economic growth.***
- ***Enhanced access to local and international markets***
- ***Improved interstate, trunk and feeder roads,***
- ***Improved routine maintenance on sustainable basis and***
- ***Improved roads safety provision to reduce accidents and their derived human and economic costs.***

A road research agenda should be responsive to the above key priority areas to assist in achieving the national aspirations as outlined in the National Vision 2040. It is anticipated that the Strategic Plan for establishment of sustainable road research capacity will align its objectives with these national priorities in order to drive growth and development goals in the country.

The Transport Sector Policy<sup>3</sup> is the key sector document that defines the overall policy objectives of the roads and the transport sector and for the development of the strategy for the implementation of the national agenda.

### 3.2.2 National Transport Sector Policy

It should be noted that, the National Transport Policy document was developed and published in 2007 under the then Ministry of Transport and Roads and is due for revision. However, it provides the necessary background to the hierarchical framework for the sector. It defines the transport system of South Sudan, which consists of four major modes namely: roads, railways, inland water (river transport), and air transport. The National Transport Sector Policy outlines specific goals for each of the transport systems.

As such, the Transport Sector Policy promotes a multi-modal approach, to allocate available resources among the various transport modes so that the resultant modal mix meets transport requirements at optimum cost to both the provider and the user.

This document indicates the importance of how devoting more resources to the transport sector will improve mobility in rural areas through the promotion of the use of appropriate means and modes of transport. It is intended to ensure the provision of coordinated transport services.

Sub-sector policies address specific objectives of the National Transport Sector Policy. However, roads as a sub-sector of the transport system are the focus of this project. In dealing with critical key road issues in South Sudan, Road Infrastructure sub-sector policy is considered key for the implementation of the strategy to provide a sustainable road transport network for the country. The following are the other sub-sector policies on road transport system:

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<sup>3</sup> Transport Sector Policy for the Ministry of Transport and Roads Government of Southern Sudan, October 2007

- Road Freight Transport,
- Road Passenger Transport Services
- Road Traffic Management and Safety
- Non-Motorized and Intermediate Means of Transport.

The Road Infrastructure sub-sector policy is the key policy to provide guidance in the development of the Strategic Plan on the establishment of the RRC in relation to the delivery and provision of sustainable road transport network. However, it cannot be considered in isolation. It must be linked to the other sub-sector policies for the strategic plan to be more responsive to the country's transport key challenges.

### 3.2.3 Sub-sector Policy on Road Infrastructure

Its overall objective is the development of road infrastructure which is to provide an integrated, efficient, reliable, and commercially sustainable road transport network that improves access and communication, reduces transport costs and provides for the safe and efficient movement of people and goods in an environmentally sustainable manner. One of the sub-sector policy is on non-motorized and intermediate means of transport, thus the road network is to include adequate provision for the non-motorized transport.

#### 3.2.3.1 Specific objectives of the sub-sector Policy on Road Infrastructure

The specific objectives of the Road Infrastructure sub-policy include:

- **Maintain, rehabilitate, improve and construct roads in order to ensure improved accessibility and minimise road transport costs. Higher priority will be given to the prime routes linking the States capitals and other urban and population centres.**
- **Establish appropriate standards for road design and construction.**
- **Preserve investments through sustainable maintenance management of road network and efficient axle load control.**
- **Establish appropriate road institutions that includes roads agencies and roads board, and road councils.**
- **Create a sustainable system for domestic financing and management of the road network e.g. through fuel level and other road user charges, establishment of road agencies and road fund administration.**
- **Take measures to develop the domestic consulting and contracting industry.**
- **Improve accessibility in the rural areas with emphasis on feeder roads leading to productive areas.**
- **Upgrade and construct roads to open up agricultural areas and promote national and regional transportation exploiting the strategic geographical positioning of South Sudan in the region.**
- **Ensure that environmental and safety concerns are adequately addressed in the design, rehabilitation and maintenance of roads.**

The sub-sector policy on Road Infrastructure makes specific recommendations in each of the following areas, in order to achieve the above stated objective goals:

1. **Establishing the institutions to manage road infrastructure**
2. **Development and maintenance of roads infrastructure**
3. **Prioritization and sequencing of the road network development**
4. **Project design**
5. **Contracting strategy**
6. **Financing the development and maintenance of roads**
7. **Establishment of financial management, accounting and reporting system**
8. **Road works standards**
9. **Material testing**
10. **Information and management systems**
11. **Human resource development in the roads infrastructure sector.**



### 3.2.3.2 *Institutional establishment for the management and financing of road network*

In order to create a management system for the road network, recommendation one of the sub-sector policy, as listed above, provided institutional framework for establishing the following agencies at different levels of Government:

- South Sudan Roads Board (SSRB)
- South Sudan Road Agency (SSRA)
- State Road Agencies
- Urban Roads Agencies
- County Road Agencies

The establishment of the Road Fund Administration (RFA) is for the purpose of creating a sustainable system for financing of the road network. Only the SSRA is a fully established autonomous body corporate. It has an Executive Director (ED) and the Board in place. RFA and the other agencies are yet to be established.

The SSRA which was set up by Act of Parliament in July 2011, has the following primary responsibility:

- ***Development and maintenance of Interstate Roads***
- ***Development and maintenance of International Roads; and***
- ***Development and maintenance of roads of national importance***

This gives a perspective of the institutional arrangements and the agencies that will play a crucial role in the management of the road network. The expectation is that the RRC will establish strong linkages with these agencies as they become more established, and they, in turn will ultimately also play a role in influencing the decision-making process on prioritization and implementation of national research projects as key stakeholders.

### 3.2.3.3 *Identified medium term priorities for road network development*

The sub-sector Road Infrastructure policy identifies the following as key activities for road network development in the medium term:

1. Institute and promulgate a clear and detailed set of standards for road design, construction and maintenance for each of the different levels of road.
2. Enact legislation and establish institutions to ensure efficiency, accountability and the participation of road user groups, including the key sectors and agencies that depend on the roads, in their monitoring and management.
3. Build public and private sector capacity to implement and manage the roads sector.
4. Identify and commence the process of rehabilitating and developing the primary road network.
5. Establish mechanisms for adequate and sustained financing for road maintenance.
6. Install axle load control, the legislation and enforcement mechanisms to protect the roads from undue damage.
7. Promote the active participation of the private sector, particularly labour-based system contractors (these goals can also provide constructive employment for large numbers of ex-combatants).

In order to effectively implement these priority activities, the interventions to provide solutions and decision-making process require systematic gathering of good quality information through well executed research programmes. However, priority activity (3), underlines the need to build capacity to implement and manage the road sector. Although not explicitly stated this ideally includes implementing research programmes in the road sector. There is therefore a need to develop a road research strategic plan, in order to address the lack of capacity.

### 3.2.4 Road sector Policy

This project is aimed at providing the means through which the Strategic Plan for road research capacity building should be developed, which responds to the national strategic objective goals. In order to enhance the quality of policy and decision-making and planning regarding road research, a specific national policy or strategy should provide the required guidance in the establishment of the relevant institution. The National Transport Policy does not specifically address the implementation of road research studies under the Road Infrastructure sub-sector policy.

The National Transport Policy was developed under the then Ministry of Transport and Roads before the establishment of the specific Ministry for road infrastructure development (the current Ministry of Roads and Bridges). The road sector specific policy is therefore drawn up and implemented by the Ministry of Roads and Bridges.

The objective of the Ministry is ***to develop, maintain, rehabilitate, and improve roads and bridges in order to ensure improved accessibility and minimize road transport costs.***

The overall road sector policy objective in the development of road infrastructure is ***to provide an integrated, efficient, reliable, and commercially sustainable road network that improves access and communication, reduces transport costs and provides for the safe and efficient movement of people and goods in an environmentally sustainable manner.*** The policy framework also recognizes the need for the network to include adequate provision for the non-motorized transport.

#### 3.2.4.1 Road sector priority areas

There are ten priority areas identified in the policy document:

1. Policies to guide Roads Infrastructure Development
2. Establishing Sectoral Institutions to manage Roads Infrastructure
3. Development and Maintenance of Roads Infrastructure
4. Financing the Development and Maintenance of Roads
5. Establishing Road Works Standards
6. Establishing Information and Management Systems
7. Human Resource Development (HRD) in the Ministry
8. Cross-Cutting Issues
9. Establishing linkages and networks with other institutions/stakeholders public, private sector, development partners, civil society organizations, communities etc.
10. Establish Monitoring and Evaluation (M&E) System for the Sector.

MRB has outlined strategic objectives towards achieving the above goals, and are presented below.

### 3.2.5 Strategic objectives of Ministry of Roads and Bridges

The stated strategic objectives are:

1. Develop, maintain, rehabilitate, and improve roads and bridges in order to ensure improved accessibility and minimize road transport costs. Higher priority will be given to the prime routes linking South Sudan to other countries, states capitals and other urban and population centres;
2. Plan, develop and maintain national highways in the Republic of South Sudan;
3. Establish improved standards for design and construction;
4. Develop standard specifications for roads and bridges in the Republic of South Sudan;
5. Preserve investments through sustainable maintenance management of roads network and efficient axle load control;
6. Establish appropriate road and bridges institutions that include Road Authorities, Road board and Road Councils;

7. Create a sustainable system for domestic financing and management of road network, e.g., through fuel levy and other road user charges, establishment of Road Authorities and Road Fund Administration;
8. Take measures to develop the domestic consulting and contracting industry;
9. Improve accessibility in the rural areas with emphasis on feeder roads leading to productive areas;
10. Upgrade and construct roads and bridges to open up agricultural areas and promote national and regional transportation exploiting the strategic geographical positioning of the Republic of South Sudan in the region;
11. Ensure that environmental and safety concerns are adequately addressed in the design, rehabilitation and maintenance of roads and bridges.
12. Establish technical engineering schools.

The decision making process to implement some of the strategic objectives will require the collection of quality and reliable data. Long term collection of reliable data is also required in order to, for example, improve development of road infrastructure for the country's road network, including improvement of accessibility in the rural areas with emphasis on feeder roads and integrated transport infrastructure.

Strategic objective (6), **establish appropriate road and bridges institutions that include Road Authorities, Road board and Road Councils**, is evidence of MRB having the mandate to establish institutions. Establishment of an appropriate institution that will implement the required interventions for addressing some of the above strategic goals is needed.

The implementation matrix of the Draft Strategic Plan (2013-2018) <sup>4</sup> of MRB, specifically for research, focuses on conducting research on materials and pavements. The strategic objective is to conduct research on soils and pavements. Table 4 shows the implementation Matrix.

**Table 4: Draft Strategic Plan matrix (2013-2018) for priority area: Conducting research on materials and pavements**

Strategies	Key activities	Time Frame (Target Date)
Recruit and Train Research staff.	Liaise with administration to recruit	October 2013
Establish Suitable Centre for testing material	<ul style="list-style-type: none"> <li>• Mobilize resources</li> <li>• Construct the centre</li> <li>• Procure and install Equipment</li> </ul>	July 2015
Liaise with Higher Learning Institution and other Stakeholders	<ul style="list-style-type: none"> <li>• Identify learning institutions and stakeholders</li> <li>• Liaise with institutions for research</li> </ul>	October 2014
Coordinate the research studies	<ul style="list-style-type: none"> <li>• Identify learning institutions and stakeholders</li> <li>• Identify Research needs</li> <li>• Engage the institutions</li> <li>• Coordinate research studies</li> </ul>	October 2016

This has not yet been achieved. The establishment of the RRC to conduct research and generate the knowledge that will facilitate informed decision making process and the adoption of appropriate solutions and improved standards and methods for the design, construction and maintenance of the road network,

<sup>4</sup> Draft Strategic Plan (2013-2018). Ministry of Roads and Bridges. Republic of South Sudan

should therefore be considered a priority for South Sudan. However, the establishment of an institutional framework for the development and establishment of the RRC in the country is urgently required.

### 3.2.6 Institutional structure

The national institutional framework within which road research capacity building is to be established, has been defined, which should ensure that the delivery of the research is aligned with the strategic objectives of the Ministry of Roads and Bridges, and national regulations and applicable laws. Successful implementation of the road research capacity building will, however, depend on institutional structures that facilitate the allocation of resources to support implementation of the strategic objective of building sustainable road research capacity.

#### 3.2.6.1 Structure of Ministry of Roads and Bridge

The MRB’s organisational structure will provide both institutional and functional framework for implementation of the national strategic plan for the road infrastructure development. The institutional structure of MRB, shows that it comprises of four directorates namely:

- Directorate of Road and Bridges
- Directorate of Administration and Finance
- Directorate of Materials and Research
- Directorate of Planning and Policy Formulations

The overall structure for the MRB is shown in Annex 1. It shows the key elements and linkages between the Directorates and the SSRA. However, it is evident that the key Directorate that would support road research capacity building is the Directorate of Materials and Research. The Directorate of Materials and Research and its key elements are highlighted in red.

#### 3.2.6.2 Directorate of Materials and Research

Development of sustainable road research capacity requires strategic planning and implementation of activities appropriate for South Sudan. Therefore, the process requires adoption of national strategies to guide the development of a strategic plan. The Draft Strategic Plan (2013-2018) of the MRB, provides insights into the priority areas for each directorate. It is therefore envisaged that the activities that the Directorate of Materials and Research will undertake, should promote road research capacity building and the development of a strategic plan for the establishment of the RRC. The strategic plan for establishing RRC should also be guided by the critical issues and priority areas identified in the Draft Strategic Plan (2013-2018) as presented in Table 5.

**Table 5: Priority areas: Directorate of Materials and Research**

Priority area	Strategic objectives
Conducting Research in material of Roads and Bridges	To conduct research on materials and manuals for roads and bridges constructions
Institutional Building	To enhance the capacity of the states /private sector in testing and calibrating equipment
Development of Standards and Specifications	To develop standards testing manuals and specifications
Road’s database production	To make available data for development and maintenance of roads and bridges infrastructure
Legislation for establishment of institution for training materials technicians and road supervisors	To formulate and enact policy for establishing the institution

The structure for the Directorate of Materials and Research and its complementary units are shown in Annex 2. However, the structure is not a typical one for a research entity and will require a review assessment.

This section has established the existing institutional framework within which the road research capacity building should be established and implemented. The extent to which the existing institutional framework and structures can provide enabling environment for effective establishment of a RRC, depends on the relevant institutional framework. This will include the coordination of the research being timely constituted and the effective facilitation of the implementation of the Strategic Plan. It is through the existence of a good framework for the establishment of the RRC, including strong back-up national support systems, that the activities of the RRC will effectively and fully benefit the nation.

The process of institutional set up for and to develop the Strategic Plan for implementation of road research capacity building is to be achieved in collaboration with key stakeholder organisations. In this regard, the stakeholder consultation process is achieved through the consultative meetings and interviews.

### **3.2.7 Management of research**

The National Research Council, is the government body responsible for reviewing and approving all research proposals throughout the country. It is attached to the Ministry of Education, Science and Technology. The council is supposedly to be responsible, for mapping the country's research needs. While planning for the consultative meetings, MRB made an effort to establish the status of NRC and contacted the Management. The feedback is that there is currently no administrative staff in place to manage the National Research Council.

## **3.3 Engagement with stakeholders on planning considerations for the strategic plan**

### **3.3.1 Introduction**

The process of engaging with the national stakeholders for broad-based involvement in the development of the Strategic Plan is crucial, to ensure national ownership and buy-in. A sequence of consultations with the major stakeholders was undertaken which will be followed by a consultative workshop. The strategic objectives of the consultative meetings were:

- To explain to stakeholders the initiative for road research capacity building and development of the Strategic Plan for establishing the RRC. During all the meetings, MRB project staff, Eng. Jeremiah Bairiak and Eng. George Duku provided the introductory remarks and project background. This was followed by the presentation of the project objectives and the vision of the initiative to establish the RRC and guided interview and discussions, led by the project team leader.
- To explain the process of developing the Strategic Plan and establish who among the stakeholders will participate in the process of developing the plan and, in addition, ultimately play a role in influencing the decision-making process on prioritization and implementation of research projects. This targeted individuals who later would commit themselves to serve on advisory committees to ensure that identified and prioritised research projects for implementation are aimed at addressing the needs of the country and the development of the national research agenda.
- To review in-depth the current state of the relationship with MRB, Central Materials Laboratory testing systems and capacity, looking at structure, human resources and research culture, potential research funding mechanism and structures.
- To ensure that there is support and buy-in from stakeholders for the development of the Strategic Plan and the initiative of establishing the RRC.
- To establish the expectations and contributions and concerns of stakeholders and proposed areas of research.

The following sections provide a description of the consolidated key issues based on stakeholder responses during the consultative meetings.

### 3.3.2 Comments on collaboration

It is essential that there exists effective relationships between MRB and all national transport sector key stakeholder organisations. Collaboration is not only in terms of the partnership during execution of projects but also bringing together diverse key national stakeholders in the development of national strategies and policies.

- **USAID** has played a very critical supportive role to MRB and national institutional development through the following:
  - (i) Setting up, capacity building and equipment procurement for the CML, established on the model that it will be able to generate own income.
  - (ii) Support to the setting up and establishment of the SSRA.
  - (iii) Funded trials programme undertaken by MRB in cooperation with UNOPS.
  - (iv) Prior to 2013, engagement between MRB was very good, in comparison to the current level of engagement, which can be considered to be cordial. The level of engagement has also been affected by the reduced technical support to South Sudan due to a Congressional directive. The focus is mainly on humanitarian support programmes. There have been moves to improve the interaction.
- **The EU has played a role in the provision of road infrastructure:**
  - (i) Prior to 2013, the level of engagement with the line Ministry was very good. However, since 2013 it has not been as effective. EU has made the effort to re-establish high-level engagement with the Ministry, with limited success.
  - (ii) The Feeder Road Steering Committee used to provide the opportunity to bring together Government and the donor community. The committee is currently dysfunctional.
  - (iii) Contributed to development of guidelines
- **WFP has been collaborating with MRB:**
  - (i) The operations work by WFP requires the approval of MRB. WFP has contributed to the improvement of feeder roads through the special operations, focusing on the construction of 1,000 km and the rehabilitation of 488 km of feeder roads in seven states in the country.
  - (ii) This has included the rehabilitation of structures along the roads, the construction of a new bridge and the implementation of maintenance activities.
  - (iii) WFP has also undertaken capacity development activities for local communities and authorities. This has included capacity-strengthening activities, whereby community members were involved in the road maintenance programmes by cutting the grass from the side drains and desilting of culverts, amongst other activities.
  - (iv) WFP indicated that they can play the role of providing inter-agency collaboration between WFP and other development partners to provide the necessary support for a more coherent and consolidated assistance for road research capacity building.
- **The College of Engineering and Architecture** at the University of Juba does not have a formal working agreement with MRB, but there is a good working relationship. However, staff have been working on individual basis with MRB, e.g participation in the development of the Low Volume Roads Design Manual, collaboration on a World Bank project - study on Social and Environmental Impacts as required for roads to be rehabilitated and maintained under the project. Students are offered industrial/experiential training periods at the Ministry and SSRA. Enhanced collaboration between the College of Engineering and DMR could foster collaborative research.
- **UNOPS** closely interacts with MRB on projects and response has been good to requests for support and approvals for the projects and works being undertaken. Under USAID funded contracts, UNOPS has conducted a series of trial of highway construction methods on roads near to Juba. UNOPS, provided project management; design; construction control; monitoring; analysis and reporting

services. MRB and Ministry of Physical Infrastructure engineers are assigned to UNOPS counterpart engineers on projects. However, the level of interaction, has not been the same in recent years.

- **ABMC** has mostly provided services to MRB as a key contractor in the development of road infrastructure in the country.
- The **Engineering Council of South Sudan (ECSS)** is under the Ministry of Cabinet Affairs, has the core function of regulating the engineering profession in the country. In this regard ECSS has interactions with the MRB as one of the technical ministries to encourage persons who meet educational requirements to register as professional practitioners: engineers, technologists and technicians. ECSS has a good working relationship with MRB and MRB has representation on the ECSS.

### 3.3.3 Institutional structure

The following are the responses regarding institutional structure for RRC:

- **USAID** supports an institutional structure for establishing the RRC, which will enable it to make independent decisions for effective implementation of research programmes, without the political influence. Policy and mandate should allow for the establishment of the semi-autonomous body. This will be a long process. The leadership should be competent, responsible, transparent and accountable.
- **EU** supports an institutional structure that will establish a strong link with the College of Engineering and semi-autonomous. This is more likely to ensure sustainability.
- **SSRA** supports the establishment of an autonomous institution over time as. This will take time due to the requirement of deliberating the legal framework to implement such a strategy. In the meantime, DMR of the MRB should host the RRC.
- The **College of Engineering and Architecture** supports the idea of establishing a RRC.
  - (i) Must have a strong link with the RRC.
  - (ii) An alternative opinion was given, suggesting the model used in neighbouring Sudan, where a research Centre is at the University.
  - (iii) The University does not have a laboratory and access to the RRC facility will enhance student training, both institutions will benefit most from formal agreements. It was agreed that developing strong and formal linkages between the College of Engineering and Architecture and DMR will increase both access to and the quality of the training of the civil engineering students as well as enhance and strengthen the road research culture in the country.
- **WFP** supports an institutional structure under the MRB, to be provided with administrative and financial support, but must have some independence.
- **ABMC** supports the idea of establishing the RRC and due to financial constraints supports the structure where RRC is under MRB with opportunity to independently raise funding.
- While **JICA** recognised the importance of research, they expressed concern, particularly questioning whether this was a priority for the country, considering the lack of funding for construction projects.
- **UNOPS** supports the institutional structure, in which the RRC is answerable to the MRB, however must be semi-autonomous to ensure some independence of project implementation. It should however, be broad-based, to provide services to serve other type of infrastructure.

### 3.3.4 Comments on research culture

In addition to the existence of national policies and strategies that can support establishment of the RRC, the sustainability of the road research capacity in the country is dependent on the existing research culture, which is influenced by the existing institutional environment to do research. The level and quantity of skill-set as well as the infrastructure determines the level of the research culture of an organisation in terms of quality of research outputs and impact on society.

- According to **USAID**, in the first place, the importance of research should be appreciated in terms of its contribution to national development. The University reflects research culture of the nation. However, the College of Engineering and Architecture does not have the capacity in terms of staff and facilities. Having the laboratory at the RRC will support the academics and develop the required research culture.
- The contribution from **SSRA** meeting included the following observations:
  - (i) Research methodology and processes are not well established. Mostly empirical research and observational methods are relied upon.
  - (ii) There is a research capacity gap in the country. More personnel need to be trained in the different areas of road infrastructure development
  - (iii) Need for establishing more opportunities for financial sustainability for research by the RRC once established.
  - (iv) Limited use of CML for research due to funding constraints relating to maintaining required maintenance of CML equipment
  - (v) Policy discussion on research seen as a waste of time and money and therefore it is necessary to sensitise stakeholders on the importance of R&D
  - (vi) No environment for research development at the University. There is institutional fragmentation in the country.
- The **College of Engineering and Architecture** meeting raised a number of issues:
  - (i) No active research unit within the College of Engineering and Architecture. Under the University Research Policy, research is still recognised as a key performance area for academic staff. However, there is very little to no budget line for spending on research. An example of a Research Fund Request Form was provided.
  - (ii) No properly established research capacity and capability in the Department of Civil Engineering. Staff profile is yet to be provided.
  - (iii) Some of the lecturers are managing to undertake research through individual initiatives and publish on a shoe-string budget for student final year projects.
  - (iv) Due to shortage of staff, unable to conduct research and focusing on teaching and learning. Experts from industry are being used to fill the gap.
  - (v) Publication obstacles due to lack of funding to meet basic financial requirements such as attending a conference when a paper has been accepted.
  - (vi) No available access to a knowledge centre; no functional ICT infrastructure to provide for access to scientific and research publication
  - (vii) No functional laboratory although plans are underway to establish four labs. A visit was made to the designated area for the laboratories. This is further elaborated on in section 4.4.
- The **Engineering Council of South Sudan** observation:
  - (i) Affirmed the lack of research capacity at the College of Engineering and Architecture at the University of Juba, including facilities to support research culture. Arrangements were initiated by the Council to facilitate the use of CML and ABMC laboratory by staff and students of the College of Engineering and Architecture. The University did not use the opportunity. ECSS could not provide the reasons. (Note the Chairman is the Dean of Faculty).
  - (ii) Urgent need for a RRC to expose students at the University to research methodology and therefore research culture.
- **WFP's** observation is that there is no real road research capacity in the country, due to limited resources. There has been lack of university involvement in the road sector.



- **UNOPS' observation:**
  - (i) Research is not considered as an important issue
  - (ii) There is lack of research champions in the country
  - (iii) There is need for promoting awareness of the importance of research to influence research culture and to secure the necessary buy-in.

### 3.3.5 Priority research areas

The purpose of this section is to establish research areas that can be delivered through the strategic plan. A number of research area were suggested by the stakeholders. However, sound background analysis of the proposed research topics is important to establish any existing research programmes or any national road infrastructure development to which any new research area developments should be linked to. This is to avoid duplication of studies.

#### 3.3.5.1 Existing road research

The level of road research is very limited in South Sudan. There have been a number of road improvement programmes and trial sections that have been built and studies undertaken, mostly by UNOPS under contract to USAID.

The most prominent project is on the investigation of the use of non-traditional road construction materials and methods as an option for sustainable road network expansion. A total of 18 trial sections and one control section were constructed along the existing Rajaf-Gumbo road in Jubek State. The project was designed to assess the effectiveness and efficiency of the trial sections and from the results, be able to inform decision makers at the MRB, SSRA and other stakeholders in their delivery of the road network service. Plans are underway to establish a long-term monitoring programme on the road.

A number of key road infrastructure improvement programmes have also been undertaken under Rural Roads project funded by the World Bank<sup>5</sup>. The project's main components were:

- Upgrading and Rehabilitation of Selected Rural Roads
- Maintenance and Spot Improvement of Selected Rural Roads
- Institutional Development for Rural Infrastructure Management.

Under the project UNOPS and the GRSS undertook the following:

- Developed the Road Maintenance Strategy;
- Developed a Business Plan for Rural Roads applicable to every State; and
- Developed a Road Safety Program and strategic studies;
- Prepared the Road Sector Development Program

Lessons can be learnt from the project outcomes, which can form the basis for future research.

#### 3.3.5.2 Proposed areas of research

The implementation of a successful research strategic plan is expected to yield many benefits, which could include: effective pavement, geometric and construction materials designs, reduction in the cost of construction; improved delivery and better services, contributing to social wellbeing in rural communities and economic growth. The need for broad based ideas becomes apparent. The following are the priority areas of research proposed by the different stakeholders during the consultative meetings.

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<sup>5</sup> World Bank. Implementation Completion and Results Report. Rural Roads Project. Report No: ICR00004114. June 2017.

**Table 6: Proposed priority research areas**

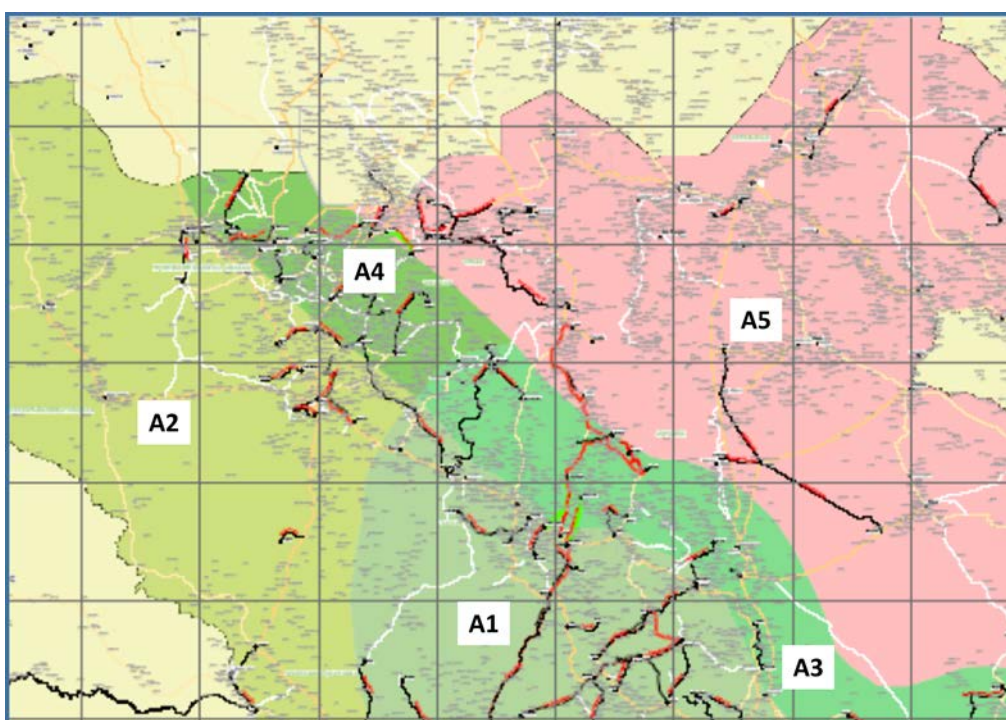
Organisation	Suggested Topic
<b>ABMC</b>	<ul style="list-style-type: none"> <li>• Assessment of quality of road works and contractor performance</li> <li>• Contractor development</li> </ul>
<b>College of Engineering and Architecture</b>	<ul style="list-style-type: none"> <li>• Soil properties analysis</li> <li>• Soil classification</li> <li>• Impact of road construction on the environment and society</li> <li>• Soil improvement</li> <li>• Hydrological impact of the environment</li> <li>• Appropriate machinery for road construction</li> </ul>
<b>Engineering Council of South Sudan</b>	<ul style="list-style-type: none"> <li>• Soils and materials for road construction</li> <li>• Distribution of soil types and road construction materials</li> <li>• Characterisation of different types of construction materials</li> </ul>
<b>EU</b>	<ul style="list-style-type: none"> <li>• Erosion and drainage control</li> <li>• Guidelines for control and monitoring of the works</li> <li>• Effects and control of traffic overloading</li> <li>• Enforcement and management of axle load control</li> <li>• Alternative methods of dealing with black cotton soil</li> </ul>
<b>SSRA</b>	<ul style="list-style-type: none"> <li>• Establishment of cost regimes of projects</li> <li>• Development of database for material properties in relation to location</li> <li>• Construction in swampy areas and with deep clay</li> <li>• Mapping of material distribution</li> <li>• Environmental impact of road construction projects</li> <li>• Environmental impact on pavement material behaviour</li> <li>• Road safety management</li> <li>• National road safety strategy and plan of action</li> <li>• Legal axle load control and enforcement</li> <li>• Pavement design standards appropriate for the type of vehicles in use in the country</li> <li>• Optimisation of community participation in road construction and maintenance projects</li> </ul>
<b>UNOPS</b>	<ul style="list-style-type: none"> <li>• Profile country subgrade conditions</li> <li>• Establish baseline data on cost of road construction</li> <li>• Establishment of local material sources</li> <li>• Monitoring, evaluation, knowledge and data management</li> <li>• Technical skills evaluation in the road sector</li> <li>• Soil improvement, performance of Geo-cell construction</li> </ul>
<b>USAID</b>	<ul style="list-style-type: none"> <li>• Fit-for-purpose design taking into account very unique soil type variation (Black cotton soil)</li> <li>• Stabilisation techniques and cost effectiveness</li> <li>• Material improvement for sustainability</li> <li>• Alternative road construction materials: plastics</li> <li>• Improving proficiency of material testing for alternative materials</li> <li>• Best practice for maintenance to improve access for agricultural productivity and the value chain</li> </ul>
<b>WFP</b>	<ul style="list-style-type: none"> <li>• Economic analysis considering limited resources</li> <li>• Economic viability of maintenance of roads</li> <li>• Database on materials in South Sudan</li> <li>• Community participation and engagement in road projects – sensitisation of material extraction requirements in the area</li> <li>• Establishment of baseline-data: construction costs,</li> <li>• Road classification</li> </ul>

The dominating priority area of research is on both the quality and availability of construction materials and the unique variability of the soils in the country. The description of the material sources is provided in Table 7 and the broad soil distribution areas are shown in Figure 1, illustrating the complexity of the soil distribution.

**Table 7: Materials resource areas in South Sudan<sup>6</sup>**

Area	Materials resource
A1	Area has good materials, lateritic gravels and rock. Assume haul at an average of 10km
A2	As above, but long logistics lines increase costs. Assume average haul 10km
A3	Area has NO gravel or rock materials, characterised by expansive soils, and sandy /silty areas. Average haul 30km
A4	Area has NO gravel or rock materials. It is characterised by expansive soils, and sandy /silty areas. Average haul is 30km. Costs are 10-20% higher than area 3 due to longer logistics lines.
A5	Area has no known gravel sources. It is characterised by expansive soils, gravel beyond 60km overhaul, currently dry season roads only.

**Figure 1: Broad divisions of the availability of road construction material**



This research theme is typically associated with an extensive study, as it would include; mapping the location and distribution of materials, determining their properties in the field and in the laboratory, assessing their performance in road construction and under traffic loading and preparing guidelines for their use.

The concern was however expressed during the meeting at UNOPS, that the focus maybe too much on road materials. The suggestion is that the priority areas should cover much more than just road materials. Research is required across other road sectors and should therefore cover the wider road sector issues to include transport services, planning and delivery.

The above results on priority research areas are to be considered in conjunction with the priority areas identified in the national policy and strategic documents, sections 3.2.3.1, 3.2.5 and 3.2.6.2. Together, they will be used as a point of departure for the consolidated research prioritisation process.

<sup>6</sup> South Sudan Low Volume Roads Design Manual

Following the presentation of the findings at the workshop, scheduled for 20 June 2019, stakeholders will be requested to rank the topics, which ultimately will be incorporated in the development of the Strategic Research Plan and map out the Plan of Action.

### 3.3.6 Funding of research

The successful implementation of the road research capacity building programme and the establishment of the RRC requires adequate, predictable and sustainable funding. Discussions during the consultative meetings revealed that current expenditure and donor support in South Sudan is focused on alleviating the humanitarian crisis and the provision of primary education (together with primary health). Until the situation improves, it is expected that funding for research will remain constrained. The budget allocated to the operations of the DMR is inadequate, let alone to deliver on substantive and quality research. The goal is therefore to have alternative sources of funding research, ensuring that the RRC is less dependent on external support.

There are various opportunities proposed by stakeholders to address the funding requirements in order to ensure long term financial sustainability of the RRC. The suggestions by the stakeholders are presented in Table 8.

**Table 8: Proposed solutions to research funding**

Organisation	Suggested solution
<b>ABMC</b>	<ul style="list-style-type: none"> <li>Specialised testing</li> <li>During bidding process, require bidders to contribute to R&amp;D for transport sector as a component of their contract pricing</li> <li>Could make direct support to research but difficult due to financial constraints as many projects were suspended in 2012 and there have been no large projects undertaken since then.</li> </ul>
<b>College of Engineering and Architecture</b>	<ul style="list-style-type: none"> <li>Provision of short training courses</li> <li>Staff providing professional services</li> <li>Collection of funds for R&amp;D from licensing of vehicles</li> <li>Ring fencing of R&amp;D funding from Ministry</li> <li>Requirement for the use of RRC facilities on Government projects</li> </ul>
<b>Engineering Council of South Sudan</b>	<ul style="list-style-type: none"> <li><i>Sales of developed standards and guidelines</i></li> <li>Government line Ministry support</li> <li>Raise income form dissemination of information</li> <li>From laboratory services</li> </ul>
<b>EU</b>	<ul style="list-style-type: none"> <li>Large project submission by both MRB and University</li> </ul>
<b>SSRA</b>	<ul style="list-style-type: none"> <li>Direct budget allocation</li> <li>Development partners</li> <li>Raise awareness on the importance of R&amp;D</li> <li>Ring fencing of the funding from fuel levy</li> <li>Every level of Government to contribute to the R&amp;D fund. Create an account by law</li> <li>Provide services to industry</li> <li>Devise own income generation activities</li> <li>SSRA requiring consultants and contractors to use RRC services</li> </ul>
<b>UNOPS</b>	<ul style="list-style-type: none"> <li>Application for funding by undertaking research linked to donor funded projects</li> </ul>
<b>USAID</b>	<ul style="list-style-type: none"> <li>Grants through direct donor funded projects responding to MRB needs</li> <li>Line budget within Ministry, specifically allocated for research as well as from other infrastructure cluster Ministries</li> <li>Budget for student research</li> <li>College of Engineering and Architecture, restructured to attract research funding</li> </ul>
<b>WFP</b>	<ul style="list-style-type: none"> <li>Through inter-agency agreement funding</li> </ul>

- |  |   |
|--|---|
|  | <ul style="list-style-type: none"> <li>• WFP in South Sudan cannot directly fund research. It mostly receives monetary contributions through directed multilateral contributions, which in recent years are mostly being directed to the emergency response and nutrition programmes</li> </ul> |
|--|---|

The allocation of a percentage of funds from construction projects is one way many countries are considering to generate revenue for R&D. The investment into an advanced laboratory under the RRC, that can provide accreditation services in the country, could charge annual fees for private labs to be accredited.

Funding for research is not a priority in most developing countries due to humanitarian pressing needs. In this respect it is however important to make decision makers aware of the benefits of research, especially the people who have the power to influence the funding for research and would be able to support it at a political level.

The existing interactions between the key stakeholders and MRB provides a basis for the stakeholders to support the RRC and towards ensuring sustainable road research capacity in South Sudan. Many of the mentioned suggestions in Table 8, will require policies and regulations to be in place for implementation. Due consideration is to be given to the legal implications and regulatory requirements to implement some of the suggestions. This will form part of the Action Plan in the Strategic Plan.

### 3.3.7 Human resources

The DMR as the overseeing Directorate for research, does not currently have the staff complement for conducting research. Research capability will have to be developed over the years. This is where the need for a Strategic Plan for the establishment of the RRC and its promotional aspects for implementation become apparent, if the initiative is to become a reality.

The University of Juba is the only one offering engineering degrees at the College of Engineering and Architecture. There are no programmes at the technologist level.

## 3.4 Summary

Information gathering was conducted through the documentation review and consultative meetings with key stakeholders in the road sector. The results from the documentation review and the opinions and suggestions by the stakeholders can be summarised as follows:

- The establishment of the Road Research Centre is unanimously supported by the stakeholders, with most of them supporting the institutional arrangement that will in the long term ensure that it is a semi-autonomous broad-based road research centre.
- There exists a road sector policy and legislative framework that provide the MRB with the key objectives and strategies to establish a research centre that will enable the development of road research capacity in South Sudan. This sets the guidance for the development of the Strategic Plan for the establishment of sustainable road research capacity in the country that is aligned with the key national policies and strategies.
- The situational assessment established the level of laboratory infrastructure capacity and staff at the Central Materials Laboratory under the Directorate of Materials and Research (DMR) at the Ministry of Roads and Bridges and also at the College of Engineering and Architecture at the University of Juba. The proposed new development of establishing a Road Research Centre, requires the appropriate human capital and infrastructure capacity.
- There are skills and staff gaps within the Directorate of Materials and Research (DMR) in the Ministry Roads and Bridges to conduct high level research. Only 2 out of the 14 staff members possess at least a bachelor's degree qualification.
- The University contribution to research outputs in the area of road infrastructure development is non-existent due to lack of funding and appropriate infrastructure to enable growth of a research culture.

The human capital with the background to undertake research, on the basis of academic qualification profile, is available.

- The main laboratory that can support research in the interim is the CML. It has four rooms (standard room size) for three sections of material testing; (1) foundation/soil testing, (2) aggregate and concrete testing, and (3) asphalt materials testing. The facility requires upgrading to improve the staff working environment and testing capacity. The College of Engineering and Architecture does not have a functional laboratory facility.
- There are various opportunities proposed by stakeholders to address the funding requirements in order to ensure long term financial sustainability of the RRC. These include:
  - (i) increased and ring fenced funding from MRB as the line Ministry and other infrastructure cluster ministries as well as other levies,
  - (ii) income generation through provision of professional and testing services
  - (iii) requirement for all testing, during execution of government projects, to be done at the RRC laboratory,
  - (iv) provision of a cost item for R&D during the bidding process of road construction projects.
- Research areas required to address the immediate and priority areas, have been identified. Generally, the stakeholders indicated soil properties analysis, classification and mapping, construction materials identification, fit-for-purpose design, impact of road projects on the environment, safety and social dynamics as priority research areas.

The findings are to be discussed at the first workshop scheduled for 20 June 2019. The stakeholder workshop will assist in identifying the structure, processes required to enable viable, sustainable and high impact road research activities at the RRC, taking cognisance of the contextual challenges for the country.

## **4 Laboratory infrastructure**

### **4.1 Introduction**

For a laboratory to serve as a research laboratory, it should function efficiently and effectively with qualified personnel and functional equipment. The equipment is expected to support the core operations of the laboratory to provide quality and reliable results. An evaluation exercise was therefore undertaken to ascertain the serviceability of CML as the main facility.

The project team visited the Materials Testing Laboratory on 22 February 2019 to conduct a preliminary assessment of the equipment and personnel to carry out road materials research in order to ascertain the current capacity. As part of the assessment, the project team engaged with engineers and technicians from the laboratory to understand the operational status of the laboratory equipment and the working environment. The observations made during the visit were presented in the Inception Report.

At the time of the visit it was agreed that more time was required to conduct detailed inventory of equipment (including provision of calibration records). This section focuses on the findings of the laboratory equipment evaluation, following the inventory exercise.

### **4.2 Equipment serviceability at CML**

#### **4.2.1 Equipment management**

Apart from having highly qualified and skilled personnel, proper management of laboratory equipment, inclusive of maintenance and calibration requirements are the most important aspects for a facility that must serve as a research laboratory. The frequency or how often the piece of equipment will need to be recalibrated, is based on its stability and manufacturer's recommendations. As a guide, recommendations

are given in Table 8 for the verification and/or calibration of equipment typically used in road materials testing laboratories.

The current status of equipment is provided in Annex 3. All the equipment does not pass the muster for proper maintenance and calibration requirements of laboratory equipment as the calibration period has since long been passed. In addition to the lack of funding for equipment maintenance, there is no service provider in the country to calibrate equipment.

Equipment priority list is to be prepared as part of the Strategic Plan. As part of the RRC establishment Plan of Action, equipment calibration will be a priority. Funding should be made available for this.

**Table 9: Equipment Checking/Calibration Frequency<sup>7</sup>**

EQUIPMENT	Check/Calibration Frequency	
	Check	Calibrate
Balances, Scales and weights	Weekly	24 months
Test thermometers	When used	24 months
Analytical balances	When used	24 months
Weights		36 months
Timers		24 months
Ovens	When used	24 months
Penetrometer: Dial, timer		12 months
Penetrometer cones	When used	
Moisture tins	When used	
Compression or loading devices	3 months	24 months
Mechanical compactor	Weekly	
Moulds		12 months
Manual hammer	Weekly	
CBR Penetration Apparatus		12 months
Sieves	When used	
L. A. machine / Texas ball mill		24 months
Steel balls (L.A. apparatus)		24 months
Aggregate Impact Value apparatus	When used	12 months
Sand replacement apparatus	When used	12 months
Vacuum systems		24 months
Atterberg Limit device	When used	6 months
Flakiness/Elongation gauges		6 months
pH meter		12 months
pH probes	When used	
Water/oil baths	When used	12 months
Penetrometer needles	When used	
Ring and ball device		12 months
Brookfield viscometer		24 months
Viscometers (other)		36 months
Ductility apparatus		24 months
TFO & RTFO oven shelf/carriage		24 months
Load cells		24 months
Tri-axial apparatus	When used	24 months

<sup>7</sup> Procedure CSIR-BE-LAB-21: Calibration and verification of equipment

#### 4.2.2 Estimated costs of putting equipment into service

It has been established that the equipment has not been calibrated for a number of years now. Each piece of equipment as shown in Table 8, has its own verification and calibration schedules based on their needs as well as maintenance requirements. It is clear that no two pieces of equipment will follow the same schedules. Prior to testing again, it is important to evaluate the performance of all the equipment to ensure it is working correctly with respect to accuracy and precision. It is usually recommended to use calibrators provided by or purchased from the manufacturer. However, it has been established that these are not available at CML and therefore service provider has to be called in for the calibration exercise. The costs are dependent on who will be doing the calibration. The standard procedure (ISO 17025) requirements, is for a specific service provider to calibrate equipment the company is accredited for.

Based on the meeting at ABMC, the practice is that equipment calibration is done by a service provider from either Kenya or Uganda. Detailed costs have yet to be provided.

Validation will be required to determine that the expected results can be obtained, by running samples in parallel using CML and ABMC equipment for a period of time. These validation procedures should be completely recorded.

As the equipment has not been in use for a number of years, the sum of yearly maintenance costs for all equipment present in the laboratory cannot be established, which would provide information for accurate budget for the future equipment preventive maintenance.

The costs of equipment repair is not possible to know as functionality testing was not possible in order to determine the exact amount of money needed for future budgeting.

The total estimated cost to bring the equipment into service is shown in Table 10. The cost for calibration of equipment is based on the quotation from Measurement Solutions Ltd, from Kampala, Uganda is UGX **12 200 000 (Uganda Shillings)**, half of which is the cost for accommodation for the service provider, as no local service provider is available. This estimate is not for annual equipment management, which is to be presented in the Strategic Plan. There is equipment laying around that needs to be installed properly in the interim, while awaiting provision of additional space. Equipment like the shear box is missing parts. The maintenance estimated cost is for such work.

In the interim, the facility itself should be refurbished to provide a safe and health working environment. There is need to provide ceilings, air conditioning and air extractor for the binders room. The details for the refurbishment are provided in Annex 4. The level of priority for action is immediate and therefore required within the next six months.

**Table 10: Estimated costs for CML serviceability**

Component	Estimated cost (GBP)
Maintenance	7 350.00
Equipment installation	3 200.00
Calibration	2 723.20
Validation	2 600.00
<b>Sub Total Equipment</b>	<b>15 873.20</b>
Refurbishment	11 001.70
<b>Estimated Total</b>	<b>26 874.90</b>



### 4.3 Equipment for long-term pavement performance monitoring

The MRB and CML do not currently have equipment for long-term pavement performance (LTPP) monitoring. Key equipment that will be required for respective pavement types during LTPP monitoring is presented in table 11. The estimated cost for acquiring critical equipment is shown in table 12.

**Table 11: Proposed equipment for LTPP monitoring**

Data Parameter	Equipment / Standard	Pavement type			
		Flexible	Concrete	Block	Unpaved
Visual Assessments	As per LVR Guideline (Appendix E)	x	x	x	x
Traffic	Manual traffic counts	x	x	x	x
Temperature	Temperature button loggers	x	x		
	Weather station	x	x		
Rainfall	Weather station	x	x	x	x
Density and moisture	Dual-probe hydro density	x	x	x	x
Permeability	Falling head in situ permeability testing	x		x	
Wind intensity	Weather station		x		x
Profile of a road section	Straight edge and wedge	x	x	x	x
	Response type devices /MERLIN	x	x	x	x
Structural strength	Light Weight deflectometer	x	x	x	x
In situ strength	Dynamic Cone Penetrometer	x	x	x	x
Skid resistance and texture	Volumetric patch method	x	x		
Soil profiling of borrow pits and pavement sub-structure	Visual profiling	x	x	x	x

**Table 12: Budget for acquiring equipment for LTPP monitoring**

S/No	Component	Quantity	Unit Price (GBP)	Total cost (GBP)
<b>1</b>	<b>Lightweight Deflectometer</b>	1	6512.94	6512.94
	Transport cart for LWD	1	656.34	656.34
	Magnetic base plate	1	153.37	153.37
	Carrying case for secure transportation	1	542.50	542.50
<b>2</b>	<b>MERLIN</b>	<b>1</b>	<b>1350.00</b>	<b>1350.00</b>
<b>3</b>	<b>Sand density core apparatus</b>	1	114.57	114.57
	150 mm sand replacement set	1	499.66	499.66
	Metal dibber	1	30.81	30.81
	Scraper	1	20.85	20.85
	Steel pointed rod	1	7.21	7.21
	Density spoon	1	2.40	2.40
	Rubber mallet 50 mm diam	1	7.29	7.29
	Club hammer	1	14.30	14.30
	Density pick	1	11.33	11.33
	Chisel 300 mm long	1	5.15	5.15
	Shovel	1	22.94	22.94
<b>4</b>	<b>MOT straightedge (aluminium alloy) + pair of measuring wedges</b>	1	436.39	436.39
	Wooden carrying case for MOT straightedge	1	145.46	145.46
<b>5</b>	<b>Fisco surveyor 50 m steel tape</b>	1	180.00	180.00
	50 m Fibre tape	1	19.86	19.86
	<b>Sub-Total</b>			<b>10733.37</b>

S/No	Component	Quantity	Unit Price (GBP)	Total cost (GBP)
6	Packaging	1	268.33	268.33
	<b>Total</b>			<b>11001.70</b>

#### 4.4 Laboratory working space at CML

It is essential to establish the facility requirements, including the requirements for physical space. Adequate and environmentally friendly working space for personnel to carry out the testing and equipment location is essential. Thus proper accommodation and working environment in a laboratory includes controlled areas, such as location of sample curing tanks, effective segregation of test areas, and adequate storage areas in accordance to the requirements of ISO 17025. The project team made some observations in relation to the working space in and around the laboratory, during their visits to the laboratory. The observations were presented in the Inception Report. Going forward, reconfiguration of the laboratory will be necessary. The provision of a moderate size laboratory facility, will be necessary.

#### 4.5 Laboratory facility at College of Engineering and Architecture

Following the consultative meeting on 17 April 2019, a visit was made to the building, earmarked as the laboratory facility. It is an open space facility, with no demarcation for testing areas. Equipment, most likely donated, has been in storage for several years and still in boxes, that have been destroyed by termites. Annex 5 shows the status of equipment boxes. Exposed equipment parts have rusted. The observation was that the equipment is not necessarily for civil engineering materials testing.

It was agreed that the College of Engineering should take the responsibility and arrange to open and clean the equipment after which DMR will assist in detailed identification and functionality assessment of the equipment.

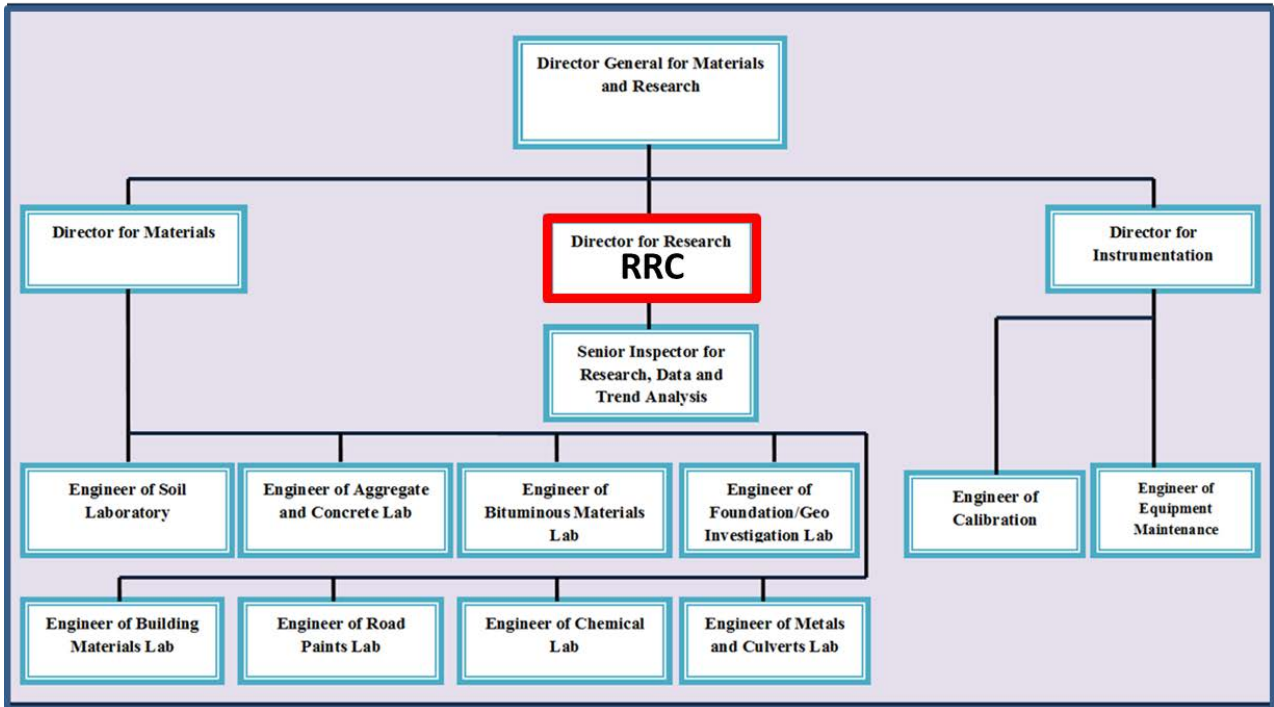
It is clear that the College of Engineering will require extensive laboratory infrastructure development and is not in the position to provide an alternative interim facility for testing to undertake road research. Institutional investment is very crucial.

### 5 Institutional options for road research capacity building

The lack of clearly defined organizational and governance structure for research implementation is more likely to constrain the research development. The organizational structure should support the development of an enabling environment for knowledge generation and professional growth of staff. The RRC will be governed by an approach which is consistent with the organizational culture of the host institution. Based on the existing organizational structures, a number of possible arrangements for the administration of road research capacity building can be considered. Three options are proposed for consideration at the workshop.

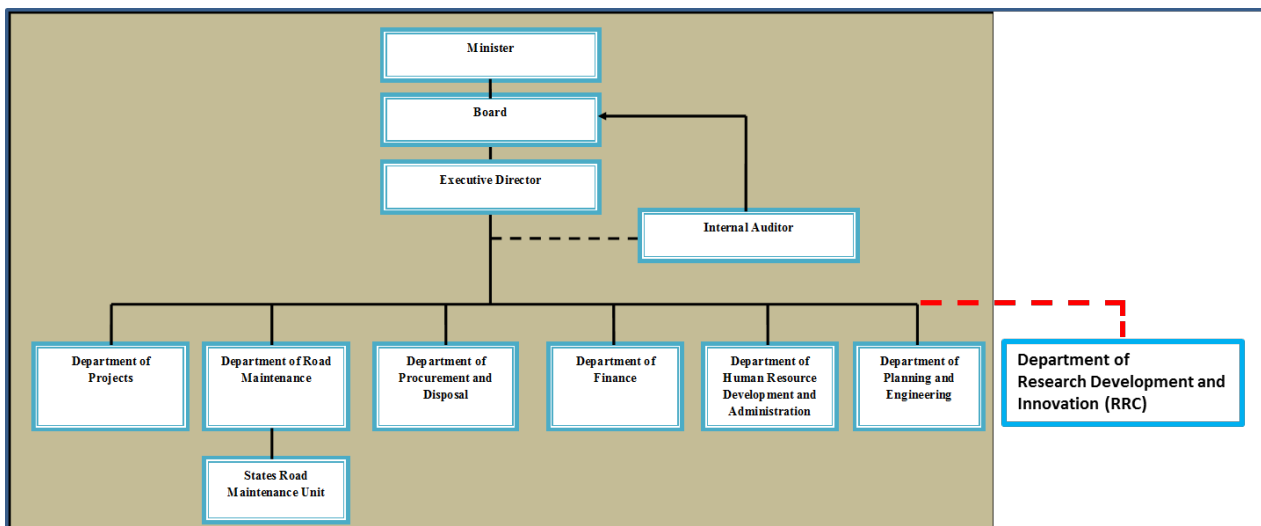
**Option 1:** RRC within the Directorate for Materials and Research. The advantage is that it is already an established Directorate and will just require recruitment of staff. This structure can be considered as stage 1 of the establishment and development of the RRC. The disadvantage is that the RRC will have little or no discretion over procedures that cover research personnel appointments and budget. It is a centralised system and the RRC is more likely to be constrained under such a structure.

Figure 2: Option 1 - RRC under the Directorate for Materials and Research



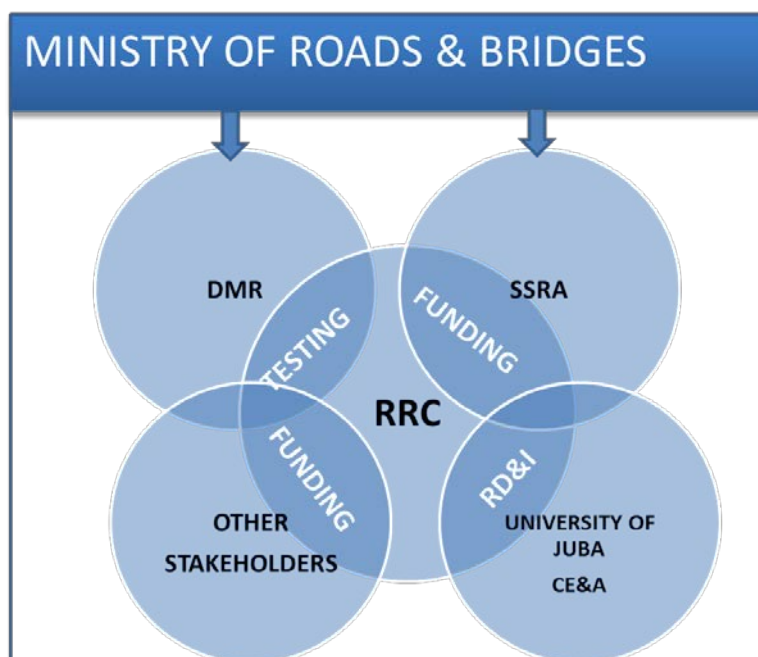
**Option 2:** RRC directly under the SSRA as a Department. In contrast to Option1, it will be in an environment that is fully established as an autonomous body corporate. There will be a need for the establishment of a laboratory facility or linkage to CML as well as recruitment and development of research staff.

Figure 3: Option 2 - RRC under South Sudan Road Authority



**Option 3:** RRC semi-autonomous entity under MRB, partially funded through the SSRA and linked to Directorate for Materials and Research for laboratory testing with direct staff involvement of the College of Engineering and Architecture for research development and innovation capability. This arrangement provides the potential for growth through diversification to offer extra services and independently access alternative sources of funding.

Figure 4: Option 3 - RRC as semi-autonomous entity



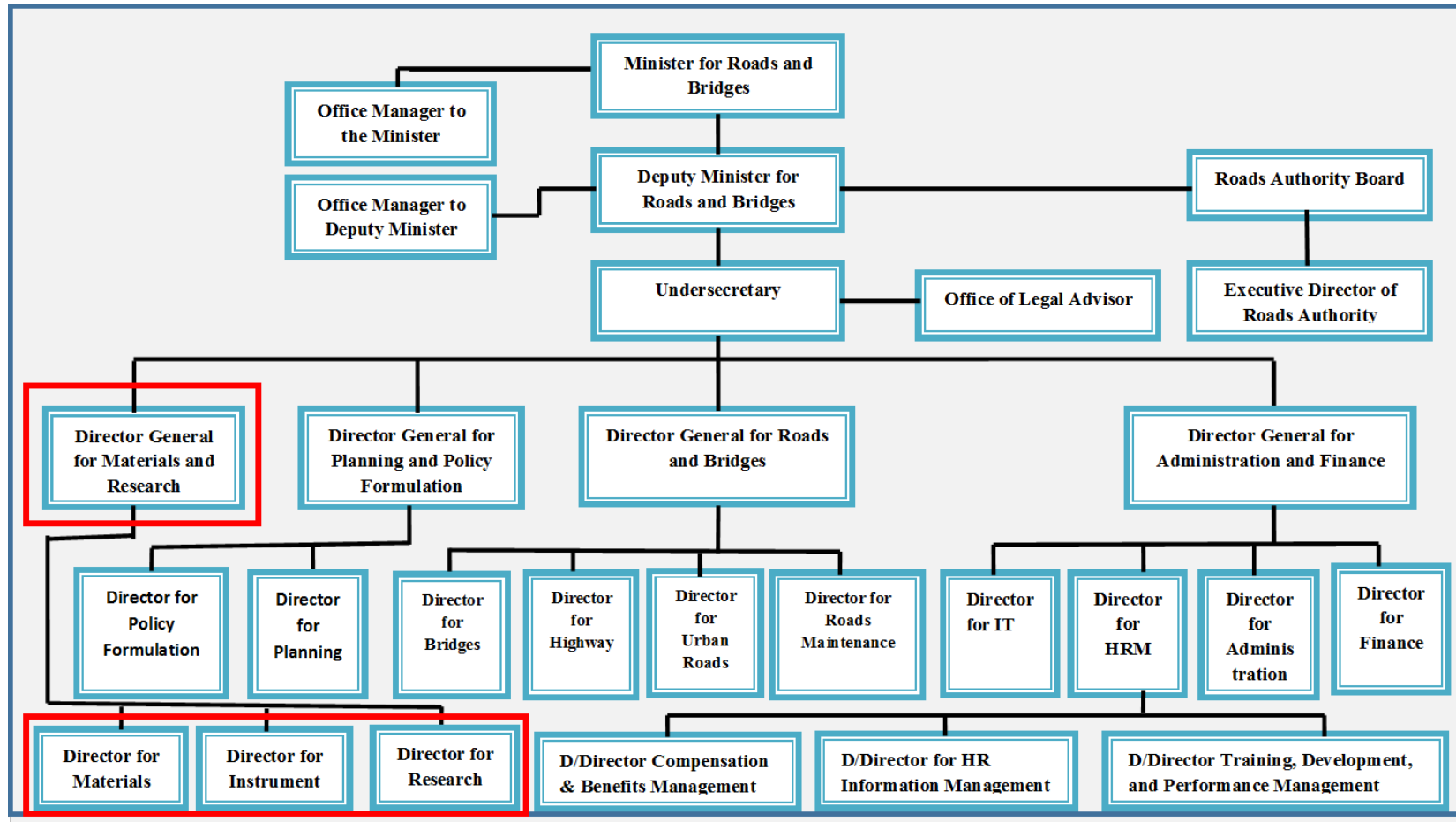
## 6 Next step

The next step is the holding of the consultative workshop on 20 June 2019 in Juba. This will set the guidance for the development of the Strategic Plan for the establishment of sustainable road research capacity in South Sudan to be aligned with the key national policies and strategies.

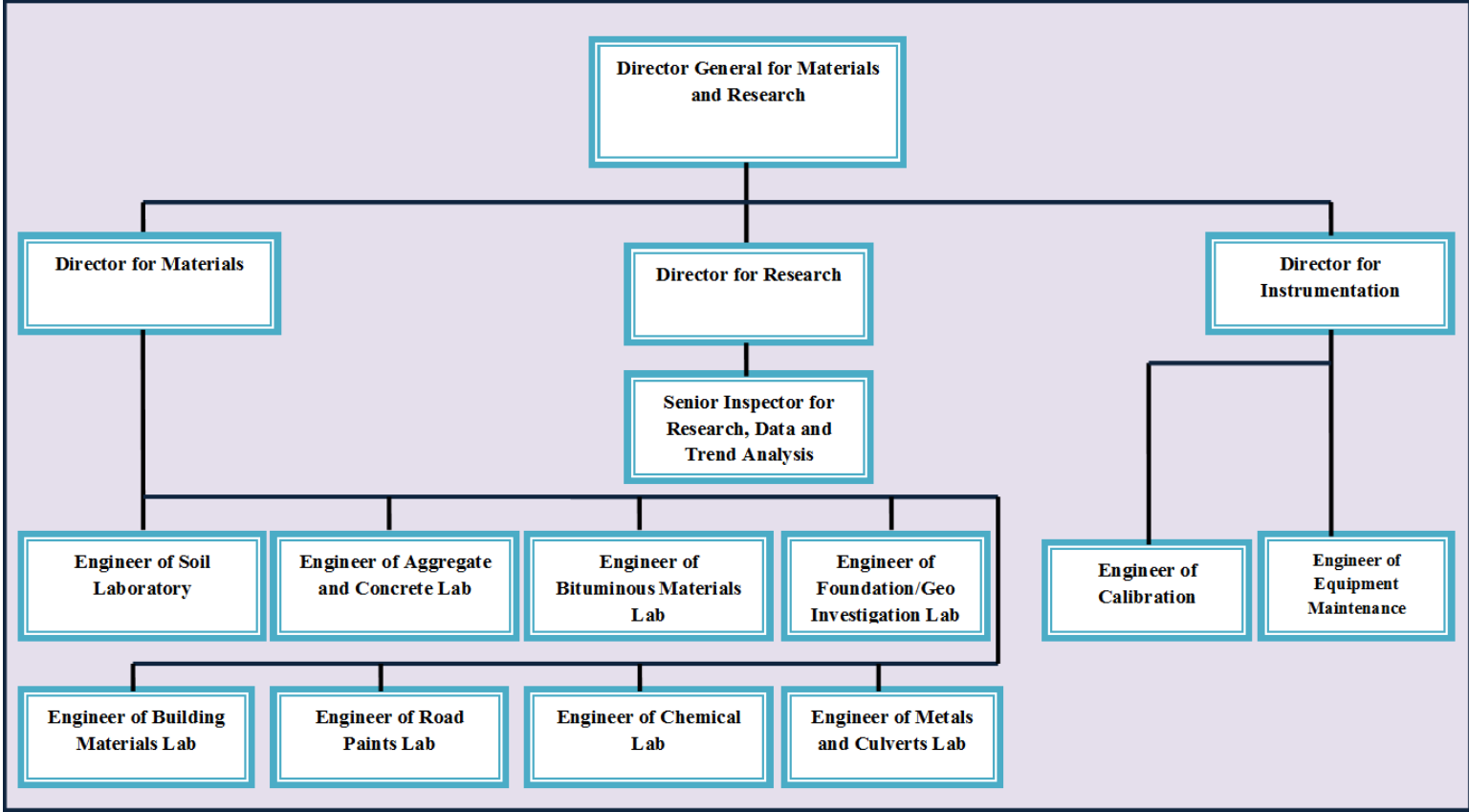
The objectives of the workshop are to:

- Explain to all stakeholders the vision of developing the Strategic Plan, as an integral part of the Ministry of Roads and Bridges to ensure quality road research for generating knowledge and solutions for the provision of improved access, particularly in rural communities.
- Provide feedback on the preliminary findings on the current state of institutional structures.
- Establish the most appropriate institutional structure for enabling the establishment and implementation of road research capacity building, taking cognisance of the contextual challenges for South Sudan.
- Seek clear guidance from stakeholders on research funding mechanisms.
- Accommodate the expectations and concerns of stakeholders and ensure that there is support and consensus and buy-in for the development of the Strategic Plan.
- Establish from within stakeholders those ready to commit and play the role of technical committee member for the establishment of the RRC in South Sudan.
- Establish and rank the top 20 research topics.
- Map a way forward.
- Explain timeframes to develop the Strategic Plan.

## Annex 1 Structure for Ministry of Roads and Bridges



**Annex 2 Directorate of Materials and Research**



### Annex 3 Inventory of Equipment and apparatus

S/No.	Equipment Name	Testing Type	Numbers	Status	Serial No.	Made	Last Calibrated
	<b>GENERAL</b>						
1	Riffler box 40 cm		1	Good Condition		UK	
2	Riffler box 15 cm		1	Good Condition		Uk	
3	Thermostatically Controlled Oven 250 Liter		2	1 Good Condition	-	Uk	
4	Metal Tray Size (90x90x6cm)		9	9 Good Condition	-	Uk	
5	Metal Tray Size (30x30x4 cm)		8	6 Good Condition		Uk	
6	Mixing Pans		6	4 Good Condition		Uk	
7	Hammer 1 & 2 Kg		4	2 Good Condition		Uk	
8	Weight Scale		10	2 Good Condition		Uk	
9	Rubber Mallet		3	1 Good Condition		Uk	
10	Scoops		1	Good Condition		Uk	
11	Sampling Spoon		2	Good Condition		Uk	
12	Venier Caliper		2	2 Good Condition		Italy	
13	Sieves Set		3	1 Good Condition		Italy&UK	
14	Brush Steel		2	1 Good Condition		Italy	
15	Plastic Cylinder		4	3 Good Condition		Italy	
16	Plastic Bags		10	3 Good Condition		Italy	
17	Wash Bottles		15	9 Good Condition		Italy	
18	Glass Plate		2	2 Good Condition		Italy	
19	Hot Plate		2	1 Good Condition		Italy	
20	Triple beam balance		3	2 Good Condition		Italy	
21	Electronic Balance 0.01g		2	1 Good Condition		Italy	
22	Heave duty Balance Capcity 150 kg		1	Good Condition		Italy	
23	Dial gauge (10mm/0.01mm)		8	4 New		Italy	
24	Specific Gravity Frame Complete		1	New	V085/AA/0063	Italy	
25	Glass Jar		2	1 Good Condition		Italy	
26	Pycnometer Bottls (Glass)		3	2 Good Condition		Italy	
27	Straight edge		1	Good Condition		Italy	

<b>SOILS LAB</b>							
S/No.	Equipment Name	Testing Type	Numbers	Status	Serials No.	Made	Last Calibrated
28	Groving Tool Type Casagrande & (ASTM)		12	4 Good Condition		Italy	
29	Porecelain Evaporating dish		6	4 Good Condition		Italy	
30	Liquid limit device (Casagrande)		4	1 Good Condition		"	
31	Liner Shrinkage Mould		8	7 Good Condition		"	
32	Spatulas (Knife)		6	2 Good Condition		"	
33	Moisture Content Tins		50	20 Good Condition		"	
34	Sample Extruder (10 & 5 cm dia)		4	4 New	S114/AB/0011	"	
35	Automatic Compactor		1	Not Working		UK	
36	Mould 1 Liter Base Plate + Colar		5	2 Good Condition		Italy&UK	
37	Mould 2 Liter Bade Plate + Colar		6	2 Good Condition		"	
37	Soaking Tank		1	Good Condition		UK	
38	Compaction Hammer 2.5Kg		6	"	S187/AB/0019	Italy	
39	Compaction Hammer 4.5Kg		14	5 N ,3 G ,Nw 6	S188/AA/0101	Italy	
40	CBR Machine		5	1 N ,1 G ,Nw 3	N,S211-10/AB/0035	Italy&UK	12/02/2008
41	CBR Moulds Complete		20	16 Good Condition		Italy&UK	
42	Shear Box		1	New ,Some parts Missing	FLM /73/72	INDIA	12/02/2008
43	Houger		2	New	S053/AA/0005	Italy	
44	Desicator		1	New	B057-03/AA/0200	Italy	
45	Dynamic Cone Penetromter (DCP) Roads		2	Not Working		It,gremen	
<b>CEMEN/ CONCRETE/AGGREGATE</b>							
46	ACV Mould Complete		4	New		Italy	
47	Concrete Mixer		1	New	C161/AA/0005	"	
48	Vicat Apparatus		1	New		"	
49	Cement Moulds		2	New	E110/AB/0012	Italy	
50	Sand Equivalent Apparatus Sets		2	New	S158-07/AB/0006	Italy	
51	Concrete Mould 150x150x150 mm dia		16	8 Good Condition		UK	
52	Loss Angloes Machine (Complete)		1	1 Good Condition		UK	
53	Aggregate Impact Value (Complete)		1	Good Condition	A0B0-04/AA/0013	Italy	
54	Concrete Crushing Machine (Complete)		1	Good Condition	YIMC 114-7/AB/0084	Italy	02/12/2008
55	Elongation Index gauge		1	Good Condition		Italy	
56	Flakiness Index gauge		1	Good Condition		"	



S/No.	Equipment Name	Testing Type	Numbers	Status	Serials No.	Made	Last Carlibrated
57	Slump Cone Test device		2	Good Condition		"	
58	Tamping Rod		3	Good Condition		"	
59	Concrete Test Hammer (Schmide hammer)		1	Good Condition		"	
60	Vicatronic		1	New	E044N/AA/0230	Italy	
61	Point Load Machine (Cores ,Rocks)		1	Good Condition	41131	"	
62	Concrete Vibrating Machine		1	New	C270/AB/0003	"	
	<b>BITUMINOUS /ASPHALTIC CON</b>						
63	Softening Point Set		1	New	B072/AZ/0109	Italy	
64	Automatic Ring & Ball		1	New	B070N/AA/0043	"	
65	Flash Point & Fire Point		1	New		"	
66	Hot Plate		1	New	B086N/AA/0047	"	
67	Furnace (Flow Ring) (Oven)		2	New (B066N/AB/0004)	B064N/AA/0010	"	
68	Asphalt heater (Marshal)		1	New	B028-01/AB/0006	"	
69	Thermostaically Controlled Water Bath (Asphalt)		1	New	V241/AB/0002	"	
70	Prentrometer PI ( Asphalts)		3	New	B057-10/AB/0027	"	
71	Ceutrifucal Extiuction Machine		1	New	B011/AB/0021	"	
72	Marshal Compactor with Hammer (Complete)		1	New	B036/AB/0013	"	
73	Sample Extruder (5 cm di)		1	Good Condition		"	
74	TRL Machine		1	New	C321-10/AA/0017	"	
75	Bench Or Morter Mixer (Marshal)		1	New	E094/AB/0004	"	
76	Marshal Compaction Moulds Complete		15	New		"	
77	Auto Compression Machine with Flow & Stability gauge		1	Good Condition		UK	
78	Solvent Recovery device		1	New	V211/AB /0001	Italy	
79	Mixer Machine 130 °C		1	New	B027/AB/0002	Italy	
Remarks : (1)All the New Machince are Not Calibrated.							
(2) Most of the equipment were not tested by electric power due to absent of electrician in the laboratory							
3 All the above equipment were supplied without calibration machines							

## Annex 4 Costs for refurbishment

S/No.	Item description	Unit	Qty	Rate GBP	Amount GBP
<b>Element No. 01 Concrete lab (6.7*4.4)m</b>					
1	Welding of suspended metal (4*2 mm thickness flat bar) from the either rafter of purlins to hold timber	pcs	10	20	200.00
2	Fixing of timber 600*600 to form a ceiling frame for attaching plywood (measured separate)	lm	154	4	616.00
3	Supply and fix air condition unit spliter type of capacity of 18,000 btu incldung connection to the electrical cable	pcs	1	960	960.00
4	Apply one coat of emulsion paint undercoat and two coats emulsion of approved color	sm	30	4	120.00
5	Fix plywood ceiling board to the prepare timber frame using nails join should be smooth	sm	30	12	360.00
	<b>Sub-Total</b>				<b>2 256.00</b>
<b>Element No. 02. Soil lab (6.7*6.1)m</b>					
1	Welding of suspended metal (4*2 mm thickness flat bar) from the either rafter of purlins to hold timber	pcs	11	20	220.00
2	Fixing of timber 600*600 to form a ceiling frame for attaching plywood (measured separate)	lm	210	4	840.00
3	Supply and fix air condition unit spliter type of capacity of 18,000 btu incldung connection to the electrical cable	pcs	1	960	960.00
4	Apply one coat of emulsion paint undercoat and two coats emulsion of approved color	sm	41	4	164.00
5	Fix plywood ceiling board to the prepare timber frame using nails join should be smooth	sm	41	12	492.00
	<b>Sub-Total</b>				<b>2 676.00</b>
<b>Element No. 03 Foundation lab (6.7*4.8)m</b>					
1	Welding of suspended metal (4*2 mm thickness flat bar) from the either rafter of purlins to hold timber	pcs	10	20	200.00
2	Fixing of timber 600*600 to form a ceiling frame for attaching plywood (measured separate)	lm	168	4	672.00
3	Supply and fix air condition unit spliter type of capacity of 18,000 btu incldung connection to the electrical cable	pcs	1	1200	1 200.00
4	Apply one coat of emulsion paint undercoat and two coats emulsion of approved color	sm	33	4	132.00
5	Fix plywood ceiling board to the prepare timber frame using nails join should be smooth	sm	33	12	396.00
	<b>Sub-Total</b>				<b>2 600.00</b>
<b>Element No. 04 Asphalt lab (6.7*4.8)m</b>					
1	Welding of suspended metal (4*2 mm thickness flat bar) from the either rafter of purlins to hold timber	pcs	10	20	200.00
2	Fixing of timber 600*600 to form a ceiling frame for attaching plywood (measured separate)	lm	168	4	672.00
3	Supply and fix air condition unit spliter type of capacity of 18,000 btu incldung connection to the electrical cable	pcs	1	960	960.00
4	Apply one coat of emulsion paint undercoat and two coats emulsion of approved color	sm	33	4	132.00
5	Fix plywood ceiling board to the prepare timber frame using nails join should be smooth	sm	33	12	396.00
	<b>Sub-Total</b>				<b>2 360.00</b>
<b>Element No. 05 Two Containers</b>					

1	Checking all electrical connections	Item	1	320	320.00
2	Servicing of the existing air conditions	Item	1	240	240.00
3	Checking the plumbing of the toilets	item	1	320	320.00
4	Cleaning of the compound	Item	1	240	240.00
	<b>Sub-Total</b>				<b>1 120.00</b>
	<b>Grand Total</b>				<b>11 012.00</b>

**Annex 5    Unpacked equipment at College of Engineering and Architecture facility**

