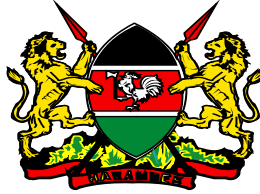


REPUBLIC OF KENYA



MINISTRY OF TRANSPORT AND INFRASTRUCTURE

STATE DEPARTMENT OF INFRASTRUCTURE

MATERIALS TESTING AND RESEARCH DIVISION

**MTRD CAPACITY BUILDING AND KNOWLEDGE MANAGEMENT NEEDS ASSESSMENT
DRAFT REPORT**

MARCH 2017

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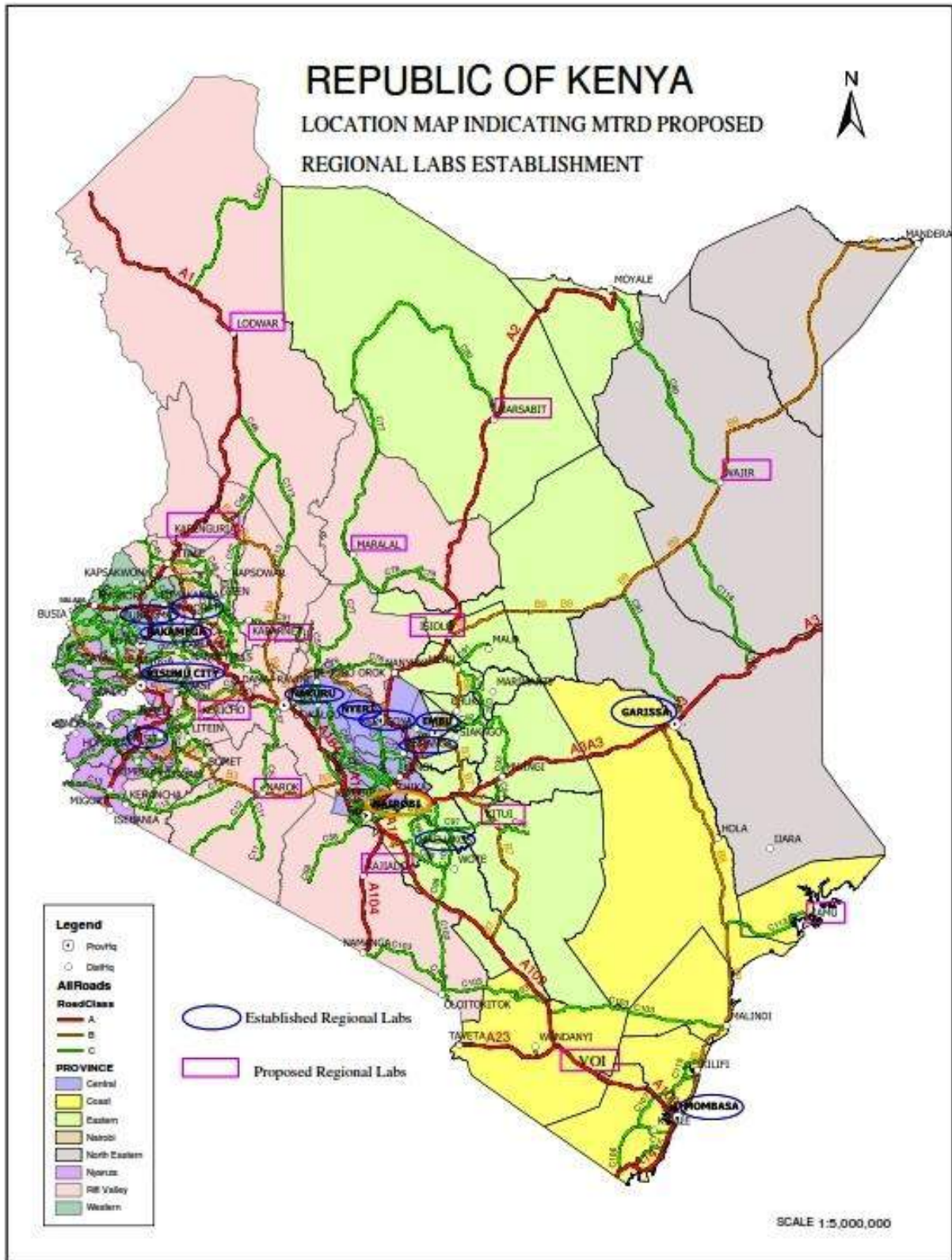
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Acronyms and Abbreviations

AFCAP	African Community Access Programme
ARTREF	African Road and Transport Research Forum
CoE	Centre of Excellence
COP	Community of Practice
EDMS	Electronic Document Management System
EIFL	Electronic Information for Libraries
FWD	Falling Weight Deflectometer
GIS	Geographical Information System
GOK	Government of Kenya
HMS	Highway Management System
ICT	Information and Communication Technologies
INASP	International Network for the Availability of Scientific Publications
KeNHA	Kenya National Highways Authority
KeRRA	Kenya Rural Roads Authority
KIHBT	Kenya Institute of Highways & Building Technology
KLC	Knowledge Life Cycle
KLISC	Kenya Library and Information Services Consortium
KRB	Kenya Roads Board
KURA	Kenya Urban Roads Authority
LIS	Library and Information Service
LMS	Library Management System
MaTRA	Material Testing and Road Research Agency
MOTIHUD	Ministry of Transport Infrastructure Housing and Urban Development
MTD	Mechanical and Transport Division
MTRD	Materials Testing and Research Division
OECD	Organisation for Economic Co-operation and Development
RCRT	Research Centre for Roads and Transport
RMMS	Road Maintenance Management System
RSS	Rich Site Summary
SAGA	Semi-Autonomous Government Agency



Executive Summary

This is the report of a study about the capacity building needs of Materials Testing and Research Division (MTRD) of the Ministry of Transport and Infrastructure Housing and Urban Development (MOTIHUD) of Kenya, in order to meet the expectations of the Division's strategic plan. Since MTRD is a knowledge based organisation, which converts heavy engineering materials data and processes into information and knowledge; the capacity building study also emphasised the knowledge management aspects of the needs of the organisation as well as the other capacity building requirements.

The study team consisted of a Capacity Building specialist and a Knowledge Management specialist. The team carried out a document review of relevant material, a series of in depth interviews with stakeholders from MTRD and various other stakeholder organisations and a study of the internal processes and procedures for information generation, analysis, storage and dissemination. The culmination of the study was a stakeholder's workshop where findings and recommendations were discussed and various options considered. A schedule of the activities undertaken during the study period is included in this report as Annex B.

The objectives of the MTRD and its vision for the future were established through the desk study of its strategic plan. It is the intention of MTRD to become a Centre of Excellence for materials testing and a research centre for roads and transport. The study looked at the facilities and equipment available, and interviews with staff and stakeholders provided an overview of the current position, working environment and processes of MTRD. A list of persons consulted is attached to this report as Annex A.

The report is structured such that the vision for the future of MTRD is described as well as the current situation. The analysis between the current and the desired situations (vision) provides us with the needs and recommended actions to be carried out as a road map toward realising the vision. This road map is described in section 4 of this document as "the way forward". The current position and the analysis naturally splits into 6 categories of situations and actions. These categories are:-

1. Institutional
2. Facilities/Estate
3. Human Resources
4. Equipment
5. ICT
6. Knowledge Management

The observed gap between the current status and where MTRD needs to be in terms of these 6 categories of capacity leads to the actions and recommendations listed in brief below and reflected in section 4 of the report where a summary of recommendations can be assessed by the Division's financiers for support. These recommendations are laid out in detail in section 4 of this report. These recommendations have then been scheduled into a road map which is described in section 4 and Annexes H and shown graphically in Annex E. The schedule of actions or "road map" covers a period of 3 financial years starting in July 2017. By the second half of FY 18/19 it is foreseen that the development actions will be complete and from then an enhanced visionary leadership and management of the organisation will continue. This road map includes the reform of the Division into a materials testing and research agency as foreseen in the Road Bill 2015, and the recruitment of much needed qualified staff and procurement of essential equipment. This institutional reform and the other changes and recommendations included in the report will require support and championing by

the leadership of the division and support from senior management levels of the parent Ministry; part of that support will need to take the form of long term technical assistance for the change process.

A first attempt at a cost estimate to implement the proposed road map has been provided and this totals some 10 million UK pounds. This estimate only covers those items of the strategic plan and road map that require extraordinary funding since many of the recommended activities can be undertaken with the existing items of budget allowed in the annual printed estimates although the level of that funding will need to be re-assessed at intervals during the change process.

The main recommended capacity building actions to achieve the strategic objective of becoming a centre of excellence and research centre for roads and transport are:-

- Institutional reform to a national Material Testing and Road Research Agency (MaTRA), with appropriate mandate and legal instruments (legislation). The recommendation is for the agency to have a regulatory mandate and be the body to accredit and certify both public and private materials testing laboratories, check the calibration of testing equipment and certify in collaboration with KETTA, KIHBT and TVET, materials testing technicians and technologists for the construction industry.
- Upgrade buildings and facilities. It is recommended that a specialised architect be engaged to determine the optimum balance between refurbishment, repair and new construction.
- Determine the optimal equipment holding for laboratories and testing facilities and procure. In order to initiate this a short term specialised equipment expert should be engaged to make a review of the equipment holding and needs, based on projected demand.
- Bring ICT equipment and staff up to date and increase; both to be able to handle information generated. As an information based organisation MTRD and MaTRA need to be up to date and at the forefront of information technology and able to exchange information with international forums and bodies throughout the world. An ICT review may form part of the proposed equipment review.
- Immediately Recruit staff to fill determined essential human resource gaps and contract-in expertise to initially provide research skills and retain/ replace experienced staff and skill shortages. This includes the contracting of senior and retired staff who hold the institutional memory of MTRD and need to pass this on to other staff as part of an overall succession plan.
- Formulate and propose a scheme of service for Materials Technicians and Technologists in line with the Engineering technicians and technologist Act 2016 that came into effect in August 2016.
- Create a GIS unit and train staff to use GIS. The road inventory at KRB and Roads Agencies is being upgraded to a GIS system. All the information and data generated by MTRD testing is geo-referenced and should form part of a GIS database of suitable materials to enhance analysis and research. MTRD should lead this initiative.
- Formulate a plan and programme to finalise existing research projects. DFID funding through ReCAP/AFCAP is generating research projects and MTRD needs to put itself in position to manage the projects and the knowledge generated in Kenya.
- Start internal training programmes with regular exchange of knowledge and reflection sessions.
- Liaise with KIHBT and universities to develop material testing skills courses for industry.

- Elaborate an attachment and exchange programme for staff with projects, universities and national and international road and transport research centres. The international aspects of this action may in future be coordinated through ARTREF.
- Build capacity in the Private sector, through certification of technicians (collaboration with KETTA) and accreditation of laboratories (under Agency mandate).

It is advisable that MTRD should, in support of its strategic goals and as a matter of urgency, implement appropriate knowledge management policies and procedures. Knowledge management initiatives proposed focus on the enhancement of research capability and strengthening and updating of the materials testing procedures to meet the demands of an increasingly digitised knowledge environment. The recommendations will support the knowledge creation and evaluation processes; optimisation of knowledge dissemination to stakeholders; and enabling the core services associated with research, testing, quality assurance and capacity building through effective management of the organisational knowledge base. Specific activities recommended include:

- Implementation of a comprehensive content management solution which will ensure the effective integration of all organisational systems and provide the necessary governance structures and standard approval and routing frameworks
- Establishment of a library and information service to negotiate and provide access to reliable information resources; preserve and make accessible the intellectual property created by the Division; and facilitate knowledge exchange, scientific interaction and networking
- Development of internal and external web based knowledge portals to enhance knowledge dissemination
- Enhancement of records management activities to efficiently manage, store and retain data, documents and other forms of information (records) for specific periods of time and thus ensuring compliance with applicable legislation; corporate governance; long term access to records; and proper project and contractual management.
- Support of collaborative research activities through virtual collaboration platforms
- Establishment and fostering of communities of practice to build relationships and networks across service and disciplinary boundaries and to increase knowledge through case-based learning and inter-professional knowledge exchange

Considering the extent of the changes proposed and the dire staffing needs of the division in the current situation It is recommended that the whole change process be supported by long term technical assistance by experienced materials testing and research organisation with experts in the change management process.

1 Introduction

The Material Testing and Research Division (MTRD) of the Ministry of Transport and Infrastructure, Housing and Urban Development (MOTIHUD) has a mandate to deliver testing and research on roads and building construction materials. As part of the on-going development process in the roads sub-sector the Ministry of Transport and Infrastructure Housing and Urban Development (MOTIHUD) and the MTRD itself have identified a need to further develop the materials testing capacity within the country and to further develop a coordinated centre for Infrastructure and materials research. Such a centre would act as both a centre of excellence (CoE) and model for materials testing and a knowledge generating (research) hub and repository for knowledge, reference and dissemination of information about construction materials in Kenya and the region.

The MTRD is charged with the responsibility of research and testing materials for quality and standard compliance both for government and the private sector construction industry. Specifically, MTRD's mandate is testing and research on roads and building construction materials, road pavement design and construction specifications, construction quality control and assurance, and post construction evaluation of roads and other infrastructure. This mandate is delivered through a number of key functions centred on research, standards and performance monitoring; project design and construction control. The provision of laboratory and field testing facilities to meet this mandate has to be constantly assessed and managed by MTRD. Its strategic goals are listed as:

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

From its position inside the Ministry responsible for transport infrastructure it coordinates with its close partner organisations of other Ministry departments such as Roads Department, KIHBT and M&TE and serves the Ministries agencies of KRB and roads agencies KENHA, KURA, KERRA and County Governments with research projects, knowledge and advice on materials specifications and design. The construction projects initiated by the Road Agencies and county governments and LGAs form the client base for control and monitoring of construction works through testing carried out for contractors and consultants engaged on road agency works.

The Division has a long history of quality materials testing for roads and conducting field trials of new techniques and road related products. In recent years, for a number of diverse reasons, the capacity of MTRD for conducting research and field trials has reduced and less research has been carried out. The store of historical knowledge has also been dissipated and only remains now as the MTRD library that is also in dis-array. The division is currently managing to meet its obligations and requests for materials testing by allocating all its reducing resources to that part of its mandate. The research and advisory role in setting materials standards for novel materials in the construction industry and innovating new construction techniques is beyond its resource capacity.

The division is made up of a main central laboratory and testing facility in the industrial area of Nairobi with 8 specialised laboratories, the main management and administration and housing for the field monitoring and testing equipment. In addition there are currently 14 satellite "Regional" laboratories for materials testing in various counties around the country. These satellite laboratories provide materials testing to local construction projects on request.

MTRD recognises the need to re-generate its research capacity and to re-establish and further develop its capacity for knowledge management while increasing its capacity for materials testing and advisory work. To this end MTRD, through the Ministry, requested support from the ReCAP programme to study the Capacity and Knowledge Management needs of the division. This document forms the report of a short study into the capacity development and knowledge management needs of the MTRD division.

Knowledge management principles will be applied in support of the MTRD strategic initiatives. In general, knowledge management refers to any initiative that focuses on knowledge as a primary resource of the organisation and includes all attempts at making it more productive. Knowledge management processes, tasks and activities are focussed on the optimisation of:

- Knowledge **creation** in response to problem identification or detected knowledge gaps through knowledge generating activities such as individual/group learning; research activity; information acquisition; or customisation of existing knowledge
- New knowledge **evaluation** through peer review or management approval structures
- Knowledge **dissemination** through publishing, broadcasting, teaching and sharing
- Knowledge **storage** in the organisational knowledge base which is held 'subjectively' in the minds of individuals and groups and 'objectively' in recorded or expressed form
- Knowledge **application** or use in the organisational environment

There have been many years of research into what characterises a successful organisation that would certainly apply to any "centre of excellence"; Mowday, Steers and Porter (1979)¹, Charles Handy (2005)², Andrew Miller (2014)³ and many more. Different authors and experts group and categorise the characteristics differently but all seem to agree that the successful organisation has to have:-

Characteristics of a successful organisation:

- Vision. Clear idea of where the organisation is going (wants to go) and how to get there. What the main purpose of the organisation is and its priorities.
- Leadership (at top but also through all levels/departments). Motivation skills and mandate to act on it. Ability and activities to influence people within the organisation to accept the vision and work towards it.
- Effective communication and applied wisdom (3 dimensional- up, down and sideways); vision communicated and shared (instilled) by all staff. Synergies of cog operations known by both cogs and managers (people should know their own and others contribution to overall results/objectives. Shared lessons (success and failure) between operational units.
- Process oriented organisation set up (re-engineering, HR matching minimum needs, flexible, lean and mean but adequate to produce output, advancement/training/growth and succession plans and procedures)
- Efficient systems and procedures (simple, understood, effective, time saving) both physical and ITC
- Organisational culture that is empowering, ethical and innovative

¹ Mowday RT, Steers RM and Porter LW. 1979. The measurement of organizational commitment. *Journal of Vocational Behaviour*, vol.14, p.224-247.

² Handy C. 2005. *Understanding organisations*. 3rd ed. Penguin Business Library.

³ Miller A. 2014. *5 characteristics shared by the most successful organisations*. Entrepreneur Media.

- Accountability both positive and negative consequences for results.
- Innovation (don't stand still, watch the market, keep up to date, try new things, follow the cheese)

The study makes an analysis of these characteristics and recommends how to develop them within MTRD towards becoming a centre of excellence for Materials testing and a Research Centre for the construction industry.

2 Study Methodology

2.1 Study Background

The Government of Kenya (GOK) has been undertaking reforms so as to improve quality, efficiency and transparency in service delivery. In order to implement the new GOK development strategy, all Ministries, Departments and Government Agencies are required to develop strategic plans which clearly define where the organisation is headed. MTRD is currently finalising its update of the strategic plan (2013-2017) and has requested short term assistance from AFCAP to translate parts of that plan into a roadmap of concrete activities that can be put forward to the stakeholders and financial support organisations of the Division to secure the means to put the plan into action.

2.2 Study Objectives

The objective of this assignment is to assist MTRD with the further preparation of the road map towards becoming a Centre of Excellence (CoE) for road research by mapping the knowledge management and capacity building needs, and scheduling the related recommended activities into the road map. The assignment is due to provide an output to the MTRD that will identify the existing needs for capacity building and knowledge management and make recommendations on how to deal with the gap between the existing situation and the requirements foreseen for a future vision and mission taking MTRD to become a *“Centre of Excellence in Materials Testing and a Roads and Transport Research Centre”*.

The results of the assignment will feed into the Terms of Reference for a longer-term technical assistance to MTRD for the implementation of a three-year Capacity Building and Knowledge Management programme. Expanding the scope of the organisation into research on other transport modes and areas such as transport services research can then be launched from a firm commercially viable platform in road research and materials testing.

2.3 Study Process

The study was originally programmed to cover a period which started from November 2015 and scheduled until the end of January 2016. The initial two week inception period consisted, firstly, of a review of relevant material including the draft MTRD business plan, AfCAP progress reports, and capacity building and knowledge management publications and, secondly, of a series of interviews with stakeholders to gain an understanding of the MTRD processes, procedures, infrastructure and



Figure 1 Plenary discussions at stakeholder workshop

environment as well as stakeholder expectations in terms of the client groups and the service scope

of the proposed CoE. This phase ended with the issue of the inception report at the end of November 2015. A further input by both experts took place in January 2016 and subsequently a Stakeholder



Figure 2 Focus Group Discussion

Workshop for Needs Assessment in Capacity Building and Knowledge Management was held in Nairobi on the 26th October 2016⁴. The workshop was attended by a high number of invited participants mainly from MTRD headquarter and regions and from public and private sector organisations forming a wide range of stakeholders from MTRD itself and from supporting organisations in Kenya. A number

of participants, by the nature of their working experience, also had knowledge of the way that other organisations handle the issues under discussion. A workshop report was issued to clients on 1st November 2016.

The results of aforementioned activities culminated with an updated detailed draft report (this report). The content and recommendations, once approved by MTRD and MOTIHUD, will be developed into concept notes and terms of reference for further interventions by others under ReCAP funding. The schedule of activities carried out during the study is detailed in [Annex B](#) to this document.

The schedule for the “road map” to implement the recommended activities outside this study is attached as [Annex E](#) and will be carried out mainly by MTRD and agencies within the GOK with support from development partners and national stakeholders.

⁴ Jennings D and van Heerden M. 2016. *Report on stakeholder workshop for needs assessment in capacity building and knowledge management*. Silver Springs Hotel, Nairobi, 26 October 2016.

3 Findings and Recommendations

The vision of the MTRD is to become a Centre of Excellence (CoE) for testing of construction Materials, and a centre for Research and field trials (RC) into Transport and Infrastructure. This vision and how to achieve it is set out in a revision of the Strategic plan (2013-2017) currently being finalised (Nov 2016). This study will identify practical activities in the short term that will complement the strategic plan and assist in putting it into action immediately. The recommendations of this study may have consequences on the timing of the planned strategic actions but will not change the direction of the agreed strategy.

The strategic plan gives an overview of objectives and direction for reform and development of the organisation together with an analysis of the stakeholders involved in both determining the needs and implementing the changes. The strategy document provides a quarterly timetable of activities for the transformation to a CoE for materials testing and a RC for transport and infrastructure in Kenya.

The strategy is split into 10 sub-divisions each with its strategic objectives, activities and sub-activities entered into a timeframe matrix annexed to the plan. Work is continuing to finalise this document with the main items now being the budget estimates for the activities. This work will continue and be complemented by the results of this study.

The plan is comprehensive in its scope and lays out a schedule of activities for MTRD to establish a firm and stable basis on which to move forward with stakeholders' support.

This study has found that MTRD is uniquely placed to achieve the stated goals of becoming a Centre of Excellence for materials testing and a research centre for roads, transport and infrastructure, as well as a repository of detailed knowledge for the roads sector. The Division has a long history of quality materials testing for roads and other construction projects, conducting field trials of new techniques and road related products. The objective of expanding the remit into other transport modes (air and rail) may take a little longer, but should be considered within the remit.

It has become clear that the stated intention of MTRD to become a CoE and a RC is supported by all stakeholders especially MOTIHUD and indeed assumed in the Roads Bill 2015. MTRD is uniquely placed to reform into such a centre; by nature of its long history as a materials testing centre and coordination and support centre for roads investigations, forensic materials investigations and field trials on transport infrastructure and techniques.

There are inevitably certain constraints that restrict the desired reform process and a number of these have been identified by previous investigations and confirmed by this study. Constraints exist within institutional setup, physical facilities, equipment availability and maintenance, human resources and skill base, knowledge and records management processes and ICT resources and skills. A description of the main identified constraints is contained in the sections below.

A limited number of the recommended activities in the reform process and in preparation for the desired reform can take place immediately and can be organised internally without additional resources. However the realisation of the desired reforms and most of the recommended actions will require additional financial, human, physical, procedural and informational resources.

The prioritisation and proper coordination of national road and transport research activities will be challenging. A National Research Forum is proposed to inform and oversee research on behalf of stakeholders and the research community. Such a forum is, in part, foreseen in the Road Bill 2015 with the formation of the Public Roads Standard Board that will coordinate research for roads. There is also a need for a national institution to act as the knowledge generation and reference centre. This will require close cooperation between the different agencies within MOTIHUD as well as with external research partners and stakeholders.

3.1 MTRD Mandate/Mission

The desired state of the mandate and mission of MTRD with its desired expanded and developed activities is set out in the strategic plan. With a vision “To be an internationally recognised Centre of Excellence for materials testing and research on roads, transport and other infrastructure.”

and to achieve this through the mission:-

“To provide independent, impartial advice and innovation on Roads and Transport in order to more effectively contribute to the national economy.”

The research and testing is deemed to cover the construction and maintenance of roads, transport and other infrastructure, similar to the requests MTRD receives currently.

3.1.1 Materials Testing Services

The Roads bill 2015 that is proceeding through parliament currently provides for Roads authorities to ensure that construction meets the required standards, but retains the setting of those standards, regulations etc. within the mandate of the Ministry in the form of the Cabinet Secretary. In this way MTRD can retain its mandate to advise the Ministry on the setting of construction standards, specifications and regulatory manuals while at the same time remaining independent of the parties to any construction contracts in order to act as an independent agent in the testing of construction materials.

MTRD has the capability and facilities to test materials in its specialised laboratories, viz:

- Chemistry Lab
- Paints lab
- Non-Destructive testing and Radiology lab
- General testing and instrumentation Lab
- Drilling and foundations Lab
- Concrete lab
- Bitumen Lab
- Soils lab

As well as more basic soils, concrete and bitumen laboratories in the regional offices.

As Kenya continues to develop and construction of infrastructure increases, in line with the development plans and Vision 2030, the demand for materials testing will increase.

At the moment MTRD is just managing to meet the demand for its materials testing services at the central and regional laboratories but its capacity is currently diminishing in terms of human resources,

testing equipment and skills. The reasons for this decline in capacity for these item are explained in the section below that deal with these specific resource items.

To match the desired state and foreseen future demand for materials testing, as described in the strategic plan for MTRD, the division will need to increase its capacity by 100% above the current level. This level of increased capacity will be required so as to allow for the consecutive development and re-vitalisation of the research and field trial operations that will utilise the same skilled staff, testing equipment and facilities. This increase will not be required immediately but can take place in stages over the next 5 years. However there is an immediate need to stop the decline in key managerial and technical staff, refurbish the buildings and update the testing equipment.

3.1.2 Road Research, Standards and Performance Monitoring

The mandate of MTRD for carrying out research, advising on standards and specifications and monitoring the performance of the construction industry against the approved standards is unaltered.

The vision outlined in the strategic plan for institutional reform is headlined as

“To be an internationally recognised Centre of Excellence for testing and research on roads, transport and other infrastructure.”

and to achieve this through the mission:-

“To provide independent, impartial advice and innovation on Roads and Transport in order to more effectively contribute to the national economy.”

The objectives of the MTRD and its vision for the future were established through the study of its strategic plan. It is the intention of MTRD to become a Centre of Excellence for materials testing and a research centre for roads and transport. The role of MTRD on these issues and activities needs to be detailed and clarified and the relationship of MTRD with other National institutions such as KEBS can be strengthened.

Research programmes and specialist services will need to be achieved through a combination of delivery mechanisms involving external stakeholders such as academic institutions, consultants and research centres.

MTRD is an organisation that converts the characteristics of heavy engineering materials and operations into information. As such it is an information based organisation and its key product, its output, is both information and knowledge. It feeds back this information and knowledge to the construction industry. It feeds back the information about test results directly to the clients, consultants and contractors on roads projects who use it to support contractual processes and inform road agency clients to take informed decisions about the works. MTRD wishes to increase its role to feed back the knowledge gained from analysis of that information and research projects to the industry as a whole, with the objective of updating and improving the regulations, specifications and manuals that guide the industry. To do this MTRD need a robust system of knowledge management.

MTRD should begin activities immediately to discuss and propose the reform of the Division into an agency, with an act of establishment and a governing board. The agency will have the mandate and responsibilities to specify standards and standard tests for construction materials for Roads and

Transport infrastructure and to carry out such tests for public and private clients on a commercial basis. The agency will carry out research to determine and modify the standards and advise government and government agencies on Design and specifications. As part of the standard setting mandate the agency will regulate all materials testing facilities in the country (both public and private) and certify the competence of individuals to carry out the tests. The reformed agency will include the existing regional laboratories and expand into more regions to serve the needs of the counties.

The activities to carry out this recommendation are all internal and should start immediately although it is recognised that the process will take some time. (1 year). The initial discussions will need to take place with a large number of stakeholders and a retreat /workshop involving decision makers from the stakeholder is recommended as an initiating action.

The vision for the future is that MTRD will reform into an agency of the Ministry and in this way strengthen its mandate. At the same time it will become an independent arbiter and adviser on Pavement and road design, Development and amendments to Standards, Manuals and guidelines and the monitoring of construction. MaTRA will continue to carry out routine materials testing at the commercial fees appropriate to the different tests and retain that money as part of the materials development and research fund. It should receive a block grant from GOK for administration and running costs, and in addition utilise the 2% (of Road Maintenance Fund (RMF)) testing and research fund as directed by the Public Roads Standards Board to carry out the research needed to develop modern road design, testing protocols, performance monitoring and maintenance standards for Kenya. In addition to the 2% percentage of the RMF consideration needs to be given to a small percentage (0.5%) of the road development budget, including projects funded by development partners. There is a clear need for testing and development research associated with project design and construction of new roads and road improvements. It is not the case that road maintenance alone should provide the funds for research

3.1.3 Roads Design and Construction Oversight

The MTRD is charged with the responsibility of research and testing materials for quality and standard compliance both for government and private sector construction and industry. Specifically, MTRD's mandate is testing and research on roads and building construction materials, road pavement design and construction specifications, construction quality control and assurance, and post construction evaluation of roads and other infrastructure. This mandate is delivered through a number of key functions centred on research, standards and performance monitoring; project design and construction control

The institutional links and relationships are complicated but in general MTRD acts as a service provider to the whole road and transport sector in the areas of Materials testing, roads research and design and specification advice.

The MTRD has a compliment of staff with a high grade of skills and experience in the field of materials testing, road and pavement analysis, materials specification and design advice

As a division of the Ministry, MTRD advises on the procedures for all aspects of the design of all classes of roads and tests materials for construction implementers for all manner of infrastructure.

It is proposed that in the new reformed agency a separate section for Roads design and construction oversight will manage the laboratories, carry out the regular materials testing for roads to ensure compliance with the existing standards, specifications and guidelines. This will be a separate section from the one that carries out the research and works on the development and adjustment of standards. In this way there will be no conflict of interest although the technical teams will cooperate fully with each other. The compliance section will carry out most of the roads related materials testing on behalf of construction clients (Consultants and Contractors) and use the fees collected to fund the investment required for maintenance and upgrading of testing equipment.

At the same time as part of the management of laboratories the reformed agency will accredit other materials laboratories in the country.

3.1.4 Capacity Building and Resource Management

Within the existing organisational setup of MTRD physical and human resource management in terms of staff training, allocation of duties and human resource management and equipment upgrading and maintenance, all fall under the general government regulations and restrictions of public service organisations. While a lot can be done internally to provide opportunities to gain experience, unusual or new procedures need already experienced staff to pass on the knowledge. These senior staff also need to have the time to devote to the transfer of technology to others. At present this is not happening in MTRD. At present capacity building and resource management is conducted as part of the Ministry's plan, and execution is controlled at ministry level. This means that MTRD's plans and programmes for capacity building are diluted or ignored and do not reach a useful level of implementation.

The intention is for MTRD to undergo institutional reform to become an agency in order to ease the constraints on resource management and expand the mandate for capacity building under a more independent setup.

Institutional reform comes with staff rationalisation. The foreseen material testing centre of excellence and research will need to build its staff through careful recruitment of fully qualified personnel. A HR management system will be introduced to motivate, train, retain and monitor staff performance. Whichever institutional option is chosen the human resources processes need to be strengthened. Recruitment, promotion and motivation opportunities need to be increased to have an effect on staff retention.

A re-engineering of processes required for testing and research will be undertaken and analysis of the staffing requirements will be carried out. The basis for this analysis is the FTE analysis of staffing levels already carried out by the MTRD management. This can be used for the first round of recruitment. Core staff forming the units to carry out the base load of tasks covering, routine testing, calibration testing, accreditation verification testing, research and monitoring of road performance will be engaged and trained to the highest standards. The complement of core staff will include the minimum of administration and support staff, all trained and equipped to utilise the modern document and records management systems. Technical staff will also be trained to use modern GIS based reporting and test result recoding systems and research methodologies.

In addition to the core staff complement a network of associates and professionals will be built up for “call down” and temporary contract work when workload demands. Such call downs will be used to bolster research teams, staff project monitoring requirements and carry out specific short term or intermittent tasks.

In this way the staff complement will be controlled and remuneration packages can be optimised for motivation.

Although rationalisation usually means a reduction in staff, in this instance the required staff level, while lower than the current full establishment list, is most certainly higher than the current numbers in post. This comes about since most of the posts in MTRD establishment list remain unfilled. A complete revision of the establishment list should take place at the same time as the urgent recruitment of essential staff. A move to an agency or SAGA will facilitate this.

3.2 Institutional Framework

Building of capacity usually focuses on Human resource development but also includes those aspects of capacity related to institutional issues, processes and procedures, physical and equipment requirements and information and knowledge management. All these requirements have to be considered also in terms of mandated core activities and key result indicators (KRIs) on the one hand and funding requirements and possibilities on the other. There is clearly a significant overlap between knowledge management and capacity building and some recommendations under the two heading may be repeated when looking at the situation from both viewpoints.

Over the last decades governments around the world have been in the process of divesting themselves from commercial enterprises and organisations and privatising operations that could potentially be commercialised. This trend has been under an objective of reducing government operations to purely governing and regulating and leaving implementation and commercial activities strictly to the private sector. For the most part this has proved highly positive from the governing point of view with Government departments reduced to concentrate on legislation, regulation and monitoring functions. The same success story has not been true when these reforms are viewed from the operations side of sectors that have been divested or privatised. A large number of formerly highly successful government run services have been woefully crippled by privatisation. Examples can be drawn from all parts of the world and include the British Rail system, the South African water supply services, Swiss Air and the Kenyan road maintenance services. All services privatised into a Private sector that was not sufficiently developed in those service areas to adequately meet the challenge.

The vision outlined in the strategic plan for institutional reform is headlined as

“To be an internationally recognised Centre of Excellence for testing and research on roads, transport and other infrastructure.”

and to achieve this through the mission:-

“To provide independent, impartial advice and innovation on Roads and Transport in order to more effectively contribute to the national economy.”

Unpacking these statements show that there is support for the reform of MTRD into a centre of excellence for testing and a research centre. The research and testing will be deemed to cover roads, transport and other infrastructure, similar to the requests MTRD receives currently. The mission statement also gives us more detail for the type of reform required. Providing “independent and impartial advice” implies that MTRD must have a certain level of autonomy. The “innovation” requires research, both active action research and blue-sky research generated from the organisation’s own knowledge and assessment of the situation and trends within the industry as part of its monitoring functions. Lastly if the work of the MTRD is to “effectively contribute to the national economy” then their work needs to be carried out within commercial principles, and the organisation should be exposed to the realities of the commercial environment without being overly exposed to existential financial risk. In other words MTRD needs to be independent of direct government or industry control while still having the stability of partial government funding. This direction of institutional reform is foreseen in the Roads Bill 2015 where the creation of a “National Agency for Testing and Research on Roads” is anticipated.

It is the intention (formulated in the Roads Bill 2015) to establish a research fund for roads that will be managed by a board where the major road stakeholders, including the materials testing and research agency, are members.

There are different ways in which the institutional changes to MTRD can head and options from other countries are summarised in Annex I below.

The resulting mandate from the reform would include testing and research, accreditation of other (all non-MTRD) laboratories, and the issue of Agrément certificates for materials. Stakeholders feel that certification for materials staff (Technicians and technologist) is not the role for MTRD to undertake. Instead MTRD or the reformed agency would support (with expertise and facilities) the testing of candidates to be certified by KIHBT and other polytechnics or through NITA and VETA under the registration board for engineering technicians and Technologists (IET and KETTB).

Other groups of stakeholders in discussions added that they noted that accreditation was the responsibility of KENAS and they already have that responsibility. There may be possibilities for MTRD or a reformed SAGA to undertake the audit of results and certification of management processes of other laboratories according to ISO 17021, and to offer certification of products/materials according to ISO 17065 under accreditation by KENAS. The certification of materials testing personnel could also be certified in accordance with ISO 17024 and this too could be under KENAS international level of accreditation.

There is certainly scope within these options for a reformed MTRD to undertake all of these activities specifically for construction materials testing laboratories and Technologist and technicians in cooperation with the relevant external authority (KEBs, KENAS, KETTB, IET, VETA, NITA etc.). The extent and level to which MTRD takes on these accreditation and certification roles is a matter for further investigation and discussion by MTRD itself together with the external authorities..

3.2.1 Legal Framework

Currently MTRD is a fully integrated division of the MOTIHUD. From this position inside the Ministry responsible for transport infrastructure it coordinates with its close partner organisations of other Ministry departments such as Roads Department, KIHBT and M&TE and serves the Ministries agencies of KRB and roads agencies KENHA, KURA, KERRA and County Governments with research projects and knowledge and advice on materials specifications and design. The construction projects initiated by the Road Agencies and county governments and LGAs form the client base for control and monitoring of construction works through testing carried out for contractors and consultants engaged on road agency works. The type of testing available at MTRD has proved useful not only for roads but also more generally to the construction industry as a whole. As such the materials testing services are available to the general public and to organisations such as universities, colleges etc. to undertake testing associated with their research projects. The institutional links and relationships are complicated but in general MTRD acts as a service provider to the whole road and transport sector in the areas of Materials testing, roads research and design and specification advice.

There has been a long standing proposal that the MTRD should reform institutionally into a semi-autonomous government agency (SAGA), at the same time as other divisions, the Mechanical and Transport Division MTD (Plant, equipment and vehicle pool) and Kenya Institute of Highways & Building Technology KIHBT (Staff Training division). This has not happened, although some moves in that direction have been made by the other departments. The revisions to the Roads Act envisioned in the Roads bill 2015 currently before parliament has missed the opportunity to enact such a reform. It does, however, contain the establishment of a National Roads Standards Board that will determine the standards for road construction and maintenance. It is foreseen that a reformed MTRD will have major inputs into the research, knowledge and information collection and management to inform the decisions about Standards.

This notwithstanding, there is the need to align the MTRD with the current constitution and provide for the division's services to the county governments and county roads authorities. This is being planned within MTRD at present with the plan for an expansion of regional laboratories as shown on the Map on page iv at the beginning of this document. Eleven new regional laboratories are planned to serve the county governments with their road works and to enhance the ability of MTRD to undertake research on a national basis. It is likely that the counties will wish to establish materials testing facilities within their own jurisdictions in order to boost the standing of the county and also the commercial opportunities locally.

Materials testing services are also provided by a growing number of private commercial laboratories. The quality of the services provided by these commercial labs is variable and may or may not be proportional to the cost of the tests. There is a need for these materials labs to be regulated, and checked for the quality of testing. They can then be accredited and testing procedures certified. Currently there is a discrepancy in the accreditation process since this responsibility lies with the Kenya Bureau of Standards as a function of the Kenya National Accreditation service (KENAS) and yet they rely on MTRD for standards and approval of materials laboratories and the tests carried out. Also when consultants and contractors do determine to use private laboratories they approach MTRD for a letter of approval for the tests even though this is not officially recognised, except internally by the Ministry in charge of roads. This Ad Hoc situation needs to be regularised with a re-constituted MTRD

having the mandate and authority to act as Materials testing accreditation for the Construction industry.

There would be a possibility for county labs and private labs to be accredited through MTRD provided such accreditation was established as part of the reform of MTRD as an agency of Government under MOTIHUD. This could be part of the institutional change in the long term.

3.2.2 Strategy and Policy

MTRD will need to consider formulating its own model of reform and institutional arrangement that matches the National and Sector situation. The most likely choices for MTRD would be:-

- a) Remain as a Government division under the Ministry responsible for Roads. In the present set up the Ministry of Transport and Infrastructure. This option is safe, but will mean that all the various constraints associated with Government departments will remain and rule out the chances of MTRD achieving its objectives set out in the Vision and strategic plan.
- b) Reform into a Semi-autonomous Government agency through executive order of the cabinet secretary. This would give the MTRD the authority to generate revenue and retain that revenue in a fund account controlled by the legal instrument (similar to the Mechanical and Transport Fund). The proposed additional regional laboratories could only be built up with the provision of government revenue as part of both the development and recurrent budgets. The independence within this solution is limited. The other mandates foreseen as part of the reform process would not materialise.
- c) Reform to a semi-commercial Government agency through an act of parliament. Such a legal instrument would provide the opportunity to include the mandates for other full institutional reforms that could enhance the outcome for MTRD. (Regulation of testing standards, accreditation of private laboratories, certification of proprietary products for the industry). Staff remuneration, incentives and training schemes could be managed independently. The new agency formed would have the ability to seek private funding through PPP initiatives to build up the additional regional laboratories and provide funds from commercial interests for research projects. The strong links to the other road agencies who act as clients for the MTRD would not be lost but would have to be re-aligned into a semi-commercial relationship.
- d) Reform to a fully commercialised independent private company for testing and research. MTRD would receive no government funding apart from payments for contracted services rendered.

It will be up to MTRD, and its key stakeholders and parent bodies, which way will be best. A hybrid model specifically for MTRD in Kenya at this time is also a possibility made up of a combination of the international and local models outlined.

The recommendation will be for MTRD to reform into an Agency for material testing and Research with the mandate for commercial operation in the fields currently undertaken by MTRD and with the additional function of advising on the accreditation of commercial materials laboratories and the issue of agreement certificates for approved suppliers of construction materials. This would be done under a mandate from KEBS. MTRD already provides facilities and skilled staff to undertake and invigilate the examinations for materials testing technicians and technologists under the various diploma courses. This function will be formalised within the reform strategy that creates the agency. There is a need for certification of materials testing technicians who have the potential to work in commercial

laboratories and the Materials testing agency of the Ministry of Transport and infrastructure would be the best agency to provide this service. Already many private companies approach MTRD for informal letters of recommendation for both technicians and private laboratories.

The reformed MTRD will determine the testing standards and the required specifications for materials used in the construction and maintenance of roads in Kenya and will determine Kenya standard specifications and procedures with reference to AASHTO, BS and EN current standards and developments. It is noted that there are current attempts through ISO to harmonise the AASHTO and EN standards and MTRD will monitor and keep up to date with these developments and ensure that equipment is available for such tests. Currently MTRD use and test to a variety of standards depending on client requirements. These include Kenyan Standards (KS), British Standards (BS), American Standards (ASSHTO and ASTM), South African (SANS) and SADC standards, Japanese (JS) Indian (IS) East African Standards (EAS), European union (EN) and general international Standards (ISO). While contributing to the continued development of Kenya's own standards the reformed Agency will retain the flexibility and equipment holding to test to any of these standards.

MTRD cannot afford to wait even for minimal reform before taking serious action to change the identified restricting processes

MTRD must undertake a process of reform. Starting with actions to improve the current situation within the Ministry, moving as soon as possible to an intermediate stage with the creation of a Saga and then proposing a full reform to an agency (like KENHA) when the time is right.

3.2.3 Governance and Coordination

The Material Testing and Research Division (MTRD) of the Ministry of Transport and Infrastructure (MOTIHUD) has a mandate to deliver testing and research on roads and building construction materials. As part of the on-going development process in the roads sub-sector the Ministry of Transport and Infrastructure (MOTIHUD) and the MTRD itself, have identified a need to further develop the materials testing capacity within the country and to further develop a coordinated centre for roads and transport research. It will act as both a centre of excellence (CoE) and model for materials testing and a knowledge generating hub and repository for knowledge reference and dissemination about roads and construction materials in Kenya and the region.

The current institutional set up for Governance of MTRD is depicted below.

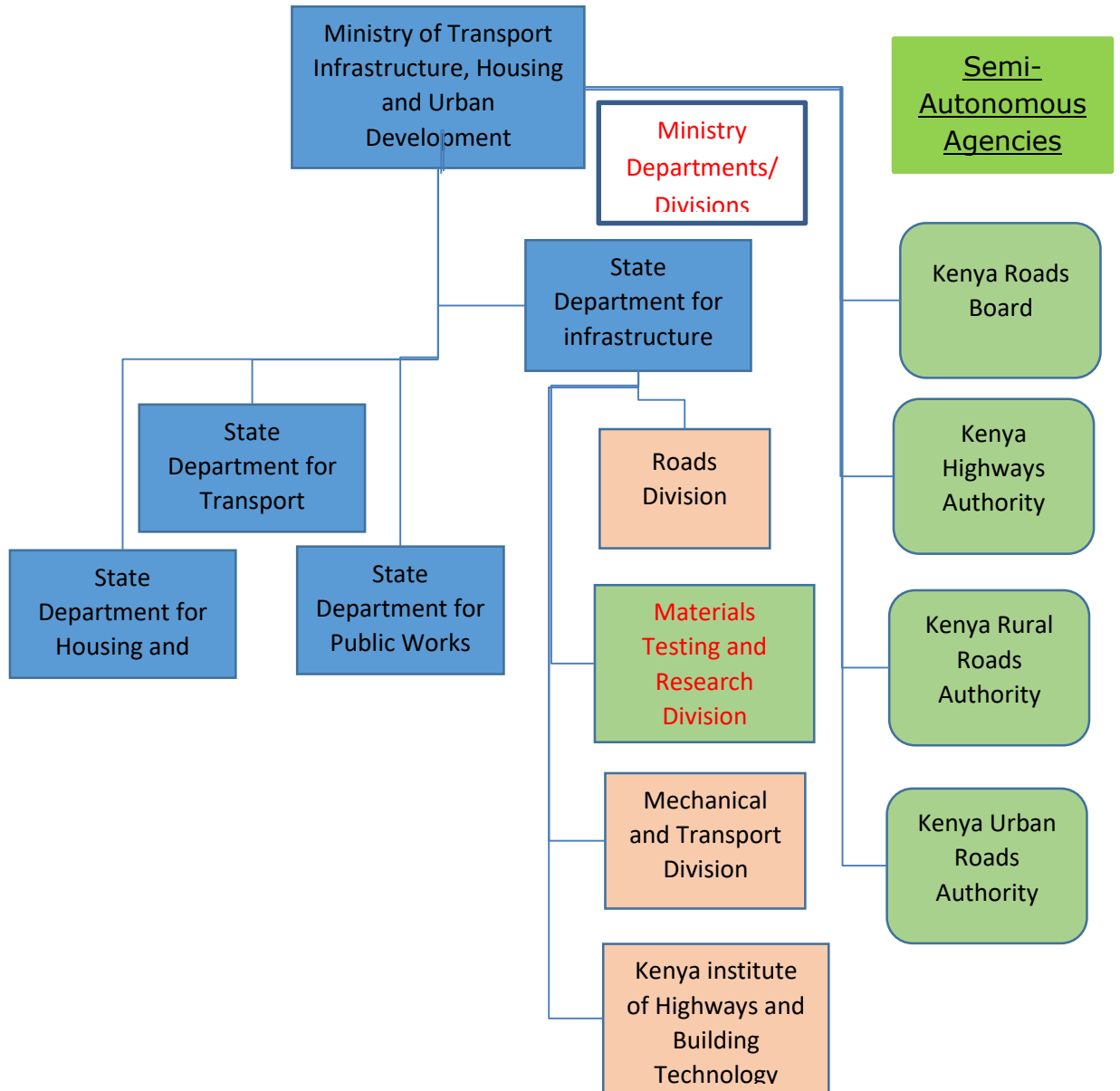


Figure 3 Current Organisation Position

This shows the MTRD as an integral part, in fact a division, of the Ministry, reporting to the State department of infrastructure. MTRD shares this status and position with the other potential SAGAs of the Ministry KIBT and MTD. Governance in this situation is straight forward as the organisation falls under the sway of the Ministry directly; follows all government regulations, pays according to government salary scales and is monitored and evaluated through government procedures. Staff reviews and performance is monitored under the procedures of the Public Service Commission and recruitment is similarly controlled under the PSC auspices.

The proposed agency will be governed by a management board that will also set the research priorities for the agency. This is already foreseen in the draft Roads Bill currently being considered by Parliament. The governance structure of the reformed MTRD would shift the organisation from

direct control of the Ministry to the position of an agency similar to the existing agencies already under the remit of MOTIHUD.

The reformed governance structure would then look like this:-

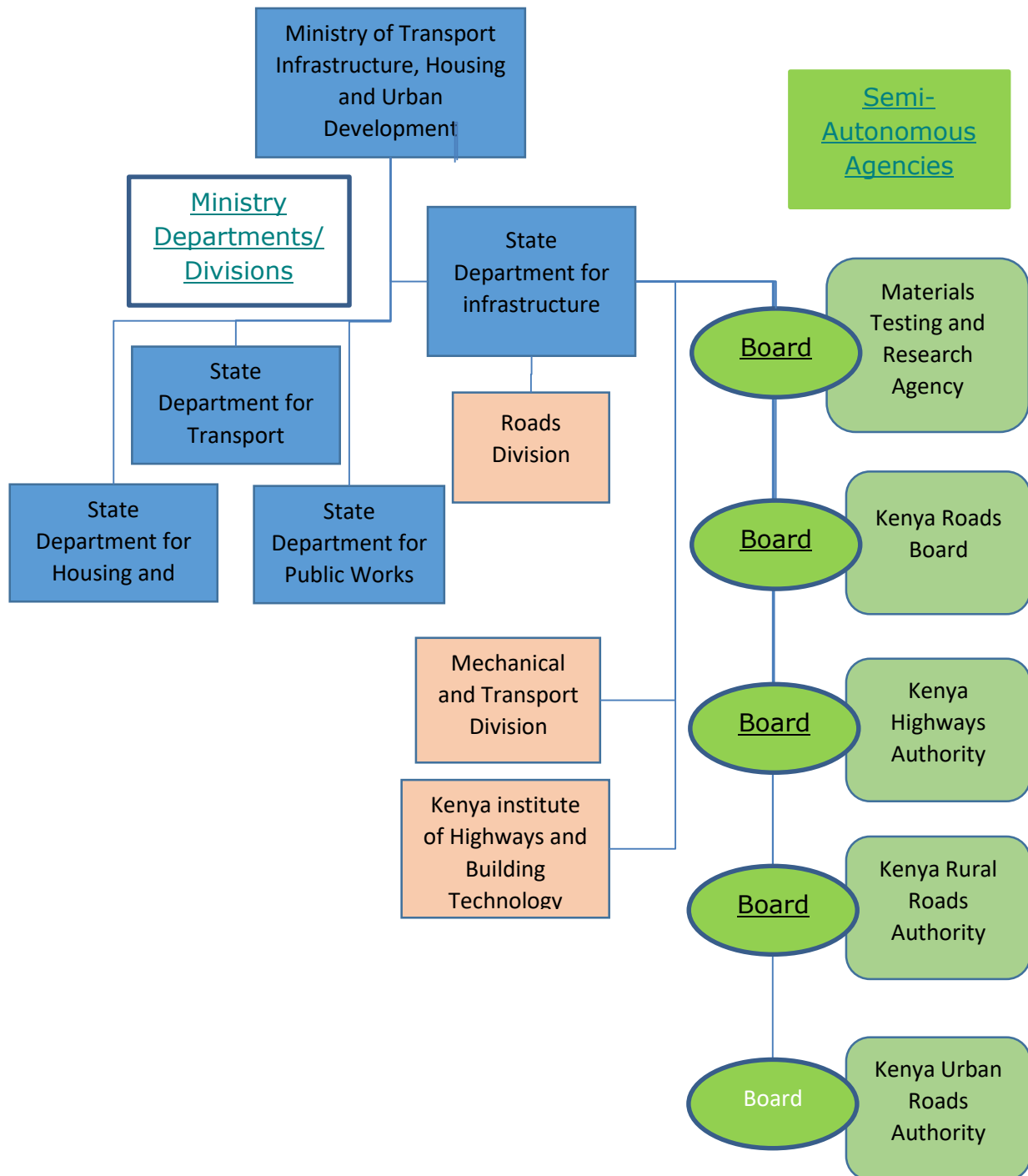


Figure 4 Reformed Organisation Position

Putting the Strategic plan into action that is The transformation of MTRD into a fully-fledged materials testing centre of excellence and a road and transport research centre will require concerted managerial activity aimed at enhancing the organisation's capability of creating, managing and integrating its information and knowledge in support of its strategic plan. This requires a major change in the organisation and will need that change to be managed. Change management principles will apply.

It is highly likely that separate short term external support will be required to determine the detailed needs for architectural requirements of building facilities, modernising testing equipment and computerising testing processes.

Good governance for any organisation relies on robust and efficient procedures and processes that help the staff carry out their functions effectively and record the steps and outcomes with as little effort as possible. The development of such procedures requires a deep knowledge of the tasks and processes carried out and where in the process checking, approvals and authorisation is required. With the reform to an agency these processes will need to be re-engineered for maximum efficiency.

Where management approval is required it is advisable to institute formal approval processes involving systematic (and preferably electronic) routing procedures

The organisational culture of the organisation will play a crucial role in the successful implementation of its strategic plan. It is necessary for management to understand the organisational culture, both on an organisational and unit level, as each unit may have its own norms, perspectives, and collective understandings and their willingness to interact and cooperate can be influenced by these collective views.

3.2.4 Operations

In the current organisational setup and institutional arrangement the MTRD finances are completely reliant on Government budget estimates under the Ministry's recurrent head and the division's sub-head. Any improvement or development of the MTRD would need to be budgeted for under the Development estimates of the Ministry's ceiling and would normally only be allowed if this could be arranged as AinA from external resources. Even then, with full donor funding, it would still need to remain within the overall Ministry budget ceiling. These budgetary ceilings cannot be exceeded, and when not fully utilised return to treasury and the following period budget is reduced. This highly constrained planning and budgeting process under direct Ministry and Treasury control leads to equally constrained financial management and procurement procedures.

The division is allowed to charge fees for materials testing and does so. With the present setup as a division of the ministry the money collected is remitted to Accountant General at treasury as revenue in accordance with the Public Finance Act 2012. This money is not credited to the Division or the Ministry and does not affect the Budget ceiling in any way.

The performance of the Division, similar to other government departments, is therefore judged and monitored by how close it comes to its spending (budgetary) targets, and not on its efficiency in providing the services to the public and its clients. The worst sin that can be committed by a government department is to underspend. Because that leads to a reduced share of the budget in the next financial year.

The constraint at the overall funding for the division means that development plans have to be constrained to fit not only within the Divisions supposed ceilings but are also constrained by the Ministry's ceilings at which level, other priorities may conflict with the divisions plans.

Procurement of updated equipment, consumables for material testing, repairs and routine maintenance of the MTRD machinery and equipment is all limited by the austere budget and squeezed government procedures. In this scenario the idea of developing the Division into a research centre is out of the question. Growing the division to be a modern, up to date centre of excellence for materials testing will be ambitious, without institutional and operational reform.

Under the proposed reform structure the Materials and Research Agency will still be linked to the Ministry and report to the Minister through a management control board. A chief Executive will run the agency under the oversight of the board and the agency will still get funding from Government through treasury and report to the Accountant General.

The government budget will now be part of both the recurrent and development accounts and the agency will have the ability to accrue and invest money on its own behalf. The funds raised from the direct work of the agency, in both materials testing and in Research and development operations for clients in the construction industry (including KRB and road authorities), will now form part of the Agencies income and can either be retained in the Agency account or used as Appropriation in Aid under authority of the Accountant General.

In this way the Material testing and research agency will have the freedom to have its independent financial and development plans, be able to manage its own procurement and resources and plan its own financial allocations to equipment upgrading, repair, consumables and running costs.

With this freedom for commercial operation the agency will now be judged, monitored and evaluated on the efficiency of its operations. The benefits and quality of the services it provides to its clients and the value for money in terms of cost/benefit of its research and material testing operations will be the criteria for monitoring of performance and oversight by the Management board.

3.3 Organizational Structure

The organizational structure of the current MTRD is depicted in figure 2 of section 3.2 above. This structure is deemed to be appropriate for the current level of materials testing and research being undertaken.

In future under a reformed institution the Materials testing and research agency will have the flexibility to adjust its departmental and organisational structure to match the demand for services that it experiences across the years. We foresee that immediately the structure of departments will remain the same but eventually the organisation will change to take account of a larger research portfolio, a vibrant knowledge management department, a GIS unit and accreditation and certification services. All these units and departments of the Agency will be served by an administration comprising of front office services, procurement unit, HR and staff development unit and ITC services. The size of the various units and will depend on the overall demand for the services from industry and will be adjusted to suit.

3.3.1 Centralization/Decentralization

The question of centralisation and the extent of decentralisation of materials testing and research services for the construction industry is overshadowed by the application of the constitution of Kenya, the role of devolved government, and the extent to which government wishes to become involved in the provision of these services.

Currently MTRD is a centralised organisation. The regional laboratories act as satellites of the head quarters and are controlled from the Nairobi office that is a division of National Ministry. Formerly the regional laboratories were an integral part of the provincial engineers setup of the Ministry responsible for Roads, which at various times has been given the title “the Ministry of Transport and Communication”, “Ministry of Public Works”, “Ministry of Roads”, and is now the Ministry of Transport, Infrastructure, Housing and Urban Development. This Ministry formerly had large offices and strong representation in the 10 Provinces of Kenya and MTRD had laboratories attached to each of these Provincial offices of the Ministry thus reflecting the setup at headquarters. In this way the MTRD organisation was deconcentrated to the Provincial level alongside the Roads Department.

Now under the new constitution, the whole government set up and organisation has changed to a situation where we have a dichotomy between “National” and “County” government. The executive wing of national government, represented by the National Ministries, administers Policy and strategy by formulating regulations, standards, specifications and procedures to be followed throughout the country. The National Government also takes responsibility for capacity building at all levels (including county level).

These national rules, and procedures are implemented, interpreted and clarified by Government agencies at the national level and by county governments at the county level. The independence of the County Governments is limited by national regulations and this is a constant cause of conflict and struggle in these early years until norms of influence and activity are established. For example, if the National government Ministry has determined that the minimum tensile strength of steel to be used as reinforcement in the construction industry is 250N/mm^2 , the county government in Kitui cannot decide to reduce this limit to 200N/mm^2 but it could decide that the minimum be raised to 300 in Kitui thus still adhering to (but exceeding) the national standard.

Each county government is gearing up to reflect the national government setup with county “Ministries” forming the executive wing of government under the elected County governor and his deputy. The devolved functions of county government are spelled out by the 2010 constitution and the members of the county “cabinet” (County Executive Committee) and county civil service will organise in line with these functions and any others that may be allocated by further acts of parliament. The functions currently devolved are:-

Agriculture, Crop and animal husbandry, Livestock sale yards, County abattoirs (slaughterhouses), Plant and animal disease control, Fisheries.

County health services, County health facilities and pharmacies, Ambulance , services, Promotion of primary health care, Licensing and control of undertakings that sell food to the public, Veterinary services (excluding regulation of the profession), Cemeteries, funeral parlours and crematoria, Refuse removal, refuse dumps and solid waste disposal.

Pollution, Nuisances and Advertising Control Control of air pollution, noise pollution, other public nuisances and outdoor advertising

Cultural activities, public entertainment and public amenities, Betting, casinos and other forms of gambling, Racing, Liquor licensing, Cinemas, Video shows and hiring, Libraries, Museums, Sports and cultural activities and facilities, .County parks, beaches and recreation facilities.

County transport, County roads, Street lighting, Traffic and parking, Public road transport, Ferries and harbours, excluding the regulation of international and national shipping and matters related thereto.

Animal control and welfare Licensing of dogs, Facilities for the accommodation, care and burial of animals, Killing of stray pets.

Trade development and regulation Markets, Trade licences, excluding regulation of professions, Fair trading practices, Local tourism, Cooperative societies

County planning and development Statistics, Land survey, planning and mapping, Boundaries and fencing, Housing, Electricity and gas reticulation and energy regulation.

Education and Childcare Pre-primary education, village polytechnics, homecraft centres and childcare facilities.

Policy Implementation Implementation of specific national government policies on natural resources and environmental conservation, Soil and water conservation, Forestry

County public works and services Storm water management systems in built-up areas, Water and sanitation services

Fire fighting services and disaster management

Control of drugs and pornography

Coordination Ensuring and coordinating the participation of communities and locations in governance at the local level, assisting communities and locations to develop the administrative capacity for the effective exercise of the functions and powers and participation in governance at the local level.

Material testing and research is not specifically a function devolved to county government, however in order to implement control over county roads, county public works and housing, county governments will require access to these testing services. At present there are 14 regional laboratories under the MTRD (as previously described) that serve the national roads authorities and county governments. As economic growth takes place and the country moves towards vision 2030, and counties develop, the need for testing services will increase. The aim for the future should be to have a materials testing and research facility in each county.

In order to fulfil this vision and adhere to the principles of devolved government, the MTRD needs to change its operational modality. The proposed modality is this:-

In order to serve its national clients the MTRD needs to reform into an autonomous agency of the National Ministry (MoTIHUD), its regional laboratories will be able to serve the national clients KENHA, KERRA/KENSRA and KURA while the county laboratories will fall under the county government.

The Central laboratory at Nairobi will develop into a centre of excellence for Materials testing and a national research centre. It will be accredited internationally by IAS and at the national level by KENAS at the level of a Calibration laboratory. In turn under the legal instrument of reform of MTRD all other construction materials laboratories, (regional, county and private laboratories) will need to obtain accreditation from the Central laboratory of the new agency (MATRA).

In this way the needs of the devolved government and the private construction industry for research and materials testing services will be met.

3.3.2 Command Structure

The command structure at the organisational level of the current MTRD and the proposed reformed agency is shown in section 3.2.3 above.

The senior management structure of the current organisation is shown in section 3.7 below. This depicts the four central branches of:-

- a) Research, Standards and performance monitoring
- b) Project design and construction control
- c) Chemistry and paints
- d) Physics and non-destructive testing

There is logically a fifth branch controlling the administration support sections but this is not established in the existing structure and the seven existing administrative sections report directly to the CEO (Chief Materials Engineer).

These four branches manage eight sections

- i. Research and standards
- ii. Pavement inventory and performance monitoring
- iii. Design and construction control
- iv. Management of Laboratories and condition surveys
- v. Chemistry
- vi. Paints
- vii. Non-destructive testing and radioactive waste disposal
- viii. General testing and instrumentation

The management of all regional laboratories is channelled through the laboratory management section, but the HQ chemistry lab is managed directly by the chemistry branch manager and the Physics laboratories are managed under the general testing section.

This organisation structure has broken down and is not operational under the present dire shortage of senior technical and management staff.

One alternative for the internal structure of the reformed agency is shown below. This structure will need to develop in accordance with demand and growth of the agency. A flexible approach to hierarchical structure is required for a dynamic and vibrant centre of excellence and as such change management will be a key factor in the overall organisation.

The two technical branches of engineering and Built Environment will carry out an expanded range of functions as set out in the mandate and an well-resourced administrative branch will provide all the support services including the knowledge management services, library, ITC and GIS units.

There will be scope in the built environment branch for expended testing in transport services and road safety. The research section will manage the external links to other research centres and manage the memoranda of understanding with universities. The design and construction standards unit will manage the road inventory and condition survey work as well as the traffic and road condition survey work, in order to monitor the performance of roads constructed under existing standards. In this way research projects and field trials for the adjustments to standards can be conceived and designed for implementation. The testing and compliance section will carry out the bulk of road related testing to ensure compliance to existing standards. This section will also manage the laboratories and run the accreditation service for regional, county and private materials laboratories

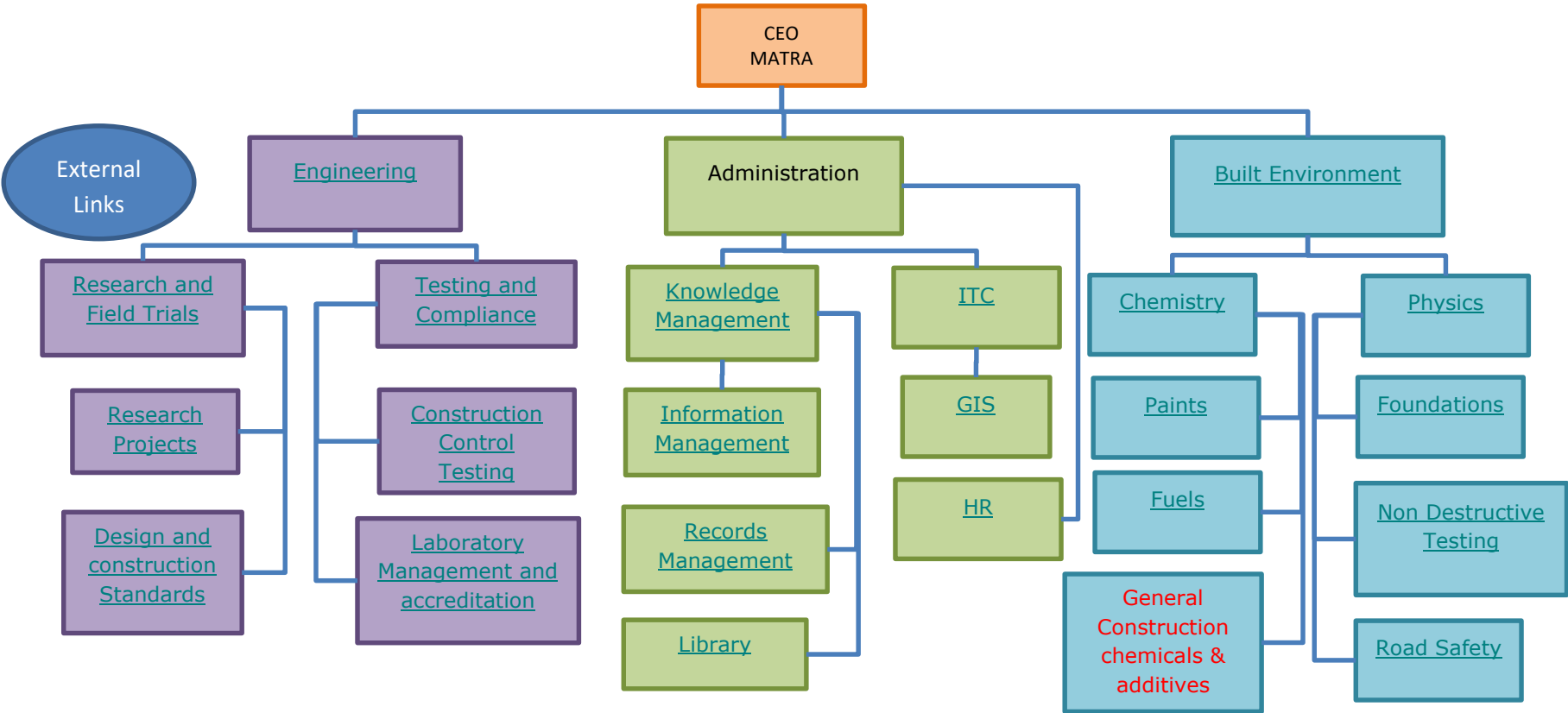


Figure 5 Proposed Structure for MATRA

3.3.3 Personnel Establishment

The current and conceived establishment lists showing the vast number of current un-filled posts and the requirements to make the organisation viable as a materials testing and research centre are shown in detail in annex C and analysed and discussed in section 3.7.

The establishment list as currently formulated is antiquated and does not take account of how a modern organisation conducts business. There is need to update the establishment to reflect the electronic and information age in which MTRD is working. The need for up to date robust ITC systems that allow constant international communications and the electronic management of the large amounts of data generated by this technical organisation is vital and should be reflected in the establishment.

The proposed establishment in addition must reflect the proposed structure and mandate of the reformed agency and can only be fully determined as that agency develops.

3.4 Estate And Facilities

The vision for MTRD to become a COE and a research centre intrinsically includes a rehabilitation and rationalisation of the estate and facilities. All current headquarters and regional laboratory buildings and offices are the property of GOK held currently through MOTIHUD. A reform of the institutional arrangement would involve an adjustment and transfer of assets to the reformed organisation. The strategic plan currently includes both refurbishment/ rehabilitation of the existing and construction of new buildings and facilities to create facilities custom built to house a Materials testing Centre of Excellence and Research Centre for Roads and Transport.

Materials laboratories need to be purpose built to accommodate the range of equipment and testing facilities peculiar to the types of tests carried out and the associated safety, administration and management functions. These tests will provide the bulk of data for research projects and will need to be combined with test results and data collected in the field (on Site). The building/facilities will have to have provision for housing and maintaining the mobile equipment that collects those field data. The current buildings and facilities have been so designed some fifty years ago. There is a need to engage specialist architects to design the requirements for a reformed MTRD and make recommendations towards the choice between refurbishment of existing or new construction and indeed a cost effective mixture of both.

The target is to have a modern fully functional specialised material laboratory and associated offices with purpose built facilities to carry out all the material testing required for Roads and roads research for the foreseeable future.

The question of the upgrading and rehabilitation of the regional laboratories is also linked to the institutional reform eventually proposed. The mandate for the reformed MTRD to certify materials technicians goes hand in hand with the accreditation of private materials laboratories and certification of the testing processes and development of testing standards and specifications. The county governments need to be serviced by the existing regional laboratories and some counties may wish to

set up their own laboratories that will be required to meet the certification and accreditation standards of the reformed MTRD.

Currently the vision included in the strategic plan is to include the existing regional laboratories in the refurbishment and construction plans for MTRD. The 14 existing regional laboratories are not all at the same level of development in terms of buildings, facilities and equipment and each will need to be assessed in terms of refurbishment and construction possibilities if standardisation is to be achieved.

Ultimately the vision would be to have an accredited materials laboratory in each of the 47 counties

3.4.1 HQ Administration Office & Central Materials Testing Laboratories

The main headquarter offices and laboratories building of MTRD is situated in the industrial area of Nairobi. The building has eight laboratories housed in four similarly arranged parallel single story building annexes (each approx. 300m²) perpendicular to the main three story office block. These building facilities require an intensive round of refurbishment and general maintenance but are adequate for the existing staff levels and testing work currently undertaken. One separate section of the Soils laboratory annex houses the mobile road testing equipment, when the vehicles are not out on the road.



Figure 6 MTRD Headquarters on Machakos Road

The facilities described above house the following laboratories:-

- Chemistry Lab
- Paints lab
- Non-Destructive testing and Radiology lab

- General testing and instrumentation Lab
- Drilling and foundations Lab
- Concrete lab
- Bitumen Lab
- Soils lab

In addition there are mobile units for traffic and road condition surveys.

All these laboratories and units deal with materials testing for clients from both the public and private sectors dealing with road construction and maintenance.

Another section of the organisation housed in the main office block manages research projects and testing standards both of which can involve materials tests in any of the 8 laboratories and measurements of performance in the field.

It is assumed that the existing building facilities occupied by MTRD will remain available if the organisation reforms into a SAGA or MaTRA, both at the central site in Nairobi and at the regions. There is need for an assessment and review for rehabilitation and repair and for a plan to house the proposed staff and equipment.

In addition there is need for a planned expansion and allocation of facilities at the county level to provide the services to county governments. This requirement would be included in the buildings assessment and review mentioned above.

Such a comprehensive assessment should take place once the institutional future of MTRD is determined. This buildings assessment can be undertaken by local consultants in close collaboration with MTRD management. It is envisioned that the assessment can be undertaken with existing revenue funds. This would be done through a local consultancy especially recruited for the purpose after or during the process of institutional reform.

At the moment the consultant favours the creation of a regulatory testing and research agency in Nairobi with private/authority laboratories in the regions and counties. These Private materials laboratories would then be accredited by the main agency based in Nairobi. In this way the newly formed agency for materials testing and roads research has only to consider the refurbishment and construction of facilities at headquarters.

With this scenario the newly formed MaTRA can contemplate a plan to construct a modern specialised unit as a new headquarters in Nairobi, while refurbishing the existing laboratories.

There remains the need to engage a specialised architect immediately once the decision is taken to design a modern materials testing and road research cluster of laboratories. This building will need to accommodate the required staff and equipment as well as the mobile units for Road Performance monitoring, axle load control calibration, GIS unit and ITC linkages nationwide, as well as the library and knowledge management requirement detailed below.

3.4.2 Regional Offices, Facilities & Materials Testing Laboratories

In addition there are 14 regional laboratories and offices located in diverse areas of the country. A number of these were formerly provincial laboratories attached to the Provincial works offices of the (then) Ministry of Public Works. Additional laboratories have been inherited from project site labs or associated national programmes. Facilities in many of these regional laboratories are not up to the standard of the National laboratory in Nairobi and also require refurbishment and maintenance. The Regional laboratories also require to be part of the review and upgrade of material testing equipment if they are to form part of the centre of excellence and to adequately carry out research.

There are currently Regional laboratories in:-

Kisumu, Bungoma, Kisii, Mombasa, Nakuru, Kakamega, Eldoret, Nyeri, Meru, Embu, Machakos, Garissa, Muranga and Kerugoya.

Each of these is headed by a senior Materials Technologist. These regional laboratories have not been visited during this study but some of them are well known to the consultant team members. The MTRD strategic plan provides for an expansion of the regional laboratories with a further 12 laboratories in Kapenguria, Maralal, Lamu, Isiolo, Lodwar, Voi, Wajir and Kitui, Marsabit, Kajiado, Narok and Kaparnet. These additional laboratories will require staffing, equipment and management. At the outset the new laboratories will need additional manpower to building the capacity, train the technical staff and establish procedures. The Human resources department of MTRD will need assistance in dealing with this additional HR burden.

There is a move on behalf of the county governments to be self-sufficient in many of the areas of service provision. Infrastructure development and maintenance is one area that the counties already have a growing mandate to provide. The provision of county roads in particular is laid down in the constitution as a responsibility of county government. The details of exactly what this means in practical terms are being defined in the Roads Bill 2015 currently under process in parliament, through which county government will get 15% of the Annual Road Fund to maintain the county road not under the remit of Highways authority KENHA (roads S, A, B, H, J) nor Secondary road authority KENSRA (C & D). A number of counties may wish to include materials testing as part of their service provision under this mandate. When that happens the county laboratories will need to be overseen and accredited for testing procedures and quality of results, while maintaining their independence.

There is a clear need to upgrade and modernise the physical facilities of the MTRD including the regional laboratories. The strategic plan calls for the addition of 13 regional laboratories onto the present complement.

It is recommended that an Architect be engaged to work with MTRD to determine the optimum balance between refurbishment, modification and new construction. Design of facilities specifically for the testing of construction materials and for research into materials, roads and transport is a highly specialised area and requires an Architect with previous experience of similar work.

Once the architectural plans are drawn up and costs estimated an implementation plan can be formulated with funding requirements spread out over a number of years. It is likely that the implementation stage may require external funding in terms of development aid, national or external borrowing or a formulated PFI.

3.5 Field And Laboratory Testing Equipment

3.5.1 Equipment Holding/Inventory

The existing laboratories are fully equipped for the testing that they currently do, although some of the equipment is overdue for replacement. The equipment is mostly old and much of it would benefit from upgrading/updating. Maintenance of this older equipment is a problem and often requires funds that exceed the budgetary provision. The asset register is still kept in hard copy and no electronic register or asset management system is in place to manage the equipment and its maintenance.

Donors in the form of development partners have been supportive in the past to the procurement of new, innovations in equipment to keep up with testing and research trends, but reluctant to fund replacement or refurbishment of older machines and equipment. The MTRD has a prioritised list of equipment that it has defined as essential for its continued current operations. That list is attached as Annex D.

The Division has been able to procure a modern Road Profiler and has 3 sets of falling weight deflectometer (FWD) machines. The latest of the FWDs is self-contained within a minibus style vehicle



Figure 7 FWD Field Testing Equipment

with all its electronic and computer equipment integrated into the vehicle (no trailer to be towed). These pieces of equipment fall under the operation of the Pavement inventory and performance monitoring unit. The unit also has a mobile abrasion tester that is used for both roads and airport runway.

MTRD has coordinated its foreseen equipment requirements for the immediate future. This requirement has also been analysed as far as possible during the study and discussed with MTRD. However recommendations concerning specific items of laboratory equipment outside the scope of this mission and a short study by an equipment expert is foreseen to finalise the recommendations for the division. The immediate review of equipment required to keep the current laboratories operational is contained in Annex D.

The ICT facilities at the central material laboratories are basic but adequate for the present needs if maintained. The internal infrastructure supporting process is primarily through older technologies, with the server and internet connection having issues, which will be explored in greater detail in a later section.

The data is stored in a mix, both in hard and soft copies. There is no set process, with many classes of information not being logged onto the server and remain as paper copies or on individual laptops.

It is observed that all the modern equipment currently used by the organisation for road monitoring and materials testing for roads produces data that is already geo-referenced.



Figure 8 Road Condition Profiler Field Testing Equipment

The MTRD has managed to acquire road profiling equipment and modern FWD equipment (through external funding arrangements). These items of equipment provide a wealth of data on road structural and surface conditions. All this data is automatically geo-referenced. The routine materials testing carried out in all the organisations laboratories have references to pin point the location of the source of samples. In other word all the data generated by materials testing, field trials and research projects is already geo-referenced, yet the organisation does not currently map this data onto the road network. At the same time the KRB and road agencies have the Road network also geo-referenced within a GIS platform. The current version of the reporting system Road Maintenance Management System (RMMS) and the Highway Management System (HMS) used by KRB and road agencies is not GIS based, however the latest move is to convert to a GIS based management system. The materials division can, with an upgrade of software and staff training,

map all the materials data onto the GIS Road Map of Kenya, and reproduce this as part of a divisional webpage.

3.5.2 Materials testing standards

The centre of excellence for materials testing will be fully equipped to carry out the full range of tests required for roads. This includes tests for development of standards and specifications and tests to aid in the monitoring of construction work and performance during life of the roads for development of design standards.

The reformed MTRD will bring its equipment stock up to modern standards for all testing required and will have sufficient numbers of each type of equipment to accommodate testing for roads throughout the country and across the road network. This level of analysis of specific testing equipment is outside the scope of this study, but a short study specifically to look at the equipment holding and equipment maintenance requirements for the intended institutional change and organisational development is required.

The reformed MTRD will determine the testing standards and the required specifications for materials used in the construction and maintenance of roads in Kenya and will determine Kenya standard specifications and procedures with reference to AASHTO, BS and EN current standards and developments. It is noted that there are current attempts through ISO to harmonise the AASHTO and EN standards and MTRD will monitor and keep up to date with these developments and ensure that equipment is available for such tests. Currently MTRD use and test to a variety of standards depending

on client requirements. These include Kenyan Standards (KS), British Standards (BS), American Standards (ASSHTO and ASTM), South African (SANS) and SADC standards, Japanese (JS) Indian (IS) East African Standards (EAS), European union (EN) and general international Standards (ISO). While contributing to the continued development of Kenya's own standards the reformed Agency will retain the flexibility and equipment holding to test to any of these standards.

Standards relevant to laboratory processes, e.g. ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*, will provide guidance on the design of appropriate automated work flows. The conceptualisation and implementation of a comprehensive content management solution (and the accompanying ICT infrastructure and capacity upgrade) is of critical importance and should be addressed as a matter of urgency as it will significantly enhance the organisation's operations in general.

3.5.3 Equipment Management System

As a centre of excellence MTRD will institute a system of equipment management that involves a process of preventive maintenance and regular calibration to ensure availability of equipment for all required testing at all times. The equipment and estate management systems based on a preventive maintenance regime will require the use of specific resources to maintain both the facilities and the essential testing equipment. The annual budget provision will need to include the periodic replacement of aging equipment and procurement of new advanced models as they are developed and become available. Out sourcing of such equipment is not considered to be a viable option for the national centre.

3.6 Knowledge Management and ICT

Numerous academic definitions for knowledge management are available, however, in general knowledge management refers to any initiative that focuses on knowledge as primary resource of the organisation, and attempt to make it more productive by increasing access to it, developing it, capturing it in databases, or applying it to enhance processes, products, and services⁵. Knowledge management is a managerial activity aimed at enhancing the organisation's capability of creating and integrating its information and knowledge in support of its business strategy. It refers to the organisational optimisation of knowledge to achieve enhanced performance, increased value, competitive advantage, and return on investment, through the use of various tools, processes, methods and techniques⁶. The above is in line with the definition of knowledge management adopted by ReCAP for the purpose of its *Knowledge Management and Communications Strategy, Sep 2015*: 'Knowledge management is the systematic management of an organization's knowledge assets for the purpose of creating value and meeting tactical & strategic requirements; it consists of the initiatives, processes, strategies, and systems that sustain and enhance the storage, assessment, sharing, refinement, and creation of knowledge'⁷.

⁵ Davenport TH and Prusak L. 1998. *Working knowledge: how organisations manage what they know*. Boston, Massachusetts: Harvard Business School Press.

⁶ Kamara JM et al. 2002. A CLEVER approach to selecting a knowledge management strategy. *International Journal of Project Management*, vol. 20(3), p. 205-211.

⁷ Frost A, MSc. 2010. In *Knowledge Management and Communications Strategy, Sep 2015*, ReCAP, Cardno Emerging Markets (UK).

Knowledge is produced and optimised in organisations through individual and shared processes which can be represented by the following Knowledge Life Cycle⁸ (KLC), a simplification of the framework originally developed by McElroy, Firestone and others.

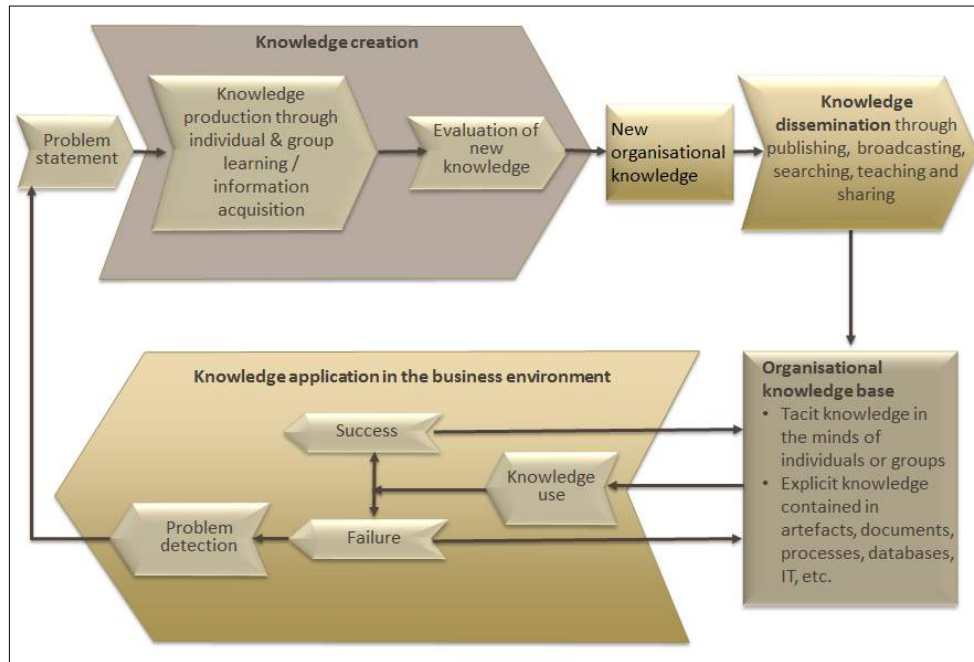


Figure 9: The Knowledge Life Cycle

⁸ Firestone JM and McElroy MW. 2003. *Key issues in the new knowledge management*. Burlington: KMCI Press/Butterworth-Heinemann.

Knowledge Management vision

Everything done under the banner of knowledge management should support the Knowledge Life Cycle. It is therefore desirable that knowledge management processes, tasks and activities should be focussed on the optimisation of:

- Knowledge **creation** in response to problem identification or detected knowledge gaps through knowledge generating activities such as individual/group learning; research activity and/or the customisation of existing knowledge; and information acquisition
- New knowledge **evaluation** through peer review or management approval structures
- **Dissemination** of new knowledge through publishing, broadcasting, teaching and sharing
- Knowledge **storage** in the organisational knowledge base which is held 'subjectively' in the minds of individuals and groups and 'objectively' in recorded or expressed form
- Knowledge **application** or use in the organisational environment.

The KLC is useful to help organisations focus on relevant knowledge management interventions (initiatives, tasks and activities) required to manage the various knowledge processes (knowledge creation and evaluation, knowledge dissemination, knowledge storage and knowledge application) as **everything done under the banner of knowledge management should support the KLC.**

Present situation in MTRD: An appraisal of current internal MTRD processes and procedures pertinent to data, information and knowledge generation, analysis, storage and dissemination as well as a series of in depth interviews with MTRD stakeholders highlighted a number of organisational constraints.

Within MOTIHUD there is no centralised policy which guides knowledge and information management practices and standards in the Ministry. Agencies within MOTIHUD are individually responsible for the management of their own organisational records and outputs. The knowledge generated by project and research activities lies scattered across the different agencies. Much of this knowledge tends to reside in reports within donor agencies, as grey literature in a few poorly resourced libraries and as tacit knowledge among the sector's consultants and experts. In addition some report collections were abandoned when the organisational structure of the Ministry changed in 2007.

Knowledge transfer mechanisms are inadequate with policies, strategies, technical guidelines, standards and associated drawings, specifications and bidding documents for the sector not consistently or readily available to stakeholders in electronic format through centralised web based knowledge portals. In an effort to improve the dissemination of knowledge and research information and to provide a peer review forum within the roads and transport sector, an international conference was organised for March 2016. It is envisaged that this KRB-funded conference will become an annual event. It will specifically be aimed at stakeholders from the universities, private sector, industry, and government agencies.

Optimisation of knowledge dissemination within MTRD should also receive attention. At present most of the staff work in silos with little interaction and knowledge exchange between the laboratories and disciplines.

Access to required information resources (such as national and international journals and standards) is negotiated on agency level with no evidence of collaboration between the different MOTIHUD agencies or cooperation with other stakeholders, e.g. universities or national library consortia.

MTRD also no longer have an operational library. Indications are that MTRD previously had a reasonably resourced library which provided access to books, journals, newspapers and standards. Few external publications are left in the library and these are mostly out of date. The physical library



Figure 10: MTRD Library and Report Collections

format of a paper register. A consultant was commissioned to submit a proposal for the digitisation of the report collection and to provide a baseline survey of MTRD publications. It is our understanding that the study was not completed.

The physical spaces associated with the library are in urgent need of upgrading, modernisation and refurbishment. Where information resources such as standards are available, it is mainly in paper format despite a preference for the electronic format expressed by most staff.

Inadequate funding, delayed disbursement of funds to MTRD and the current moratorium on staff appointments have severely impacted on the Division's ICT capability resulting in insufficient and outdated infrastructure, disrupted Internet connectivity, limited technical support and poor data and information back-up procedures. Without the necessary ICT capacity and infrastructure the future implementation of much needed digitised functions, such as web-based knowledge portals, electronic document and laboratory management services as well as collaborative research platforms will not be realised. Service provision to the regional laboratories will also remain rudimentary and compliance with standardised knowledge management initiatives will be difficult to enforce throughout the distributed organisational structure.

By a wide margin the bulk of the work carried out and revenue/income generated by the Division currently is in the form of materials testing; both in the regional labs and in the 8 specialised laboratories at the national headquarters. At headquarters at least, the test results are kept on the server and can be accessed by authorised staff. These data sets are however not managed optimally with minimum backup procedures in place putting at risk data sets required for long term analysis. Furthermore the processes for registering the test requests by clients, creating job cards/work orders for the laboratories, linking the financial payments and eventually disseminating the results to the clients are all controlled through a hard copy (paper based) system.

There is a plethora of double handling of data in the testing processes in the laboratories. The process for a typical test is for a technician to receive the sample together with a paper job card/test order and sample identification number. The samples are identified by allocated number, that links them to the clients and where appropriate to geographical location of the sample site. The technician will carry out the required test and enter the measurements and raw results on the appropriate paper form. That form will then be handed to a senior technician/technologist for checking and she/he will transpose the same measurements and results onto an electronic version of the same form in a laptop/desktop at the specific laboratory. That electronic data file will then be copied from the laptop to a data terminal connected to the division's server. The same data is then printed back into hard copy from the server to be entered in the paper filing system and linked to the hard copy payment records and disseminated /provided to the client.

A noteworthy exception to this typical testing process is the results from the road condition survey equipment as described above. The road profiler and the FWD equipment collect electronic data that is already geo-referenced. The data is recorded on the integrated computers within the equipment and uploaded to the server once the equipment is back from a survey.

Clearly there is a lot of potential for modernisation of the process of data handling, and for management of the test data process, for greater efficiency and accuracy and for better record keeping.

Collaborative research activities with other MOTIHUD agencies as well as national, regional and international research centres will require suitable infrastructure in the form of shared research and collaboration platforms. Intellectual property issues will also have to be addressed.

Irrespective of whether MTRD remains an integrated division of MOTIHUD or if it reforms institutionally into a SAGA, it is advisable that the organisation should, in support of its strategic goals and as a matter of urgency, implement appropriate information and knowledge management policies and procedures. MTRD will also have to ensure better access for its staff to data and information generated by other MOTIHUD agencies and should lobby for optimal knowledge exchange within the Ministry. Duplication of effort in terms of data and information repositories within the Ministry should be avoided. A formal linkage with all stakeholders through an institutionalised platform for systematic dialogue and engagement is advisable.

MTRD currently does not have an internet web presence but website development is planned. It is foreseen that MTRD will have a separate portal from that of MOTIHUD. Proposed content will focus on what MTRD does (testing & research); advice on the usage of materials; as well as an institutional repository. There is no evidence of a comprehensive dissemination programme to improve research uptake and outcomes.

Data sets created as part of testing and quality control activities are not managed optimally with double entry of data and minimum backup procedures in place. This puts at risk data sets required for long term analysis. Data created as part of pavement inventory and performance management is automatically GIS enabled but is not stored in a GIS based system. Well documented materials, testing and research procedures exist on paper and these need to be updated and converted into electronic formats.

3.6.1 Knowledge Management Strategy

As knowledge management initiatives should be closely aligned with the business strategy and processes of the organisation the *MTRD Draft Strategic Plan, Base Document: Version 1, Nov 2015*, as well as the strategic plan for the *Development of Low Volume Roads Research Capacity in Kenya, AFCAP/KEN/089/G, Mar 2013*, were reviewed to inform the strategic knowledge management goals of the Division. From the Strategic Plan⁹ it is clear that MTRD's purpose is knowledge generation and dissemination:

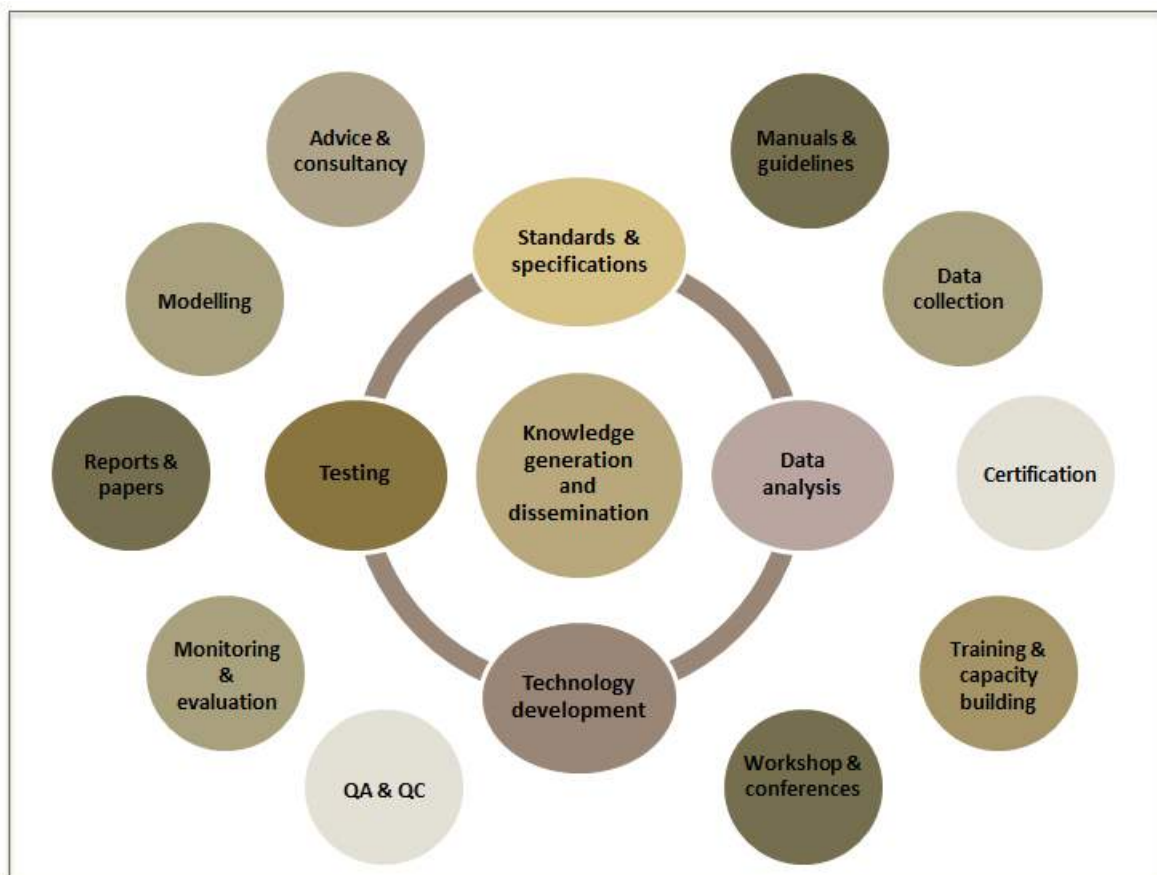


Figure 11: Activities and services necessary for MTRD to function as a research institute

The knowledge capital MTRD will accumulate in their activities therefore will be a strong strategic issue and the management of these assets will be crucial.

The review of the Strategic Plan also highlighted a number of aspects which might influence the knowledge management solutions implemented. These are (in no particular order):

- *Research programmes and specialist services will be achieved through a combination of delivery mechanisms involving external stakeholders such as academic institutions, consultants and research centres.* Resultant issues to address include the provision of collaborative electronic research platforms as well as ownership of the intellectual property created through joint research activities. Access to electronic information resources will also have to be monitored in terms of

⁹ MTRD Draft Strategic Plan, Base Document: Version 1, Nov 2015.

publisher/supplier license stipulations. In addition clear guidelines regarding research records management will have to be established.

- *The prioritisation and proper coordination of national road and transport research activities will be required. A National Research Forum is proposed to inform and oversee research on behalf of stakeholders and the research community.* This will require close cooperation between the different agencies within MOTIHUD as well as with external research partners and stakeholders.
- *Where it is foreseen that research will initially focus on road development, maintenance and operations including research on new construction materials, construction methods and road safety studies, diversification into rail and aviation transport is envisaged.* In terms of information acquisition this diversification will require additional information resources as well as researcher capacity.
- *As MTRD has a country wide presence internal coordination and standardisation of knowledge management activities will be required to ensure both service delivery to and compliance by the regional offices.*
- *Satisfying external stakeholders is a pre-requisite for attracting support to fulfil the mandate of the Division and the expectations of the following stakeholders should be paid particular attention:*

Stakeholder	Expectations
Ministry, KRB and the road authorities (KURA, KeRRA & KeNHA)	Assistance with the development of policy, standards, manuals & specifications; implementation of strategic initiatives; research and innovation; and quality assurance
Consultants, contractors, suppliers and the public	Consultancy services; quality assurance; and testing services
Development partners	Improved planning and implementation of research, development and innovation activities
Learning institutions	Collaborative research and student training opportunities
Other research institutions	Collaboration and coordination of research activities
Other ministries and the county governments	Consultancy and testing services

Figure 12: MTRD stakeholder expectations

In response to the above, knowledge management efforts undertaken should deliberately seek to improve the outreach to, and involvement of all stakeholders. The generated evidence base of low volume rural road and transport services knowledge should be widely disseminated to, and easily accessible by, policy makers and practitioners. This will contribute to the high level aim of facilitating effective research uptake into policy and practice.

- Although MTRD has the desire and intention to become a research centre, the majority of its day to day activities will remain for some time to be routine materials testing. Knowledge management initiatives also need to address those aspects of the Division’s activities.

The Strategic Plan further identifies the need for far reaching changes in the knowledge management area of MTRD operations. “Both Government and other stakeholders have agreed that there is a need to transform MTRD to *improve its effectiveness, efficiency in service delivery* and to *strengthen its research capability*. In addition, there is a need for a national institution to act as the *knowledge generation and reference centre*.” The specific vision expressed is for a fully operational library that includes web based knowledge access; professional support for publications by MTRD staff;

collaboration with other national and international institutions for sharing of knowledge and best practice; and the installation and maintenance of an electronic document management system (EDMS).

To ensure that the strategic knowledge management goals are aligned with and in support of the MTRD business strategy, and to enable the knowledge life cycle processes described above, **knowledge management activities** will focus on the following three highly interdependent initiatives:

- The **enhancement of research capability** by strengthening the knowledge creation and evaluation processes
- **Optimisation of knowledge dissemination** to stakeholders and the promotion of a knowledge sharing culture
- **Enabling the core functions of the organisation** associated with research, testing, quality assurance, advice to design and standard setting and capacity building through good data and information management procedures as well as the effective management of the organisational knowledge base

Activities to be considered in support of these initiatives will be discussed in detail in the following sections. The degree to which the proposed knowledge management solutions are put into practice will be determined by user needs, organisational culture as well as enabling factors such as funding; ICT infrastructure and support; along with staff capacity and skill levels. It is evident that the transformation of MTRD into a fully functional research centre will require concerted managerial activity aimed at enhancing the organisation's capability of creating, managing and integrating its information and knowledge in support of its business strategy.

3.6.2 Organizational Culture

The organisational culture of the Division will play a crucial role in the successful implementation of its knowledge management initiatives as it can either hamper or empower knowledge creation and sharing activities. It is necessary for the management structure to understand the organisational culture, both on an organisational and smaller unit level, as each unit may have its own norms, perspectives, and collective understandings and their willingness to share knowledge will be influenced by these collective views¹⁰.

A knowledge culture in the organisation should be promoted through management attention, compliance requirements and incentives to share.

Management attention:

- The importance of sharing knowledge should be made clear to staff and should be supported by the required resources, policies and recognition.
- The move to a SAGA should be supported by change management initiatives as the willingness of staff to share knowledge is influenced by job security and trust. Staff involvement in the design and development of knowledge management procedures and platforms will further ensure ownership and participation.

¹⁰ Frost A. 2014. *The significance of organisational learning*, <http://www.knowledge-management-tools.net/organizational-culture.html>.

- Encouragement and legitimisation of the use of the proposed [knowledge spaces](#) and the establishment of and participation in internal and external [communities of practice](#) is essential. Submissions should be encouraged and acknowledged.
- Management should ensure that project managers and project coordinators become knowledge integrators by demonstrating the value of knowledge management in terms of decision making and problem identification and solving. For each research project a team member should be appointed as the knowledge management facilitator.
- Knowledge propriety issues (or perceptions thereof) should be managed and internal competition that may interfere with knowledge sharing should be eliminated.
- Adequate training should be provided and it should not be assumed that people have the technical abilities to utilise knowledge platforms.

Compliance requirements:

- To support the strategic goals of the Division knowledge dissemination should form an integral part of research project implementation and it should be addressed from the start in the planning phase of the project. Clear evidence thereof should be required in the project proposal.
- It should be compulsory to capture lessons learnt at the conclusion of each project. Similarly, it should be necessary to show that these learning documents were interrogated during the planning phase of new projects.
- Related knowledge management activities should be included as part of the key performance indicators of MTRD staff on all levels.
- A project should not be signed off before the related project outcomes (e.g. project reports) are submitted to and recorded in the knowledge base.

Incentives to share:

- In order to make knowledge management initiatives work, staff should be willing to share their knowledge with others. “One major influence to a culture’s knowledge sharing willingness is the issue of reciprocity¹¹. This refers to the individual’s need to perceive a current or future return on the knowledge he chooses to share. This could be in the form of direct compensation of some kind; it could be something intangible like enhancing the individual’s reputation; but it can also be the knowledge that the favour will be returned the next time he requires assistance”¹².

3.6.3 Knowledge, Information and Data

It is important for the Division to enable its core functions associated with research, testing, quality assurance and capacity building through improved data and information management procedures as well as effective management of the organisational knowledge base.

3.6.3.1 Library and Information Services

In knowledge intensive organisations, including research institutions, knowledge generating activities such as information acquisition should be optimised. Libraries (physical or virtual) are uniquely

¹¹ Davenport TH and Prusak L. 1998. *Working knowledge: how organisations manage what they know*. Boston, Massachusetts: Harvard Business School Press.

¹² Frost A. 2014. *The significance of organisational learning*. <http://www.knowledge-management-tools.net/organizational-culture.html>.

positioned to support information acquisition. In the most traditional sense, libraries provide access to materials and space that support the research endeavour, whether it be in the physical form (books, special collections materials, study carrels) or the virtual (digital collections, online exhibits, electronic resources). Moreover, librarians/information specialists are frequently involved in aiding researchers as they navigate those spaces and materials. This aid is often at the information seeking stage, when researchers have difficulty tracking down references, or need expert help formulating search strategies¹³.

The research capability of the Division will therefore be enhanced through the resources and services offered by a fully functional Library and Information Service (LIS) with skilled staff. The information acquisition related activities of the LIS should be structured around the following:

Negotiating and providing access to reliable information resources (both commercial and open access content) through subscription, document ordering and inter library loan services

- Researchers typically require access to the primary published literature in their field, preferably in electronic format. In general the acquisition policy should consider commercially available information resources (i.e. electronic journal platforms and databases; standalone journals; standards; conference proceedings and publications from professional societies) as well as open access resources (i.e. portals and report collections from other research organisations and government agencies; technical specifications; codes of practice; and publications from aid organisations).
- In addition the Division's LIS will be required to maintain a [grey literature collection](#) consisting of relevant reports & publications from other MOTIHUD agencies as well as national, regional & international research centres. The collection should be restricted to publications which cannot be found easily either from the websites of these organisations or through conventional channels such as publishers.
- Standard library technical services to manage these collections, such as document delivery, inter library loan services, cataloguing, indexing and shelving, will be required.

Information specialist intermediary services focussed on the detailed scientific, business and management information requirements of the staff as well as user enablement through training

- Value-added information services should be provided to Division staff on both a pro-active and reactive basis. The information specialist will be responsible for building and maintaining relationships with the various operational units to ensure continued awareness of researchers' information related needs as well as to improve service delivery. Supporting services offered should focus on the retrieval of published information, current awareness and alerting services, management of personal information collections through reference management programmes, assistance with the publication of research outputs as well as measuring and monitoring of research impact.
- The enablement of researchers through training in the use of electronic information resources as well as the critical evaluation and selection of authoritative information resources should be

¹³ Shorish Y. 2015. The library as research partner. *ACRL TechConnect Blog*, 23 Nov.

prioritised. Involving product suppliers as expert trainers as well as capitalising on the available on-line training material should be considered.

3.6.3.2 Records Management

The Division has a responsibility to efficiently manage, store and retain data, documents and other forms of information (records) for specific periods of time and thus ensuring compliance with applicable legislation; corporate governance; long term access to its own records; and proper project and contractual management. A record is defined by the International Council on Archives¹⁴ (ICA) as *recorded information produced or received in the initiation, conduct or completion of an institutional or individual activity and that consists of content, context and structure sufficient to provide evidence of the activity*. Therefore, while the definition of a record is often associated strongly with a paper document, a record can also be digital.

Records management is the practice of identifying, classifying, archiving, preserving, accessing, using and destroying records. The records management system, at its base, makes use of a file plan to consolidate instructions regarding the creation, storage, preservation and destruction of records. It should be noted that the National Archivist must approve all file plans before governmental bodies and organisations may implement them. Records may be managed in a centralised location or the control of records may be decentralised across various departments and locations within the organisation.

Within the Division records relevant to its research and consulting services as well as to its support services will need to be managed.

Research & consultancy related records management

- **Research publications:** The Division will require a [research outputs database](#) with linked routing/approval procedures to manage research and consultancy project outputs and related material such as project proposals, progress reports, research reports, learning briefs, safety documents, laboratory reports, technical manuals as well as information published externally by MTRD staff, e.g. conferences papers and posters, journal articles, books, chapters in books and training material. (The MTRD publication collection is in urgent need of organisation and [indexing of backlog documents](#) should be prioritised. Procedures to fast track the organisation of the MTRD reports collection are provided in [Annex G](#).)
- While the Division's file servers will remain useful for storage of data sets created as part of research or laboratory activity, it is not suitable for research document management as the use of file servers for document/content management has a number of disadvantages. Since metadata is not assigned to documents, searching and locating the correct document/file is inefficient. This situation is often worsened by poor server structure. Whereas file servers generally do offer some form of security to limit access to files to specific users or groups this also limits collaboration within the organisation, especially between user groups from different units within the organisation. Version control of documents is also not easily managed. To alleviate these problems and to enhance collaboration and version control an **Electronic Document Management System (EDMS)** is proposed. The EDMS should typically offer configurable security profiles to enforce

¹⁴ <http://www.ica.org/>

access control and assign appropriate reading, modification and approval rights; version control; linked workflow and approval processes; and powerful searching and retrieval tools.

- **Data sets:** Data sets created as part of the research activity form part of the research outputs of the Division and, as such, it is important for on-going research as well as verification of research results that these data sets be preserved along with the reports and results. It should be noted that many journal publishers and international funders now also require that associated data sets are made available as part of the publication process. In addition, the Division's materials testing, road monitoring and field tests activities provide a wealth of geo-referenced data on road structural and surface conditions which are not currently shared with other MOTIHUD agencies. Therefore, data management procedures and infrastructure for the curation and sharing of data sets should be provided. Provision should be made for the preservation and secure storage of research data sets with archival value. These data sets could be stored, along with the context giving documentation, in an access controlled folder on the file server. The folder will function as a data archive. Attention should be paid to standardised file naming conventions. These datasets should be indexed on metadata level in the Research Outputs Database with links provided to the datasets on the storage server.
- **Other project specific records:** Besides the project reports and research data sets other documentation associated with research projects also form part of the records of the Division. These include risk assessments; contracts and proof of delivery of contract; project management plans; records of researchers involved in the project; reviews of literature and relevant protocols and standards; research ethics approvals; equipment calibration reports and operating procedures; laboratory workbooks; project finances and records of client interaction. This type of content is mainly stored in project files (either in paper format, e.g. arch lever files, or electronic on file servers). Other project related records, such as financial transactions, are managed in a variety of systems across the organisation.

Governance related records management

- The Division's records management file plan and procedures should also make provision for records relevant to the its regulatory framework (policies & procedures); organisation and control (executive matters, strategic and operational plans, SHEQ records); as well as records created by support services such as its Legal, HR and Finance departments. The associated infrastructure required includes the individual departmental systems as well as a **corporate archive and correspondence registry**.

To establish a sustainable records management system it is recommended that the design and implementation methodology provided by ISO 15489-1:2001 and ISO 15489-2:2001 is followed. It should be noted that the methodology proposed was not designed to be linear and that tasks may be undertaken in different stages in accordance with organisational needs. Steps in the design methodology are summarised below:

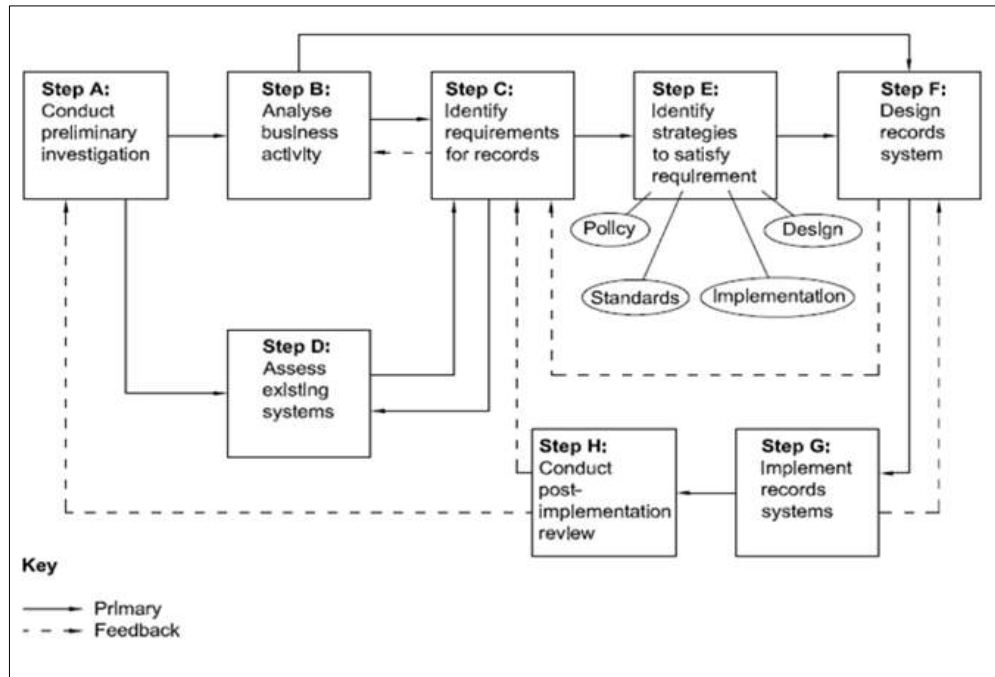


Figure 13: Steps in the design and implementation of a records management system

- **Step A: Preliminary investigation.** This initial step is undertaken to identify the organisation's structure, its legal and regulatory framework, as well as its strengths and weaknesses in managing its records.
- **Step B: Analysis of business activity.** Identify and document each business function within the organisation and its associated activities and transactions. Establish a business hierarchy system and the flow of business processes and transactions therein. The reason for this step is to provide an understanding of the relationship between the organisation's business and its records.
- **Step C: Identification of requirements for records.** The purpose of this step is to identify an organisation's requirements to create, receive and keep records and to document the requirements in a structured form. The requirements can be derived from an analysis of the regulatory environment and the risk of not creating and maintaining the records. Thereafter it should be determined how each requirement may be satisfied through records management processes.
- **Step D: Assessment of existing systems.** Identify and analyse the organisation's existing records and information systems to measure their performance and capabilities against the requirements determined in Step C.
- **Step E: Identification of strategies for satisfying records requirements.** The purpose of this step is to determine the most appropriate policies, procedures, standards and tools that should be adopted to ensure that that records requirements are met. Strategies may be applied to each records requirement separately or in combination. This step will provide the basis for the design or redesign of the records system.
- **Step F: Design of a records system.** This step involves adapting the strategies and tactics selected in Step E into a plan for a records management system (including a file plan) that meets the requirements identified in Step C and addresses the deficiencies identified during Step D. Step F covers people, processes as well as tools and technologies.
- **Step G: Implementation of a records system.** The plan designed in step F is systematically implemented using appropriate project planning and methodologies.

- **Step H: Post-implementation review.** This step aims to monitor the performance of the records system on an ongoing basis so that deficiencies can be remedied.

From the above it is clear that records may be managed in a centralised location/records management system or the control of records may be decentralised across various departmental locations/systems within the organisation. The costs associated with the implementation of a comprehensive proprietary records management system might not be justified and the Division might benefit from rather optimising its current decentralised systems (e.g. moving the paper-based Registry function to an electronic system; and the implementation of an EDMS). Further aspects to take into account include:

- Records management requirements should be considered as part of the [comprehensive content management solution](#) proposed.
- Records management should form part of the continuous improvement approach which is recommended under quality management systems such as ISO 9001. (Currently MTRD strive to comply with the 2008 edition of ISO 9001. It should be noted that a 2015 version was published recently. ISO 9001:2015 replaces previous editions and certification bodies will have up to three years to migrate certificates to the new version.) Records management procedures should therefore be documented as part of the Division’s quality management system.
- There are many aspects to records management. Whereas ISO 15489-1:2001 and ISO 15489-2:2001 provide general records management guidelines aimed at the records professional community, the ISO 30300 series was developed primarily for a management audience. The ISO 30300 series was created to link the management of records to organisational success and accountability. For a complete understanding a full reading of all relevant ISO standards is recommended. The following illustration¹⁵ might be of assistance:

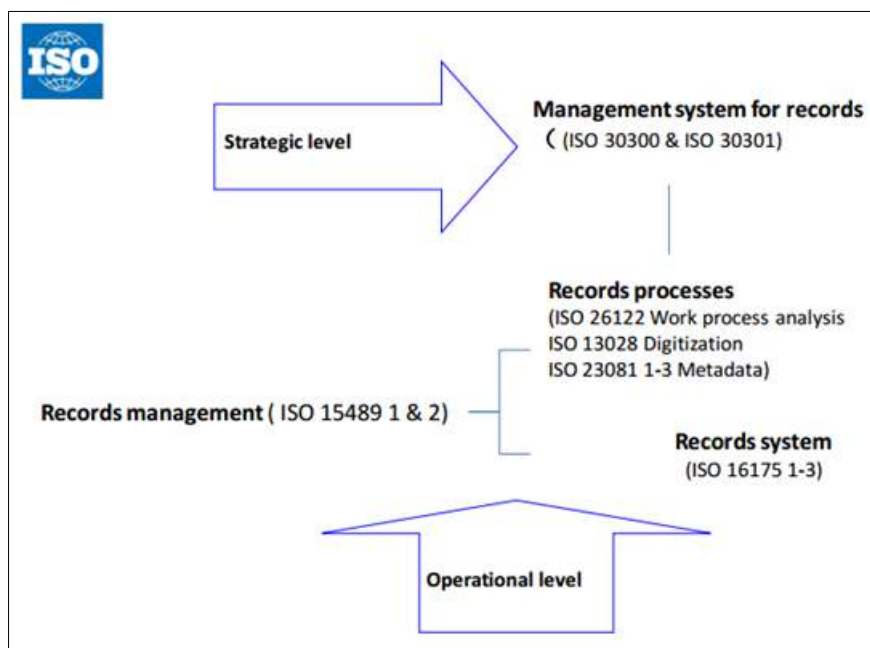


Figure 14: Relationships of ISO MSR series and products and ISO 15489 series products

¹⁵ Xiaomi A. 2011. Second National Forum on Electronic Records Management, Beijing, China, 12 November 2011, provided in *White paper: Relationship between the ISO 30300 series of standards and other products of ISO/TC 46/SC 11: Records processes and controls, March 2012.*

- The design of the records management solution should be done in consultation with the Kenya National Archives and Documentation Service (KNADS) as it has the responsibility to formulate, implement, coordinate and oversee the execution of records management within the public sector.

Recommendation: Comprehensive and consistent records management will require the appointment of a suitably qualified and experienced **Records Manager**.

3.6.4 Collaboration and Knowledge Sharing

The main purpose of knowledge dissemination initiatives should be to facilitate the link between producing research evidence and influencing policy (decision making) and practice (application). This will be by making research output accessible and setting up systems for dissemination and the flow of knowledge thereby supporting research uptake and lobbying on policy. Knowledge dissemination systems should help to ensure the long term sustainability of access to transport information and the continuing exchange of knowledge.

Satisfying external stakeholders is a pre-requisite for attracting support to fulfil the mandate of the Division and knowledge dissemination efforts undertaken should deliberately seek to improve the outreach to all stakeholders. The generated evidence base should be widely disseminated to, and easily accessible by, policy makers and practitioners.

Research influence on policy could be strengthened by:

- translating and synthesising research evidence into policy implications and impacts
- facilitating policy dialogues with key policy makers and other stakeholders

Research uptake by practitioners could be enhanced by:

- supporting the documentation, storing, accessing, publication and dissemination of research
- strengthening the interconnectedness of practitioner communities nationally and internationally
- hosting stakeholder workshops (either during a project to gather information and to test ideas; or at the end of the project to report findings) and organising and presenting at national and regional conferences for feedback on latest best practice
- embedding research knowledge into national standards, best practice manuals and specifications (and compiling simple manuals and guidelines that could also be used at district and village level)
- compiling short digests and policy briefings as few practitioners will read lengthy research publications
- providing input and contribute to development of academic and training curricula

Optimisation of knowledge dissemination within the Division should also receive attention. At present most of the staff work in silos with little interaction and knowledge exchange between the laboratories and disciplines. If used effectively the proposed knowledge spaces and the associated events programme discussed in this section could contribute to knowledge sharing and organisational learning. The proposed knowledge portal in addition to activities covered under the section on Communities of Practice will similarly enhance knowledge dissemination efforts within the Division.

3.6.4.1 Web-Based Knowledge Portals

MTRD will require both an internal website (intra web) as well as an external website.

The **intra web** should afford staff quick and efficient access to the information and operational systems below. An intra web serves as a portal for staff to find all organisational information and learn about developments and news about the organisation. Guidelines and standards for uploading information and links on the intra web are required to ensure that pertinent information is given preference; that the quality of information is assured (in terms of completeness, accuracy and quality of language); and that a proliferation of links is avoided and the site remains simple and easy to use.

Although website development is planned by the ICT unit of the Division, MTRD currently does not have an internet web presence to support its knowledge dissemination efforts. This could be an important marketing and communication tool for the Division as a sustainable, easily accessible **external website** which provides a clear description of the Division's purpose and services will assist it in building a strong reputation in the transport sector and will provide a snapshot of the organisation to the outside world.

Whereas the ICT unit will be fully capable to provide a technical portal solution, holistic website design also requires consideration of knowledge dissemination perspectives. From a knowledge management perspective a website should be a sustainable, easily accessible knowledge portal providing a clear description of an organisation's purpose and services and, in the case of the Division, access to its research and consultancy output. The external website should therefore also make MTRD research output accessible to external stakeholders through an [institutional repository](#).

An institutional repository is a web-based database of scholarly material which is institutionally defined; cumulative and perpetual; and open and interoperable¹⁶.) The repository will include selected non-confidential MTRD research reports as well as publisher approved versions of external publications authored by MTRD staff. The primary aim of the repository is to make the research outputs of the Division as widely available as possible and thereby to support research uptake. The repository should categorise research publications into logical sections and topics of interest. Through well-established routing processes newly produced research output can be added to the repository on a continuous basis.

Guidelines and standards for uploading information and links to both portals are required to ensure that pertinent information is given preference; that the quality of information is assured (in terms of completeness, accuracy and quality of language); and that a proliferation of links is avoided and the sites remain simple and easy to use. The use of standardised branding and navigation items will create a consistent user interface. The visual elements of the websites should assist users to understand the content, structure and navigation. Design should not be used to entertain, but to make the websites informative.

In general the portals should be searchable and have a professional look and feel while affording simple navigation. The external website should allow search engines to harvest content. Push technology such as RSS feeds could be used to automatically inform users of content updates to the portal. (The Division might also opt to keep high level stakeholders and industry practitioners updated

¹⁶ Ware M. 2004. *Pathfinder research on web-based repositories: final report*.
<http://www.markwareconsulting.com/wordpress/wp-content/uploads/2008/12/pals-report-on-institutional-repositories.pdf>

through other means. As Starkey¹⁷ pointed out, many organisations feel it is necessary to engage in more active diffusion processes by informing people of the existence of new knowledge products through electronic newsletters, printed publications and/or the dissemination of policy briefs.)

Enough time must be allowed to plan and conceptualise the intranet as well as the external website, as this is the most important step in the development of a website. The conceptualisation of a website is a creative and consultative process and it is crucial to involve managers of all units in the Division to ensure that their requirements are considered from the start of the project. The following broad steps normally form part of a website development project:

- **Determine the purpose and aim of the website:** The Division should have a clear purpose for its online initiative to ensure it is a success. The expected benefits of the website should be determined, for example why the organisation should have an intranet/website, what will be its objectives, and what value will it add for the organisation.
- **Identify the website's target audiences:** An understanding of the audience may influence how the website will be designed and developed, for example what should be available on the website, what functionalities will be included, and how information will be structured.
- **Develop a content plan:** A crucial element of an effective website is good content and it is advisable to identify and/or create suitable content before the website is developed. An information audit/inventory within all units in the organisation can be done to determine what information and communication products meant for public consumption are available in the organisation and where the main content sources are.
- **Decide on a static or dynamic website:** Until recently, most websites comprised "static" pages with an HTML structure. This type of website allows for little interactivity and can be time-consuming and expensive to update or revamp. A more flexible approach is the "dynamic" website where part or all of the content resides in a database. The website itself consists of one or more design templates that define the website's look, along with some programming that describes what information from the database is to be included and where it will appear. When users browse the website, the pages that appear in their browsers are assembled "on the fly" from the templates and relevant information from the database.
- **Structure information:** The first step after identifying information that should be published on the website is to break the information down into logical and digestible units. Prioritise the potential content by identifying what information the target audience will request most often and what information supports the Division's programmes.

The final portal design, both in terms of software and content, should take into account the limitations of local and regional internet access.

Recommendation: The services of a **Communications Practitioner** should be obtained, not only to assist with portal content but also to design a general communications plan for the organisation which would take into consideration other communication channels such as social media, print media, local media (radio, newspapers), and mass media (TV). The Communications Practitioner will also be able to assist with science communication and transforming research outputs into targeted information products such as technical briefs synthesising best practice in key areas; policy briefs targeted at decision makers in which the policy implications of research are documented; and abstracts summarising new knowledge.

¹⁷ Starkey P. 2013. *Feasibility study of options for long term knowledge sharing & management*. Project AFCAP/GEN/096, Cardno Emerging Markets (UK).

3.6.4.2 Communities of Practice

A Community of Practice (COP) is a group of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an on-going basis. Group members share a common interest and a desire to learn from and contribute to the community with their variety of experiences¹⁸. COPs are useful for building relationships and networks across service and disciplinary boundaries, increasing knowledge through case-based learning and inter-professional knowledge exchange and providing space for reflective practice¹⁹. COPs differ from project teams which are driven by deliverables and which have a team membership defined by task.

The Division would benefit from the establishment and fostering of COPs as these networks of research peers and stakeholders facilitate low-threshold ways of exchanging experience and of lessons learnt between the key target groups²⁰. In addition networks can enrich research through discussion and interaction between peers. They also serve the purpose of getting more research evidence exposed in order to promote research uptake through transferring, replicating and identifying policy impacts of research. A number of toolkits for developing, implementing and maintaining COPs are freely available on the internet and it is recommended that these are customised with the help of the Library and Information Services for use by MTRD staff.

Access to knowledge also concerns the declining pool of experienced experts both within the Division and in the transport sector in general. Much of the sector's information and knowledge exists among consultants and older experts. This knowledge is not sufficiently shared and risks being lost if there are not good systems put in place to transfer this expertise to the younger generations. COPs should involve these experts in their interactions. Mentorship programmes should also be established in which younger researchers can work under the guidance of these experts.

Learning briefs and reflection workshops are further tools which could be used to improve research performance, share experiences and convey lessons learnt:

- Learning briefs are short documents which summarise learning from failure; learning from implementation success; or learning from review of previous research and practice. These briefs typically provide the context of the learning/project, an indication of why the learning is important, the evidence base for the learning and recommendations for future similar projects.
- Reflection workshops through project team interaction consider questions such as 'what worked/didn't work?' and 'what should be done differently in future?'. Where appropriate the reflection workshops should also include representation from the target community who are/were affected by the project activities and outcomes.

Learning briefs and outcomes of reflection workshops should be captured in the [research outputs database](#) and should be consulted (with clear evidence given in project proposals) before new projects are started. Outcomes should also be shared wider than the project team with the remainder of the organisation. The knowledge spaces proposed below would be ideal to host these discussions.

¹⁸ Lave J and Wenger E. 1991. *Situated learning: legitimate peripheral participation*.

¹⁹ Hennessy C and Anderson S. 2013. *Toolkit: developing a community of practice*.

²⁰ *ReCAP Knowledge Management and Communications Strategy*. Sep 2015. Cardno Emerging Markets (UK).

3.6.4.3 Journals and Publications

To establish the Division as a reputable research organisation and to promote knowledge dissemination and uptake researchers should be supported to publish their research in high standing, peer-reviewed journals where the standard of objective reporting is strictly controlled. Publishing is one of the necessary steps embedded in the scientific research process and is necessary for career progression. It further provides the opportunity to influence policy and practice through academic channels. To build researcher capability within the Division the following is recommended:

- A mentoring programme should be put in place whereby first-time authors could be taught the complexities of academic writing.
- The Library and Information Services should be in the position to provide advice on journal selection, the management of copyright, citations and the compilation of bibliographies as well as how to avoid the pitfalls of plagiarism.
- Scientific publishers, such as Elsevier, Springer and Wiley, should be approached to present workshops and to provide guidelines which will allow potential authors to obtain the basic methodologies necessary to develop good research articles. Their workshops normally cover criteria required by the majority of national and international academic journals, including aspects to consider before starting a manuscript; choosing the most appropriate type of manuscript; language and manuscript writing; the article structure; peer review and editorial processes; and author ethics. (To justify the travel expenses of publisher representatives these workshops could be arranged in conjunction with local universities and academic institutions.)
- Researchers should make use of the opportunities offered through INASP's AuthorAid²¹ project. AuthorAid offers research writing courses, an active discussion list and a mentoring platform that matches early career researchers to more experienced researchers.

The Division should however ensure a balance between academic publication and information intended for decision makers. It should be kept in mind that journal articles can take up to 18 months to be published. As Starkey²² cautioned, many international peer reviewed journals will not take information that has already been published elsewhere, for instance on the organisation's website. A further aspect to consider is that most peer-reviewed journals are subscription based and are read by a limited number of people, mainly academics. (Reputable open access journals are increasing in numbers but so are journals offered by predatory open access publishers. Open access journals should therefore be evaluated carefully before article submission.)

The organisation's publication strategy should also address mechanisms for individual researchers to present their research at conferences:

- To develop staff skills in both writing and presenting conference papers a mentoring programme aimed at speaker support should be established. Part of this staff development can begin with internal processes and procedures for knowledge exchange between laboratories and research disciplines. A regular programme of short presentations should be organised internally so that

²¹ www.authoraids.info/

²² Starkey P. 2013. *Feasibility study of options for long term knowledge sharing & management*. Project AFCAP/GEN/096, Cardno Emerging Markets (UK).

staff within MTRD develop their presentation skills within the relatively safe environment of the organisation itself.

- The Library and Information Services should be able to assist with conference announcements as well as guidance on conference selection.
- As personal contacts are important financial support mechanisms should be put in place for individual researchers to attend relevant international conferences with a view to encourage personal contact between peers.

The survey conducted by Starkey indicated that much of the transport sector, including staff of transport agencies, NGOs, donor agencies and consultancy firms, tend to exchange information through reports, conference papers and newsletters which tend to be freely available. These publication channels should therefore not be neglected.

3.6.4.4 Provision of Knowledge Spaces

The use of [knowledge spaces](#) should form an important part of the Division's knowledge management strategy as the physical work environment can encourage knowledge sharing practices, internal dialogue, networking and science communication. Dedicated spaces should therefore be provided where staff (and external stakeholders) can interact on both a formal and informal basis.

Knowledge workers typically require three types of spaces and, depending on available floor space, the following should be considered as each supports different knowledge transactions:

- **Personal space** for knowledge workers requiring a different environment to stimulate creativity or individual time for concentration, reflection and learning away from continuous office interruptions.
- **Team space** for collaborative learning by teams of knowledge workers. During certain phases of collaborative teamwork, such as the starting or creation stage, teams need protection from intrusion. Team spaces should be removed from the immediate work areas of staff to minimise interruptions. As team needs vary from time to time, these areas should ensure flexibility through the use of modular furniture.
- **Social space** for informal learning through interactions with co-workers as innovation is fundamentally social. Ideas arise as much out of casual conversations as they do out of formal meetings. More precisely, as one study after another has demonstrated, the best ideas in any workplace arise out of casual contacts among different groups within the same company²³. Casual conversations provide an opportunity for tacit knowledge transfer as they have the advantage of opening the door to serendipity. They are opportunities for spontaneous meetings of the mind that have the potential to generate new ideas and solve old problems in unexpected ways²⁴.

²³ Gladwell M. 2000. Designs for working: why your boss wants to turn your new office into Greenwich Village. *The New Yorker*, Dec 11, p.60-70.

²⁴ Davenport TH and Prusak L. 1998. *Working knowledge: how organisations manage what they know*. Boston, Massachusetts: Harvard Business School Press.

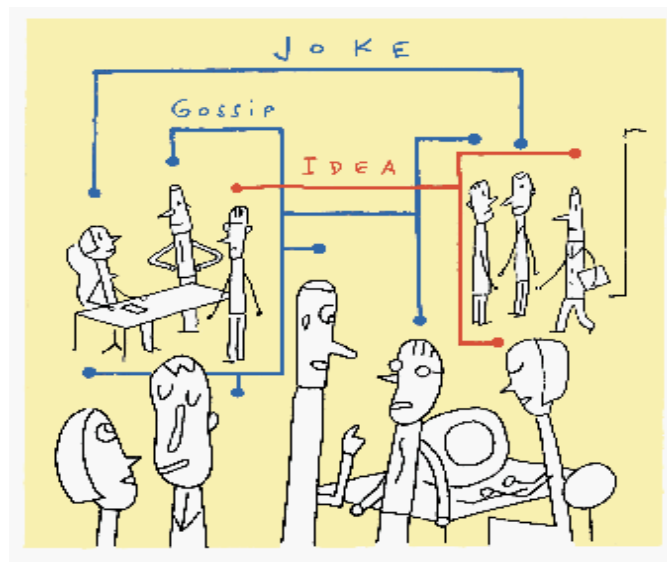


Figure 15: The social side of innovation (graphic from Gladwell)

The [knowledge spaces proposed for MTRD](#) could assist with the transfer of knowledge to practitioners and industry. A regular [programme of events](#) during which new documents (manuals, guidelines and standards) and research findings are presented should be established. All new manuals and research findings can be introduced at such events as it could be useful to hold workshops or feedback sessions prior to release of the final documents so that stakeholders can contribute to the content before finalisation of the documents. Such events are essential to ensure dissemination of the research findings, to increase awareness of MTRD and to establish its credibility and status among practitioners.

Optimisation of internal knowledge dissemination **within** MTRD should also receive attention. The proposed knowledge spaces should also be utilised to optimise knowledge transfer and organisational learning within the organisation, both on a formal and informal basis. This will ensure that staff do not work in silos and could encourage interaction and knowledge exchange between the materials laboratories and research disciplines.

3.6.4.5 Supporting Collaborative Research Activities through Virtual Collaboration Platforms

Research is no longer conducted in isolation. It is increasingly done collaboratively in teams, both within the organisation and between organisations, and is often interdisciplinary of nature. In the proposed CoE it is foreseen that research projects will be achieved through a combination of delivery mechanisms involving external stakeholders such as academic institutions, consultants and other national and international research centres. While the final research outputs of these collaborative research projects will be captured in the formal organisational knowledge base, access to web based collaboration platforms (e.g. DropBox, Google-Drive) will be required to allow file sharing and collaborative report writing between team members during project duration. Free, open source web applications such as the Open Science Framework²⁵ (OSF) are available to assist researchers manage their workflows. (The OSF is part collaboration tool, part version control software, and part data archive. It also connects to popular tools researchers already use, like Dropbox, Box, Github and Mendeley, to streamline workflows and increase efficiency.)

²⁵ <https://osf.io/>

In most organisations the formal organisational knowledge base also does not make provision for the management of day-to-day information required and created by these distributed project teams. (Project managers generally require this type of information for decision making, problem identification and solving as well as writing of progress reports. Team members on the other hand require this information to enable collaborative research efforts). As team members are often not working in close proximity to each other virtual information sharing platforms are required. Mobile centred discussion platforms such as WhatsApp, can be used effectively during project execution. In addition content analysis on the data generated from these platforms can provide valuable information for project leaders, for instance to determine how the conversations changed and evolved over time and what was learnt at what point.

Social networking tools can effectively be used for interaction with the project target community to gather input and ensure community participation. These all require a reliable, high speed, broadband connection to the internet.

Virtual collaboration platforms	
Social network, e.g. Twitter, Facebook	Project hashtag for interaction with project target community Community participation, gathering input from target communities Citizen science (data collection) Content analysis (emotional evaluation, topic spotting)
Information sharing platform, e.g. WhatsApp	Closed WhatsApp groups (for each aspect of the project) Sharing platform for project execution (text, photos, videos) Management & coordination tool (high speed & reduced effort) Content analysis and curation
File sharing, e.g. DropBox, Google-Drive, Open Science Framework	Working documents User create single folder on computer, synchronise with DropBox
Content management system, e.g. OpenCMS, OpenCloud, Vibe, WordPress (Blog), Wiki	Shared organisational knowledge base Include progress & final project reports Project evaluation and lessons learnt

Figure 16: Virtual platforms available to collaborative research teams

3.6.5 Individual, Group and Organizational Performance

In the knowledge based economy, research centres, whether industrial or public, play a fundamental role. In terms of knowledge management, these organisations have a special status, because their production is knowledge and only knowledge²⁶. The knowledge capital they accumulate in their activities therefore is a strong strategic issue and the management, including the evaluation, of these assets has become crucial.

²⁶ Ermine J. 2010. Methods and tools for knowledge management in research centres. *Electronic Journal of Knowledge Management*, vol. 8(3), p.293-306.

New knowledge generated through research activity needs to be evaluated before it can be put into practice. In a knowledge intensive organisation such as the proposed CoE, this evaluation typically is done through internal or external peer groups and/or the authority structure of the organisation.

Peer review is a system of self-regulation that has evolved in science to ensure scientific quality, validity and relevance. It means that at two important stages - the research proposal and the research report - the work is exposed to people who are knowledgeable in that field for critical assessment. If they find it lacking, the work is unlikely to be funded or accepted until the faults are corrected.

Project monitoring and evaluation should, where possible, be done through both internal and external review processes. External peer review platforms should include the proposed National Research Forum which will be responsible for the prioritisation and coordination of national road and transport research activities and which will inform and oversee research on behalf of stakeholders and the research community. Monitoring and evaluation is essential to determine effectiveness of the research activities and to inform future policy improvements.

Publications such as journals articles and books are subjected, before publication, to the scholarly peer review process by experts in the same field. Besides ensuring academic quality the review process also assist the publisher in deciding whether the work should be accepted, considered acceptable with revisions, or rejected.

Where management approval is required as part of the new knowledge evaluation processes it is advisable to institute formal approval processes involving systematic (and preferably electronic) routing procedures.

3.6.6 Information, Communication, Systems and Technology

The Information and Communication Technologies (ICT) function of the proposed CoE will need to be robust, efficient and adequate to ensure the organisation's national and international presence in an electronic world. As such the ICT services function has an inextricable responsibility to:

- manage technology and the attendant services to address business needs,
- meet service delivery expectations,
- govern the information security risks across all layers of the organisation,
- implement sound configuration management practices to improve awareness of the ICT components and their relationships to each other,
- increase staff productivity through self-service and automation,
- empower its user community, and to
- demonstrate the expected value and return on investment.

To stay abreast with developments in the ICT field trends need to be anticipated through technology tracking and participation in different national and regional fora.

Present situation in MTRD: The ICT facilities at the central material laboratories are basic but adequate for the present needs if maintained. There is internet connection through fibre optic cable and offices and laboratories are networked through a LAN. There is generally no Wi-Fi facility. The data is stored and managed using 5 racked servers of which only 2 are currently in working order. The air-conditioning system in the server room is not working, leading to a situation where the windows

to the room have to be kept open and the room and servers are covered in dust. The data is not backed up and no off site back up exists of any of the data. There are many classes of information that do not find their way into the server storage and information management systems. Many reports are created by individuals and remain on their desktops or laptop and are never logged into the system. None of the pavement monitoring data is transferred from the on-board computers to the organisation's servers. There is a shortage of ICT staff at all levels that mean that senior ICT managers have to carry out menial computer and software maintenance and troubleshooting activities.

It is observed that all the modern equipment currently used by the organisation for road monitoring and materials testing for roads produces data that is already geo-referenced.

The Ministry is in the course of setting up an all-inclusive data centre. The World Bank has funded the provision of state of the art equipment for date storage. The first floor (one up from upper ground level) of Transcom House, houses an installation consisting of 10 servers with back up facilities and uninterruptible power supply with fire suppressant gas and security systems installed. It is the intension that this will be a data repository for all roads and infrastructure data. At the present moment the equipment is installed and operational, although it does not hold any actual data. Phase 2 of the project development is to discuss with the departments and agencies to determine what data will be stored at the facility. The release of funds for that phase of operation is currently awaited.

The potential for this data centre to act as a mirror data base and backup repository for all data of Materials division and other MOTIHUD agencies is inspiring. Once the data is in one place, the opportunities for research analysis increase exponentially.

Recommendations: The current ICT systems within MTRD are fragile and significant financial investment will be required to ensure that the ICT infrastructure functions as a business enabler to the organisation's research as well as its routine laboratory and testing activities.

Internal GIS unit for roads condition, research results and materials testing result data storage: In order to keep up with the trend by the roads authorities and external agencies and to enhance its skills and abilities as a CoE the MTRD will need a GIS unit with all the hardware, software and skilled staff to manage the data and materials mapping processes generated by its existing and future equipment. The regional laboratories and eventual country laboratories will need to be brought into the system through a WAN and provided with the ICT hardware, software and skills to fully utilise the system.

Connectivity, maintenance and support: Access to the Internet with sufficient bandwidth and a reliable supply of electricity is similarly an essential prerequisite for the organisation to function optimally. Existing ICT capacity within the organisation will need to receive urgent attention as adequate infrastructure and a skilled support team will be required to support the organisation's business requirements and to implement the proposed knowledge management tools and initiatives.

Upgrade of the data storage system and linking of the system to be mirrored at the Ministry Data Centre: The Ministry data centre has the potential to act as a backup for all the MTRD data and a repository for generated information. It can also provide the data centre operations of the overall WAN for the organisations under MOTIHUD, as shown in the WAN diagram depiction below. MTRD should take the opportunity to discuss and make use of the data centre to assist its ICT development.

Knowledge portals: Once memoranda and protocols are established with other knowledge and research based national organisations (universities, professional associations and road agencies) MTRD shall establish web based knowledge portals, for the collection, sharing and dissemination of information. This will include the setting up of an MTRD web page.

ICT review: There is an urgent need for a comprehensive review of the ICT requirements both present and future (taking into account the needs for existing and proposed regional labs) and also the need for protocols for electronic document management as part of a full information management system. This will begin with the appointment of a **Systems Architect** to work with an appointed MTRD design team. The review should be an addition to the planned long term assistance to be provided under the strategic plan for support. The review should consider:

- long-term strategies relating to servers, data storage and server operating systems
- the overall design of enterprise storage and application services
- WAN, LAN and Internet design, installation and administration
- hardware and software standards for operating systems, servers and peripheral equipment
- the effective integration of all organisational systems, databases and procedures to reduce duplication of effort and information

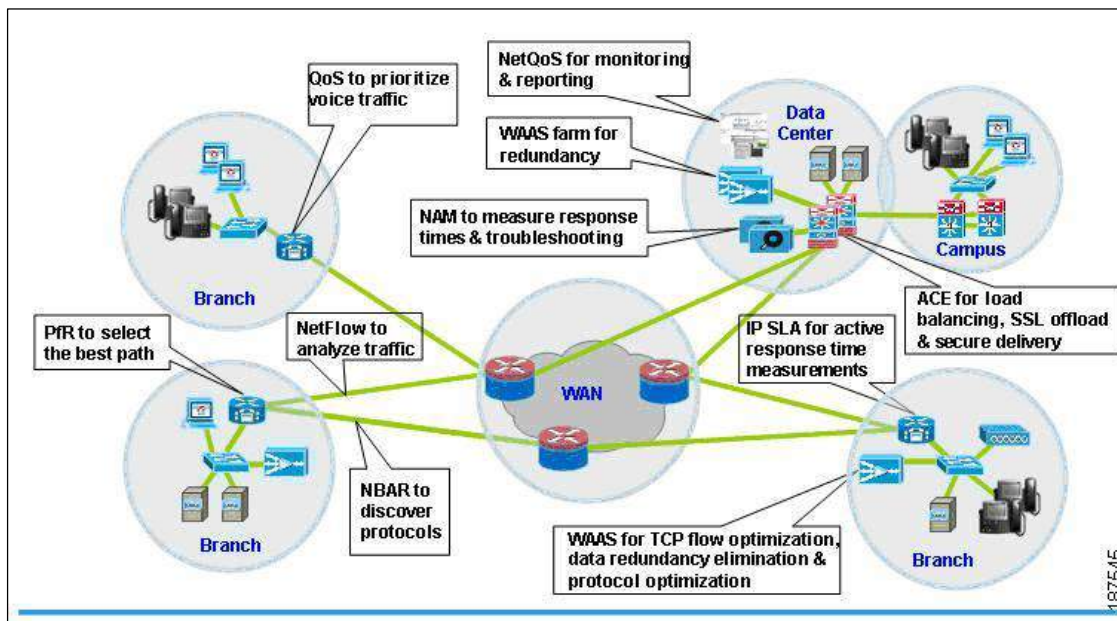


Figure 17: End-to-End WAN and Application Optimization. (Source CISCO systems)

3.6.7 Organizational Structure and Systems Architecture

It is important for the Division to enable its core functions associated with research, testing, quality assurance and capacity building through improved data and information management procedures as well as effective management of the organisational knowledge base. In this regard MTRD would gain from implementing a comprehensive and integrated content management solution aimed at the integration of all organisational systems, databases and procedures.

Present situation in MTRD: Currently the Division utilises a number of stand-alone paper-based systems as well as file servers to support its operations. The file servers are used to provide shared, but unstructured, storage of documents and laboratory test data. The servers are not regularly backed

up and no procedure exists for the offsite storage of back-up media. In addition information is managed in an ad-hoc manner. Data and documents are often stored on personal hard drives and as a result, never logged into a system. The Division would thus gain from implementing a more comprehensive content management solution.

Recommendations: A comprehensive **content management solution** enables the core services of an enterprise through good governance as it supports a formalised and structured environment for the management of documents and other records related to its core business and processes. It encompasses auditable procedures throughout the lifecycle of the content and is applicable to information created by the organisation and as well as information obtained from other sources. Comprehensive content management is required both for content created, used and disseminated internally in the organisation as well as content made available externally, for instance in the form of web content.

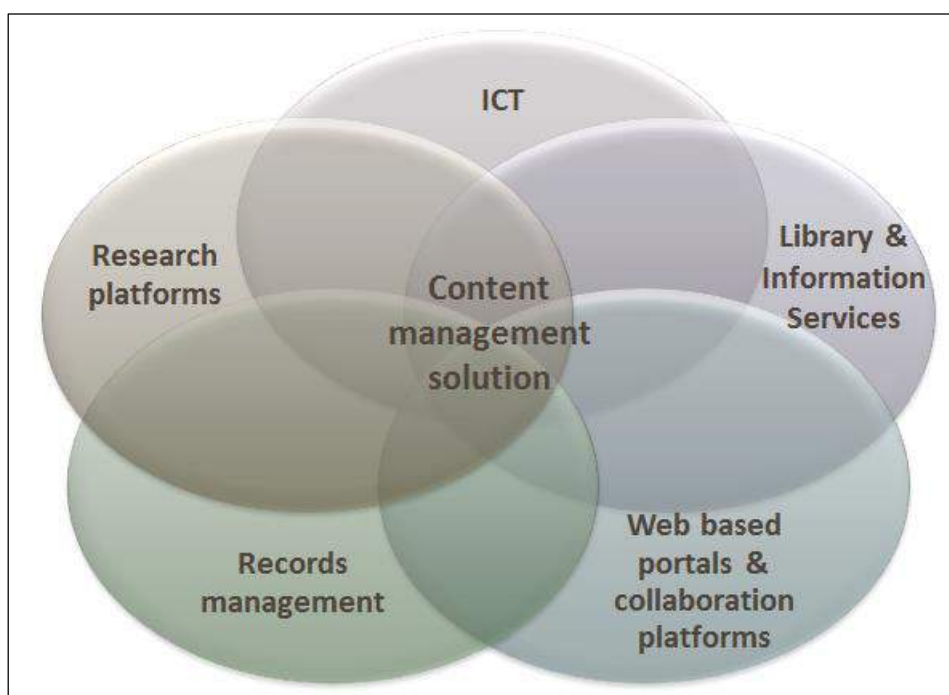


Figure 18: Comprehensive content management

The content management solution required to enable the core services of the Division should consider both the current as well as the future needs of the Division. As a minimum requirement the content solution should provide:

- the effective integration of all organisational systems, databases and procedures to reduce duplication of effort and information
- governance structures, e.g. roles and responsibilities, supported by policies, procedures and guidelines
- standard frameworks, e.g. an approval/routing framework
- standardised and controlled vocabulary for the assignment of metadata to ensure ease of retrieval, e.g. a taxonomy/thesaurus/glossary used for descriptive indexing and enhancing the integration of systems

The content solution should take into account the required ICT capacity within the organisation in terms of skills levels as well as adequacy of infrastructure and viability of technologies. Constraints such as cost, implementation schedules and support staff computer literacy levels should be considered. It should further take into consideration the Division’s quality management systems, for instance, the EDMS chosen/installed must allow for specified levels of control in accordance with ISO 9001 requirements. Other standards relevant to laboratory processes, e.g. ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*, might provide guidance on the design of appropriate automated work flows.

From an information management perspective, the comprehensive content management solution should make provision for the databases, work flows and systems discussed under the knowledge management initiatives covered in earlier sections of this chapter. These are indicated in red in the table below:

<p>Enhancement of research capability by strengthening knowledge creation and evaluation</p> <p>Information acquisition through library and information services (Library Management System)</p> <ul style="list-style-type: none"> • Access to reliable information resources (Library portal) • Information specialist services <p>Supporting collaborative research activities through virtual collaboration platforms</p> <p>New knowledge evaluation through peer review or management approval structures (Work flows)</p>	<p>Optimisation of knowledge dissemination to stakeholders and enablement of a knowledge sharing culture</p> <p>Knowledge dissemination to external stakeholders</p> <ul style="list-style-type: none"> • Web based knowledge portal & institutional repository • Communities of Practice (COP) • Journals & publications <p>Knowledge dissemination to internal stakeholders</p> <ul style="list-style-type: none"> • Intraweb / internal website • Provision of knowledge spaces • Enhancing the organisational culture to optimise knowledge sharing 	<p>Enabling the core services through effective management of the organisational knowledge base</p> <p>Comprehensive data and information management of:</p> <p>Records Management:</p> <ul style="list-style-type: none"> • Research and consultancy related publications, project specific records and data sets (EDMS, Research outputs database, File servers) • Governance related records (Corporate Archive; Registry; Dept. records, e.g. Legal, HR & Finance) <p>Management of:</p> <ul style="list-style-type: none"> • Externally acquired information (Grey literature database) • Content disseminated externally
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The conceptualisation and implementation of a comprehensive content management solution (and the accompanying ICT infrastructure and capacity upgrade) is of critical importance and should be addressed as a matter of urgency as it will significantly enhance not only the organisation’s knowledge management initiatives but also its operations in general. It is important to note that the conceptualisation of a content management solution suitable for the Division should involve its management structures as well as its ICT division.

Recommendation: To ensure the optimal integration of all organisational systems, databases and work flow procedures in order to reduce duplication of effort and information it is recommended that a **Systems Architect** is appointed on a contractual basis as an addition to the planned long term assistance to be provided under the AFCAP strategic support. The Systems Architect will be responsible for the conceptualisation of an appropriate content management solution suitable for the Division. This will require interaction with all stakeholders in the Division, i.e. the management structures, its ICT unit as well as all other units within MTRD, to determine their current and future needs and to understand the organisational environment.

3.7 Human Resources

There has been a moratorium on recruitment of staff by GOK for many years now. This has inevitably led to a shortage of staff at all levels and an aging of the work force. This has now become so acute that highly specialised departments such as MTRD are losing institutional memory and expert skills to natural attrition (death, retirement and career moves) with no prospect of retaining or replacing that level of expertise.

The state of the general economy has a significant effect on the availability of skilled technical staff in the field of materials testing. When the economy is booming and construction work is plentiful the relatively few materials engineers, technologists and technicians are all in high demand and not available for recruitment by MTRD that finds itself unable to compete in terms of remuneration with private construction industry. In times of bust (such as at present) there are a high number of technical materials people available for recruitment but MTRD is barred by the moratorium from taking this opportunity. A SAGA would not be so greatly affected by this situation, since it would have more flexibility on recruitment and remuneration packages.

The staffing levels have been analysed by the MTRD management for the processes and outputs required and a staffing summary has been produced. The summary shows the current establishment list, the level of staff actually deemed to be required (in full time equivalents, FTE) and the staff actually in post at present. This analysis has been reviewed jointly by the consultants and the MTRD management and a summary of the result is provided as Annex C. This summary shows an overall establishment list of 566 posts, a restructure considered staff requirement of 839 persons, including the additional 13 Regional Laboratories proposed. The current staff level is only 197. In addition the analysis also shows the requirement of 379 persons required for HQ laboratories alone should have a technical/managerial to administration ratio of 70/30. While the actual staff compliment in post is a total of only 197 with a T/A ratio of 66/34, somewhat short of the target. 33% of technical managerial post are filled while 44% of administrative posts are filled.

Staff HQ	In post HQ	Required	Existing split	Required split	In post
Tech/M	90	271	66%	72%	33%
Admin	47	108	34%	28%	44%
Total	137	379			

Figure 19 MTRD Human Resources Analysis

The situation is similar in the regional laboratories, with only 22% of required posts filled, and a current technical to administrative ratio of 60/40 instead of the proposed 80/20 split. This situation will, of course, be exacerbated by the addition of new regional laboratories that currently have no staff in

post. Some of the existing regional laboratories are staffed with only one technologist and staff borrowed/ seconded from other departments.

This means that not only is there an overall shortage of staff at all levels, there is a more acute shortage of technical staff than administration staff. These raw numbers, as worrying as they are, mask another fact that the most highly skilled individuals in the organisation are approaching retirement age and the wealth of institutional memory and technical skill that they hold will soon be lost to the organisation. The situation of having this critically fragile resource carrying a lot of the institutional memory and knowledge of where to find information, is exacerbated by the limited levels of information, records and data management within the organisation. There is an immediate need for succession planning and the need to transfer, preserve and access the institutional memory of MTRD.

MTRD have an existing plan and programme for training and development of staff. This plan is mainly based on budgeted training conducted by School of Government. The training is mostly in terms of government regulation and procedures for civil servants. In recent years the training decision and budget has been centralised at Ministry level. This has led to a serious reduction in the amount of training being carried out for MTRD staff. The last two years only two people have been taken for masters courses and a limited number of promotional (government procedure) skills courses have been provided. Again a SAGA would not be quite as constrained and could use some of its generated income as a non-profit organisation for staff training purposes.

At the present time MTRD do not have a planned and coordinated human resource development plan. That is a coordinated plan of how junior staff will gain experience from more senior colleagues and develop their own skills and progress up a clear scheme of service within this specialised industry to become senior researchers in the field of materials technology.

Skills training for technical personnel is offered by the Ministry's own training division KIHBT. KIHBT offers courses ranging from driving and construction equipment operator training through contract management and LVRS (all certified internally) to trade test and diploma courses (accredited externally). Currently the institution does not offer any courses on materials testing or active action research on roads (conducting of field trials). Such courses would have to be organised externally or designed and mounted jointly by MTRD and KIHBT combined expertise. This would be possible with independent leadership, organisational vision and staff motivational packages. That sort of organisational culture can only be found in relatively small, specialised, private or semi-private organisations.

The MTRD has a compliment of staff with a high grade of skills and experience in the field of materials testing, road and pavement analysis, materials specification and design advice. This wealth of knowledge and skill is not being passed on to colleagues and junior staff because of the shortfall in staff numbers. Where there are both senior and junior staff to have such training interactions the work load is too heavy and frantic to allow the organised transfer of knowledge and skill. Thus it becomes an ad hoc process that goes un-monitored and unrecognised. .

At present most of the staff work in silos with little interaction and knowledge exchange between the laboratories and disciplines. The technicians and engineers working in the Foundations lab know little of what is done by the chemists in the paints laboratory, and the same is true across the division. The regional laboratories are even more isolated from any form of knowledge and skills exchange. At the

same time, because there is no longer a period of induction training for engineers and technicians in the Ministry to gain experience through different departments and project work, many of the technical staff in the laboratories have little comprehension of the effects their work and test results have on the ground at the road construction site. A programme of inter-laboratory communication and site visit training could enhance both the vision and the motivation of the staff and junior and middle levels.

The need for improved internal communication between laboratories and road work sites is evident and should be coordinated by the human resources section of the division

There is a gross shortfall in staff numbers and particularly in the highly skilled staff to undertake research, monitoring of testing and interpretation of test results in order to be able to advise government, agency and other clients on standards, designs and compliance. The long term solution lies in the institutional reform and commercialisation of the organisation. The staff numbers have been determined and a revised establishment list proposed. The staff on this list will also be required by the reformed organisation. However the promise of staff numbers sometime in the future (no matter how likely) is not sufficient to solve the problem. Even when the staff numbers are adequate they need to be instilled with the skills and experience to allow efficient and effective Materials Testing and Research. There are certain posts that need to be filled as certain facilities and equipment become available or in order to prepare procedures for use of such equipment. Key posts of this nature are the Knowledge management, document management and library related posts and the ITC, GIS and networking development and maintenance posts.

The figure below shows the current organisation of the most senior managerial and technical posts within the division with the vacant posts highlighted in red. This snapshot shows the critical state of the staffing situation in the organisation at the moment. It has to be considered also that the remaining senior management posts are consequently under pressure and the transfer of skills to more junior staff can hardly take place. Looking at the figure it will be seen that the 3rd and 4th levels down in the hierarchy are close to empty. These are the levels where capacity has to be developed and skills transferred to, if MTRD is to grow into a centre of excellence, or even to maintain its present position as a provider of materials testing and advice on design, manuals and standards.

ORGANIZATION STRUCTURE - MATERIALS TESTING AND RESEARCH DIVISION, DOI, MINISTRY OF TRANSPORT AND INFRASTRUCTURE

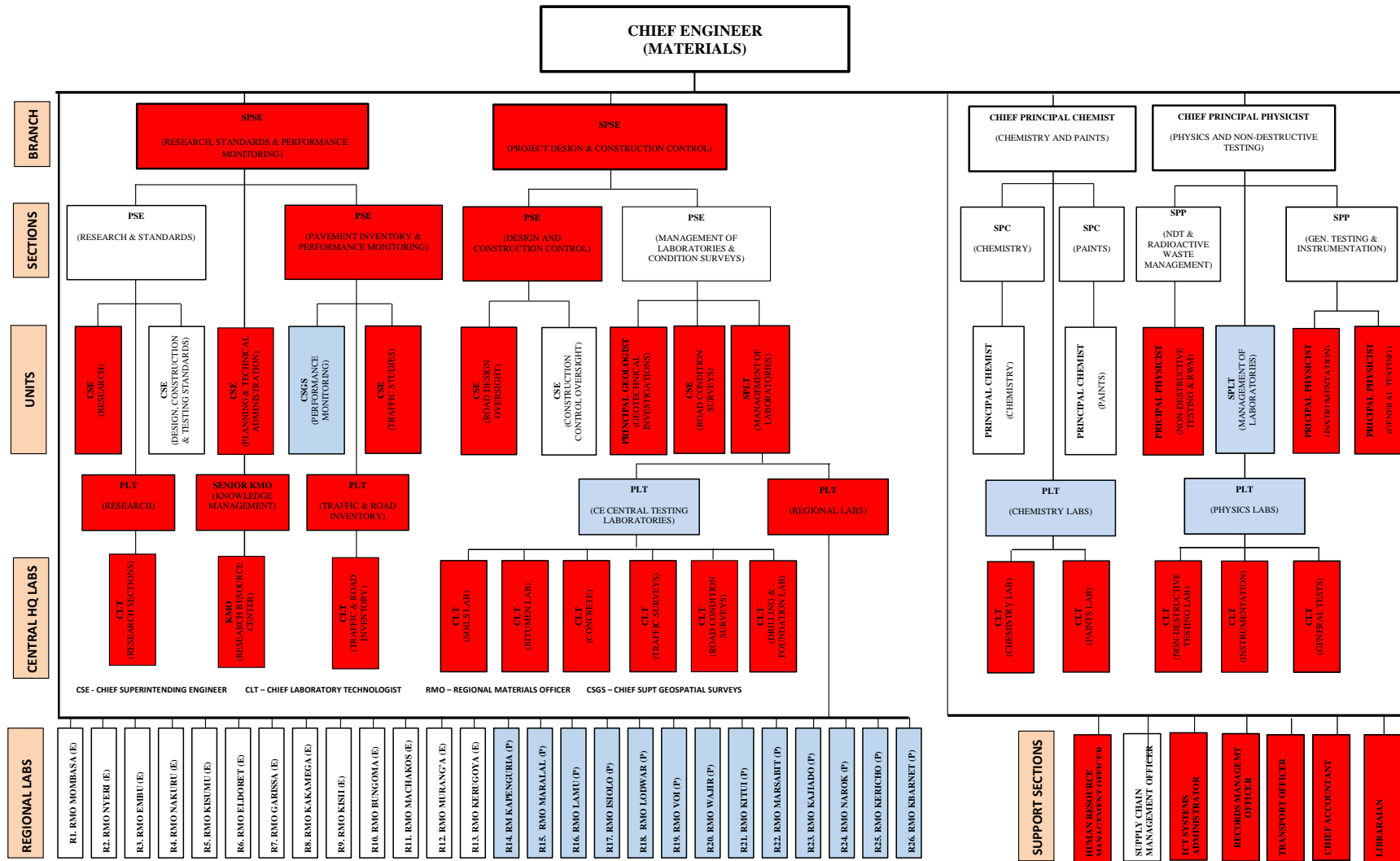


Figure 20 MTRD Current Senior Staffing

Serious consideration needs to be given to keeping the highly skilled and experienced individuals beyond retirement age until suitable replacements can be brought in or trained up. The reform to a MaTRA or similar will allow the contracting-in of expertise to boost the knowledge and skill base. A fast-track staff development programme needs to be put in place for this, consisting of:-

- Internal training and skills/knowledge transfer within the MTRD organisation.
- Development of skills training courses for technicians run jointly with KIHBT for materials technicians.
- External attachment/secondment programme to universities and international research organisations.
- Memoranda of understanding with universities (both local and international) on sharing of human resources for research projects and skills transfer.
- Attendance by technical staff at all levels on training courses for Research methodology.

To become a research centre the MTRD will need to develop the skills of its staff in both writing and presenting research reports and papers. Part of this staff development can begin immediately with internal processes and procedures for knowledge exchange between laboratories and disciplines.

A regular programme of short presentations should be organised internally so that staff within MTRD develop their presentation skills within the relatively safe environment of the MTRD itself and inform colleagues about what is happening within the division.

MTRD already has the staff that provide the potential to make the organisation into a CoE. The technical staff are highly specialised and skilled in what they do and have procedures built up over many years to ensure that generated information is held and passed to only the right people at the right time. Certain constraints described above prevent the fulfilment of this potential.

The moratorium on recruitment, the loss of senior staff by natural attrition, the lack of control over training programme, constraints on incentive payments, deteriorating facilities, aging equipment, ancient paper based systems, Neolithic organisational culture; all take their toll in preventing the staff to perform at the level of excellence foreseen in the Vision for MTRD.

The staff of MTRD are highly experienced, skilled and dedicated to the roles and functions that they undertake. There are a number of existing human resources constraints that prevent a higher level of operational efficiency and effectiveness. These situations lead to frustrations for the staff and leave them prone to low level of motivation with its consequent impacts on performance. The most pressing of these constraints is the general shortage of staff in the organisation

3.7.1 Staffing Establishment and Levels

The current and conceived establishment lists showing the vast number of current un-filled posts and the requirements to make the organisation viable as a materials testing and research centre are shown in detail in annex C and analysed and discussed in section 3.7.

The establishment list as currently formulated is antiquated and does not take account of how a modern organisation conducts business. There is need to update the establishment to reflect the electronic and information age in which MTRD is working. The need for up to date robust ITC systems that allow constant international communications and the electronic management of the large amounts of data generated by this technical organisation is vital and should be reflected in the establishment.

The proposed establishment in addition must reflect the proposed structure and mandate of the reformed agency and can only be fully determined as that agency develops.

3.7.2 Training and Development

Within the existing organisational setup of MTRD physical and human resource management in terms of staff training, allocation of duties and human resource management and equipment upgrading and maintenance, all fall under the general government regulations and restrictions of public service organisations. While a lot can be done internally to provide opportunities to gain experience, unusual or new procedures need already experienced staff to pass on the knowledge. These senior staff also need to have the time to devote to the transfer of technology to others. At present this is not happening in MTRD. At present capacity building and resource management is conducted as part of the Ministry's plan, and execution is controlled at ministry level. This means that MTRD's plans and programmes for capacity building are diluted or ignored and do not reach a useful level of implementation.

The intention is for MTRD to undergo institutional reform to become an agency in order to ease the constraints on resource management and expand the mandate for capacity building under a more independent setup.

Institutional reform comes with staff rationalisation. The foreseen material testing centre of excellence and research will need to build its staff through careful recruitment of fully qualified personnel. A HR management system will be introduced to motivate, train, retain and monitor staff performance. Whichever institutional option is chosen the human resources processes need to be strengthened. Recruitment, promotion and motivation opportunities need to be increased to have an effect on staff retention.

A re-engineering of processes required for testing and research will be undertaken and analysis of the staffing requirements will be carried out. The basis for this analysis is the FTE analysis of staffing levels already carried out by the MTRD management. This can be used for the first round of recruitment. Core staff forming the units to carry out the base load of tasks covering, routine testing, calibration testing, accreditation verification testing, research and monitoring of road performance will be engaged and trained to the highest standards. The complement of core staff will include the minimum of administration and support staff, all trained and equipped to utilise the modern document and records management systems. Technical staff will also be trained to use modern GIS based reporting and test result recoding systems and research methodologies.

In addition to the core staff complement a network of associates and professionals will be built up for "call down" and temporary contract work when workload demands. Such call downs will be used to

bolster research teams, staff project monitoring requirements and carry out specific short term or intermittent tasks.

In this way the staff complement will be controlled and remuneration packages can be optimised for motivation.

Although rationalisation usually means a reduction in staff, in this instance the required staff level, while lower than the current full establishment list, is most certainly higher than the current numbers in post. This comes about since most of the posts in MTRD establishment list remain unfilled. A complete revision of the establishment list should take place at the same time as the urgent recruitment of essential staff. A move to an agency or SAGA will facilitate this

3.7.3 Performance Monitoring and Appraisal System

With the existing MTRD performance monitoring and appraisal is carry out under the normal Government staff appraisal system. This system is geared towards general administrative staff and favours staff who teo the line rather than those who innovate.

A reformed Agency will require a very different monitoring and appraisal system that can only be developed as the agency grows and should be formulated specifically for the particular skills and characteristics required by the organisation.

A performance monitoring and appraisal system should be implemented to increase staff interaction. These can be combined with internal knowledge sharing sessions, where achievements and areas of concern are highlighted to the group. For example, group presentations on a monthly basis which each regional laboratory taking turns to report to the group.

Internally, in the laboratories, all staff should have, as a minimum, yearly professional development reviews (PDRs) with their line manager. This will explore any needs of the employees, highlighting strengths and weaknesses, and establishing job targets and personal targets fro skill development and certification.

There should also be a system implemented, potentially on the intraweb, praising top employees. Whether employee of the month or year, with appropriate rewards being offered – funding for learning being an example.

3.7.4 HR Planning and Succession Management

While the MTRD remains a division of the Ministry of Transport its HR requirements, plans and management are determined by government procedures. These are fixed overall by the “Establishment list” of the division that was inherited from former incarnations of the division and is extremely difficult to change. In part this has led to the current critical situation with staffing and succession planning. A Lot of talent and institutional memory has already been lost to staff attrition and cannot be replaced.

Under the government system there is little room for incentives and no room for financial bonus payments. Training is looked upon as the only incentive available to management and often used for this purpose, with the result that a capacity building and succession plan is undermined. In the present

situation even training planning is determined at Ministry level and therefore the divisions nominated candidates for training are seldom funded.

This situation can only be improved under a new institutional setup with MTRD converted to an agency with independence to recruit, retain, train, remunerate and provide incentives to staff. Under such a organisational setup, a coherent HR plan that includes proper training and development, certification and succession planning can be formulated. Until that time it is imperative that senior, experienced and skilled staff be retained. Those about to retire need to be offered contracts to remain and train others. Contracts of engagement need to be offered to skilled staff from outside the division. Funding needs to be secured for the engagement of technical assistance to fill the short term gaps and build capacity of existing and recruited new staff.

3.7.5 Welfare

There should be spaces created to allow staff to have informal meetings and presentations, and could act as a social space. Converting the Old Canteen into a multiuse tea room / training centre would create this space. Having interest work spaces and additionally working zones would stimulate the employees mind and help keep them focused. Changing environments should help improve productivity but also stimulate new discussions, improve employee satisfaction and give them a more relaxing areas – away from the laboratory equipment. This change could improve the general physical working welfare of the staff.

Work environment that cares for psychological and physical welfare needs e.g. health care, social, recreational and sporting and counselling services

4 The Way Forward

The recommendations made in [Section 3](#) are varied, intricate and interrelated, however, great progress can be made relatively quickly by undertaking those recommendations that require only internal actions and can utilise existing facilities and structures. Other steps will require funding outside the usual recurrent budget or additional resources, either physical or human or both. Some of the changes may be reasonably straight forward but inevitably take an extended amount of time. Institutional reforms and building the staff skills base fall into this class of actions.

The results of the Stakeholder Workshop for Needs Assessment in Capacity Building and Knowledge Management²⁷ informed the drafting and prioritisation of implementation plans for the future of MTRD outlined in this Section.

4.1 Institutional Framework

Many of the identified constraints cannot be overcome under the present institutional arrangement of the MTRD as a fully integrated division of the MOTIHUD. The main constraints will be in HR area where remuneration, motivation and incentives are constrained, outsourcing, secondments and flexible utilisation of staff is more difficult. The main overarching recommendation in order for MTRD to begin to become a CoE for Materials Testing and a Roads and Transport research centre is that MTRD should immediately begin the process of institutional reform to become a SAGA or other authority or institution, to provide it with the ability to have an independent budget, collect and use revenue from commercial activities, recruit and adequately remunerate key technical and managerial staff and keep its skills and equipment updated with the latest technology. At the same time it will need to provide a regulatory and accreditation function for road, transport and construction materials testing and skilled personnel for the country.

Judging the vision outlined above together with the current institutional situation and balancing this with the best aspects of the various international institutional models described in Annex I, then it becomes clear that Kenya needs to formulate its own institutional model to fit its particular circumstances.

Our recommendation set out below was discussed in the stakeholder workshop in 2016 and will be put to a wider group workshop in preparation for formulation of the required legal instruments.

It is proposed (in line with the strategic plan) that MTRD should reform into a materials testing and roads research agency. The agency (MaTRA) will be the executive agency of the roads research fund that will receive a 1% allocation from the KRB for material development and 1 % for research and testing. The Public Roads Standards Board will oversee the material and research fund usage. The CEO of the MaTRA should provide the secretariat to the Public Roads Standards Board, (amendment to proposals in Roads Bill 2015), where MOTIHUD is chair and KRB and the other road authorities are members.

²⁷ Jennings D and van Heerden M. 2016. *Report on stakeholder workshop for needs assessment in capacity building and knowledge management*. Silver Springs Hotel, Nairobi, 26 October 2016.

The MaTRA needs to be created by legal instruments and could have been part of the current proposed Roads Bill 2015, as it is mentioned already in that bill. However a separate piece of legislation makes it clearer and more distinct but should be promulgated soon.

An internal working group of stakeholders need to be established now to formulate the details of the required legislation before the drafting is handed over to a legal specialist.

4.2 MTRD Mandate/Mission

In addition to its present mandate of materials testing and research for Public roads, buildings and other construction works, the reformed organisation will need to be mandated through the creating legal instrument to act as the accreditation agency for road material testing procedures, for accreditation of private materials laboratories and certification for artisanal and craft level technicians for material testing. In light of this it is recommended that Kenya makes moves to join the international bodies under the Dublin accord, the Washington accord and the Sydney accord.



Figure 21 Laboratory Steel Strength Testing Equipment

These are agreements for international recognition of engineers, technologists and technicians under the international engineering Alliance. Procedures for the establishment of membership will require close liaison with the Institution of Engineers of Kenya, the ERB and the academic institutions of higher learning.

It is recommended that a reformed MTRD becomes the regulatory body for materials testing for construction. It will be based in Nairobi and have teams of senior technical people to visit regional and county laboratories and private laboratories to carry out accreditation inspections and bring samples to headquarters laboratories for repeat (confirmation) testing as part of the accreditation process. The Nairobi laboratories will continue to do routine testing of materials for projects and maintain the full set of equipment for all the required tests. They will also develop the capacity to calibrate equipment in regional, county and private laboratories and accredit these laboratories annually at a pre-determined to those laboratories.

In order to put this expansion of the mandate into practice clauses will have to be included in the legal instruments of reform to allow for this. Before that legal document is drafted MTRD needs to hold comprehensive discussions with the other local institutions involved in various aspects of accreditation and certification of technical personnel. These will include, KEBS, KENAS. IET, KETTB, IAS, VETA, NITA, and KIHBT. The discussion will produce the best possible role for the Materials testing and Research Agency

4.3 Organizational Structure

The recommended organisational structure is depicted in section 3.3.2 above.

The most pressing need is to immediately fill the senior staffing posts with experienced personnel. This can be achieved either by contracting in experienced former MTRD staff, extending the service of staff about to retire through contract, or engaging technical assistants on contract from outside the organisation.

The eventual organisational structure will depend of the mandate of the reformed organisation and decision taken in the official formulation of the agency.

The existing regional laboratories could move towards becoming county laboratories or could be handed over to KeNHA as part of their regional establishment where they would be subject to accreditation checking by MaTRA each year at a fee. Certification of materials technicians and technologists will need to be coordinated with the Ministry of Education and the institutes of higher learning (Universities and Colleges). The Institution of Engineers of Kenya (IEK) and the Engineers Registration board (ERB) do not register materials engineers separately from other engineers. Similarly it is assumed that the new KETTB will similarly have no separate category for Materials Technologists. However there is no obstacle in the way of MaTRA certifying suitably qualified and experienced engineers, technologist and technicians as certified materials testing professionals / Craftsmen in addition to the more general qualification and registration. As IEK, IET, ERB and KETTB grow and develop it is inevitable that they will formulate different categories of engineer and Technician membership. With MaTRA certification the materials category will be ready when the time comes.

The checking of the certification of materials professionals will form part of the accreditation of the private and other agency laboratories.

4.4 Estate And Facilities

There is a clear need to upgrade and modernise the physical facilities of the MTRD including the regional laboratories. The strategic plan calls for the addition of 13 regional laboratories onto the present complement.

It is recommended that an Architect be engaged to work with MTRD to determine the optimum balance between refurbishment, modification and new construction. Design of facilities specifically for the testing of construction materials and for research into materials, roads and transport is a highly specialised area and requires an Architect with previous experience of similar work.

Once the architectural plans are drawn up and costs estimated an implementation plan can be formulated with funding requirements spread out over a number of years. It is likely that the implementation stage may require external funding in terms of development aid, national or external borrowing or a formulated PFI.

4.5 Field And Laboratory Testing Equipment

Equipment requirements for Materials testing and road and transport research is highly specialised. As such it is recommended that a materials testing equipment specialist be engaged to review the

MTRD equipment holding and condition and recommend an optimum programme of equipment maintenance, refurbishment, replacement and new procurement.

The review should cover the equipment requirements for all materials testing for the laboratories including the regional laboratories, the roads data monitoring requirements, the roads and transport research needs including road safety. The review should also assess the specific equipment needs of the ITC unit and the recommended GIS unit as well as Wifi networking and electronic records management.

This may need the input of more than one person to cover the full range of equipment needs.

Once the review has taken place a programme and budget for repair and procurement can be finalised.

The need for upgrading, updating and refurbishment of equipment is already recognised by MTRD management and the list of immediate prioritised equipment is already prepared. This list has been reviewed by the consultants and will be further revised and assessed by MTRD and Stakeholders during the workshop. The scope and timing of procurement with foreseen funding scenarios is detailed in Annex D. This list only caters for the immediate needs of MTRD in the current setup. A short term input from a Materials testing and road research equipment specialist is required to determine the full needs of the reformed materials testing and roads and transport research agency.

It is recommended that the procurement of new equipment should be formulated, planned and scheduled through a procedure of joint internal planning by inclusive procurement management board. The Equipment group of senior managers (perhaps twice per year) and discuss the scheduling of both major maintenance repairs and new procurement for a planned and cost effective outlay. The plan and specifications for the agreed equipment will then be handed over to the procurement unit to undertake the purchase or repair of the agreed items. There are a number of procedures to help the board in coming to the priority listing. One of these is pair-wise ranking that can be applied to the most expensive of the equipment items. While small items and minor repairs can be decided upon under the routine equipment management budget.

Clearly the development of the equipment holding and the growth of the asset register will be phased, and will be guided by the inputs of short term specialist in materials testing and road monitoring equipment. Eventually the procedures adopted for the development phase will become routine and be integrated into the normal running of the reformed agency as part of the national Roads research agency managed by the agency secretariat and governed by the National Research Board as foreseen in the proposed Road Act.

The current ITC systems within MTRD are fragile. The ITC requirements of the proposed agency will need to be robust, efficient and adequate for a national and international presence in the electronic world. A number of detailed recommendations have been made in section 5 above. These can be summarised here as follows:-

It is recommended that MTRD upgrade the data storage system and link the system to be mirrored at the Ministry Data Centre. This will begin with the appointment of a systems analyst and architect to work with an appointed MTRD design team.

It is recommended that MTRD establish an internal GIS unit for roads condition, research results and materials testing result data storage.

Once memoranda and protocols are established with other knowledge and research based national organisations (Universities, Professional associations, Road Agencies MTRD shall establish Web based knowledge portals, for the collection, sharing and dissemination of information. This will include the setting up of an MTRD web page.

4.6 Knowledge Management and ICT

Many of the basic knowledge management and record management systems have been operational within MTRD at various stages in the past. These were all paper based systems and a number of them are retained and still operational today. There is need to re-establish systems and to modernise all. Records and information is quickly becoming digital in format and electronic in mode.

There is a pressing need for MTRD to upgrade its knowledge management processes and procedures in line with detailed recommendation contained in section 3.6, if it is to become a centre of excellence for materials testing and research in roads and transport.

It is recommended that MTRD should re-engineer its Library and information service. This will begin with the appointment of a fully qualified senior Library and information service manager.

It is recommended that MTRD should move towards electronic records management system. This will begin with the appointment of a fully qualified senior records manager.

It is recommended that MTRD should formulate procedures leading to the establishment of a community of practice for the exchange of knowledge and information around the aspect of materials and research on roads and transport. This forum may link to similar international fora already in existence.

It is advisable that the Division should, in support of its strategic goals and as a matter of urgency, implement appropriate information and knowledge management policies and procedures irrespective of whether MTRD remains an integrated division of MOTIHUD or if it reforms institutionally into a SAGA.

A priority has to be the MTRD reactivating and organising the library as its most pressing priority. This would massive improve the data / information storage system, benefitting all staff. Along with improving the library a strategy for creation of knowledge spaces where staff can safely exchange information is another top priority. The Old Canteen can be converted into a tea room and training centre where staff can meet informally and where internal presentations can be made on a regular basis. Weekly sessions for all MTRD staff, monthly sessions for Project to present findings. As part of improving the systems of the MTRD the Register of Research projects should be brought up to date and digitised then kept in a soft version on the MTRD server. To maintain this register as a core document, it should be insisted no versions are saved on local desktops and it must remain on the server.

Other suggestions to improve data collection, storage and accessibility include the following systems; research reports should be reinstated, collected from offices and organised in hard copy – being stored in the reorganised library. All document, report and book /manual collection should be indexed and recorded on both a hard and soft register - This could be done by interns on short term engagement with guidance and supervision. An IntraWeb portal is a vital tool for Knowledge dissemination -it should be a focus for ITC staff to design and manage content and use of social media

Findings and recommendations offered in Section 3.6 were provided in light of the information available at the time of compiling this report. Organisational priorities as well as enabling factors (funding; ICT infrastructure and support; staff capacity and skill levels) will determine the degree to which the proposed solutions are put into practice. Nonetheless, all of the solutions should be considered as part of the Division's transformation activities.

It is also recommended that the staged implementation process with scalable activities discussed below is followed. It should be noted that the prioritisation of implementation plans was informed by the Stakeholder Workshop for Needs Assessment in Capacity Building and Knowledge Management²⁸ held in October 2016. (The proposed high level schedule for the implementation of recommended knowledge management and ICT initiatives is available in graphic format in Annex H.)

4.6.1 Start-up Actions

In terms of Knowledge and Information Management the Stakeholder Workshop indicated that MTRD should reactivate and organise the library as one of its most pressing priorities. Start-up actions for the **establishment of the Library and Information Services (LIS)** will entail the following:

- The LIS will provide services as determined by its **mandate**. It is therefore important for the MTRD management structures to, as a first step in the establishment of the LIS, confirm its mandate. (It is foreseen that the LIS will support and enable the Division through the provision of relevant information and knowledge management services that allow access to information, facilitate knowledge creation and sharing, and contribute to the preservation of the organisation's intellectual assets. This, however, need to be confirmed.)
- A key recommendation that necessarily precede most of the LIS implementation actions is the **appointment of the LIS Manager** to conceptualise and establish the service, its infrastructure, systems, policies and procedures. It is recommended that the appointee should hold at least a Master's degree in Library and Information Science with significant experience in an academic environment. A detailed breakdown of the services to be established is provided in [Annex G](#).
- As the LIS will initially have limited information resources the implementation of an integrated Library Management System (LMS) may be postponed to a later stage. Individual manual **library systems** could be put in place to address the required standard technical library services (acquisitions, cataloguing, lending and circulation, serials management and user access) at very little cost making use of Microsoft Excel and/or Microsoft Access. Attention should be paid to structure, metadata and indexing standards during the planning phase to ensure ease of migration when the LMS is finally implemented. An outline of the infrastructure required is provided in [Annex G](#).

²⁸ Jennings D and van Heerden M. 2016. *Report on stakeholder workshop for needs assessment in capacity building and knowledge management*. Silver Springs Hotel, Nairobi, 26 October 2016.

- Until the LIS is in the position to provide access to the required electronic **information resources**, corporate membership of the library of the University of Nairobi should be negotiated. Such membership will allow MTRD staff access to the paper and electronic resources (e-books and e-journals) of this library during staffed service hours. In addition Open Access resources could be made accessible to MTRD staff through the **Information Centre portal** at no additional costs. (The Information Centre portal could be designed using free versions of blog software, e.g. WordPress or Drupal.)

Participants in the Stakeholder Workshop also indicated the urgent need for the **existing MTRD report and grey literature collections** to be organised.

- The Register of Research Projects should be brought up to date and digitised then kept in a soft version on the MTRD server and the research reports should be reinstated, collected from offices and organised in hard copy.
- It will be necessary to index these collections. This could be done by interns on short term engagement with guidance and supervision. **Database functionality** will be required to manage these collections. Until an LMS is implemented a relational database such as Microsoft Access or Q&A could be used. As is the case with the library systems, substantial attention should again be paid to metadata and indexing standards during the planning phase of the databases to ensure ease of migration when the LMS is implemented. Pending the implementation of institutional repository software non-confidential research publications could be listed on the (still to be established) MTRD internet website.
- MTRD does not currently have the **electronic document management system (EDMS)** required to manage and store full text electronic documents. Until this solution becomes available it is advisable that a separate, access controlled folder is created for the Information Centre on the MTRD server where full text research publications can be archived. The server will also host the library systems and databases to allow access to and searching by MTRD staff.
- [Annex G](#) provides a step-by-step approach to the organisation, storage and indexing of these collections.

The strategy for **creation of knowledge spaces** where staff can safely exchange information was also regarded as a top priority by Workshop participants. These knowledge spaces could be instrumental in breaking down silos within the Division and as such will require management support.

- It was suggested that the Old Canteen should be converted into a tea room and training centre where staff can meet informally and where internal presentations can be made on a regular basis, e.g. weekly sessions for all MTRD staff and monthly sessions for project teams to present findings. Technical committees from industry could also be hosted here from time to time.
- On the question of how to retain staff in MTRD the group thought that a lot could be done to improve working conditions in terms of knowledge sharing; training opportunities; succession planning; and improving the sense of purpose of staff responsibilities.
- The Group felt that team building exercises and meetings could go a long way to improve the organisational culture and therefore the reputation of MTRD. It was discussed how the Workshop itself was acting as a teambuilding exercise and how many of the MTRD staff were meeting each other for the first time at the Workshop.

- It was also indicated that comprehensive change management is required to ensure staff buy in and commitment to the organisational transformation.

A **Systems Architect** should be appointed as a matter of urgency to plan and implement a comprehensive [content management solution](#) aimed at the integration of all MTRD systems, databases and procedures. The solution should also consider the requirements of the district and regional laboratories.

The MTRD Internet domain should be reactivated and both the external website and the internal website/Intraweb should be developed. Principles of holistic website design need to be considered to ensure that both websites are sustainable **knowledge portals**. It is recommended that a **Communications Practitioner** is appointed to assist with website content, organisational branding and science communication.

4.6.2 Medium to Longer Term Actions

The expected growth in MTRD research activities and staff compliment will require the actions listed below:

- Longer term facility planning and renovations should provide for the various **physical spaces** (see [Annex G](#)) required by knowledge workers. The spaces should be well equipped with appropriate audio visual and video conferencing equipment as well as modular furniture to allow the venues to be multifunctional. During the planning phase the **services of an architect** should be obtained to ensure optimal usage of the various physical spaces. The LIS Manager should be consulted to provide input from a knowledge management perspective.
- Initially the LIS's **information resources** will focus on road engineering, however, resources and services will be expanded as the spectrum of MTRD research activities is broadened. Access to electronic journal platforms and databases should be negotiated through library consortia to ensure the most cost-effective way of delivering commercially available information resources. An information resources budget will have to be prepared and funding allocated accordingly.
- As the collections and databases of the LIS will outgrow the initial library systems used, an online **Library Management System (LMS)** will have to be implemented to ensure efficient management of collections and library functions. Selection of a suitable LMS will be determined by user requirements; the existing ICT infrastructure, architecture and support; as well as affordability. Optimally the LMS should incorporate MTRD databases (e.g. the Research Outputs Database and the Grey Literature collection) and provide portal functionality to make the LIS collections accessible to the end users. A comprehensive list of the available library management systems (both proprietary and open source) is published annually in the Library Technology Guides²⁹.
- As the MTRD research publications grow **institutional repository** software should be implemented (see [Annex G](#)). As repository software (e.g. DSpace, EPrint, Fedora, Islandora) is mainly Open Source, implementation will require substantial support from the ICT Department.
- The LIS will be highly reliant on the ICT Department for both system implementation and support. As the LIS strategy would focus on electronic products and systems for both research output created internally and items sourced from outside the organisation, cloud based solutions could

²⁹ Breeding M. 2016. Perceptions 2015: an international survey of library automation. *Library Technology Guides*, <http://librarytechnology.org/perceptions/2015/>.

be considered. Cloud services will, in the longer term, require a lower ICT skills set within the organisation. It might also be advisable to **contract-in the services of an experienced systems librarian** during the inception phase to assist the LIS Manager and the ICT Department with the design and implementation of the required library systems.

- As the demand for information increases an **Information Specialist** (see [Annex G](#)) should be appointed. This will require the formulation of a job description; position evaluation and salary determination; advertisement of the position and recruitment of a suitable appointee.
- Attention should be paid to the establishment of a sustainable **records management** system for MTRD. The design and implementation methodology provided by ISO is discussed in detail in Section 3.6.3.2. Records management efforts will also be enhanced by the implementation of an **electronic document management system** (EDMS) as file servers are not suitable for research document/content management. The EDMS should typically offer configurable security profiles to enforce access control and assign appropriate reading, modification and approval rights; version control; linked workflow and approval processes; and powerful searching and retrieval tools.
- The knowledge management **initiatives aimed at stakeholder interaction and communication** (communities of practice; journals and scientific/technology communication; utilisation of collaboration platforms) as well as the optimisation of a knowledge sharing organisational culture do not require additional investment in terms of infrastructure. These initiatives are none the less important and should receive equal management attention as the MTRD starts functioning as a fully-fledged research centre.

These planned changes to the way that knowledge, information and data are handled goes hand in hand with the recruitment and training of specialist staff to operate these systems and the training of all staff to access and fully utilise the systems.

4.7 Human Resources

It is recommended that MTRD immediately begin regular internal knowledge sharing sessions (perhaps monthly) where senior staff make presentations to all staff about particular aspect of their work.

MTRD should petition MOTIHUD and PSC to be allowed to retain or engage on contract, staff nearing (or past) retirement age.

Once sufficient staff are available MTRD should train a number of technicians and technologists to handle GIS data and software and to convert test result data into GIS network related attributes.

MTRD should discuss and agree with MOE, UoN and KIHBT to mount courses for Materials technicians and technologists in Materials testing and research. Such a course would eventually form part of the certification process for Materials Technologists.

Once the institutional reform process is underway and the staff complement is healthy enough, MTRD should approach AFCAP and ARTREF to arrange for, implement and monitor a programme of exchange and attachments for staff with other Roads research centres and materials testing facilities.

Considering the full extent of the actions required and set out above and in previous sections of this report and in light of the current situation of the lack of human resources within the division it is clear that additional external support will be required to implement these actions.

The recommended initiatives and actions constitute intense changes to and within the organisation. As such this change process will require not only the backing of senior management of the division and support from the various organisational and individual stakeholder but will need additional change management external support in the form of technical assistance to champion, steer and guide the changes and reforms.

It is recommended that long term technical assistance be engaged to support the change management of the division.

Initially this support should consist of experts in the field of materials testing and research in roads and transport with the addition of change management expertise. The support will be required for the first 3 years of organisational development of MTRD and cover the institutional reform period as well as the period of internal actions and development of organisational networks

4.8 Summary of Recommended Actions

The main recommended capacity building actions to achieve the strategic objective of becoming a centre of excellence and research centre for roads and transport are (in no particular order):-

- Institutional reform to a national Material Testing and Road Research Agency (MaTRA), with appropriate mandate and legal instruments (legislation). The recommendation is for the agency to have a regulatory mandate and be the body to accredit and certify both public and private materials testing laboratories, check the calibration of testing equipment and certify materials testing technicians and technologists for the construction industry.
- Upgrade buildings and facilities. It is recommended that a specialised architect be engaged to determine the optimum balance between refurbishment, repair and new construction.
- Determine the optimal equipment holding for laboratories and testing facilities and procure. In order to initiate this a short term specialised equipment expert should be engaged to make a review of the equipment holding and needs.
- Bring ICT equipment and staff up to date and increase both to be able to handle information generated. As an information based organisation MTRD and MaTRA need to be up to date and at the forefront of information technology and able to exchange information with international forums and bodies throughout the world. An ICT review may form part of the equipment review.
- Recruit staff to fill determined essential human resource gaps and contract-in expertise to initially provide research skills and retain/ replace experienced staff and skill shortages. This includes the contracting of senior and retired staff who hold the institutional memory of MTRD and need to pass this on to other staff as part of an overall succession plan.
- Create a GIS unit and train staff to use GIS. The road inventory at KRB and Roads Agencies is being upgraded to a GIS system. All the information and data generated by MTRD is geo-referenced and should form part of a GIS database to enhance analysis and research. MTRD should lead this initiative.
- Formulate a plan and programme to finalise existing research projects.
- Start internal training programmes with regular exchange of knowledge and reflection sessions.

- Liaise with KIHBT and universities to develop material testing skills courses for industry.
- Elaborate an attachment and exchange programme for staff with projects, universities and national and international road and transport research centres. The international aspects of this action may in future be coordinated through ARTREF.
- Build capacity in the Private sector, through certification of technicians and accreditation of laboratories (under Agency mandate).

It is advisable that MTRD should, in support of its strategic goals and as a matter of urgency, implement appropriate knowledge management policies and procedures. Knowledge management initiatives proposed focus on the enhancement of research capability and strengthening and updating of the materials testing procedures to meet the demands of an increasingly digitised knowledge environment. The recommendations will support the knowledge creation and evaluation processes; optimisation of knowledge dissemination to stakeholders; and enabling the core services associated with research, testing, quality assurance and capacity building through effective management of the organisational knowledge base. Specific activities recommended include:

- Implementation of a comprehensive content management solution which will ensure the effective integration of all organisational systems and provide the necessary governance structures and standard approval and routing frameworks
- Establishment of a library and information service to negotiate and provide access to reliable information resources; preserve and make accessible the intellectual property created by the Division; and facilitate knowledge exchange, scientific interaction and networking
- Development of internal and external web based knowledge portals to enhance knowledge dissemination
- Enhancement of records management activities to efficiently manage, store and retain data, documents and other forms of information (records) for specific periods of time and thus ensuring compliance with applicable legislation; corporate governance; long term access to records; and proper project and contractual management.
- Support of collaborative research activities through virtual collaboration platforms
- Establishment and fostering of communities of practice to build relationships and networks across service and disciplinary boundaries and to increase knowledge through case-based learning and inter-professional knowledge exchange

Considering the extent of the changes proposed and the dire staffing needs of the division in the current situation It is recommended that the whole change process be supported by long term technical assistance by experienced materials testing and research organisation with experts in the change management process.

Annexes

Annex A: Stakeholders Consulted

MTRD

- Eng SK Kogi, Chief Engineer (Materials)
- Eng M O Ndeda, Research, Standards & Performance Monitoring
- Abdala JM Kulah, Chief Physicist, Planning & Technical Administrator
- WN Mutuiri, Physics Branch
- Eng D Wanyiri, Pavement Monitoring
- Eng JN Mbarua, Research & Standards
- Eng Esther Amimo, Research & Standards
- Veronica Akinyi, Technologist
- Beatrice Okoth, Technologist
- JM Kirugumi, Procurement Section
- CN Wamai, Chemistry Section
- Peter Kiarie, Senior Technologist
- Isaac Mugamangi, Geologist
- George Otieno, Technician Pavement monitoring
- JG Atuti, Human Resources Management Officer
- Rex Okinyo, Senior Records Manager
- Justus O Musakala, Senior Principal Chemist, Secretary training committee
- Elishifa Kiboi, Records Management Officer
- George Ogutu, ICT Officer

Ministry of Transport & Infrastructure

- Eng PC Kilimo, Infrastructure Secretary
- Eng F Gitau, Chief Engineer Roads
- Prof O Mbeche (MOTIHUD Data Centre, Consultant)
- Mani Iyer, CEO, Pinakim Africa Ltd (MOTIHUD Data Centre, Contractor)

KENYA ROADS BOARD

- Eng JZ Ruwa, Executive Director
- Eng BK Maingi, General Manager, Planning and Programming

KIHBT

- Eng MO Ontomwa, Principal
- J Waithaka, Lecturer

KeNHA

- Eng CO Obuon, Manager (Roads)
- Eng O Ogalo Oguta, Manager (Roads D&C)

KeRRA

- Eng Wanjohi, General Manager
- Eng H Akwiri, Planning & Roads 2000
- Mr Wambugu, HR Manager
- Timothy Kandie (RMMS)

University of Nairobi

- Dr SW Mumanya, Chairperson, Dept of Civil & Construction Engineering
- Prof (Eng) SK Mwea, Dept of Civil & Construction Engineering
- Peter Weche, College Librarian
- Rosemary Otando, Systems Librarian

Annex B: Study Activities

Annex C: Staff Analysis**STAFF ANALYSIS MATERIALS TESTING and RESEARCH DIVISION****A. NAIROBI HEADQUARTERS**

DESIGNATION	J/G	IN POST	PROPOSED
Chief Engineer (Materials)	S	1	1
Senior Principal Superintending Engineer (Materials)	R	0	2
Chief Principal Physicist	R	1	1
Chief Principal Chemist	R	1	1
Principal Superintending Engineer (Materials)	Q	2	4
Senior Principal Physicist	Q	2	2
Senior Principal Chemist I	Q	2	2
Chief Superintending Engineer (Materials)	P	2	7
Principal Physicist	P	0	3
Senior Principal Chemist II.	P	2	3
Chief Superintending Geologist	P	0	1
Chief Superintending Surveyor	P	0	1
Senior Principal Laboratory Technologist	P	0	2
Senior Superintending Engineer (Materials)	N	0	9
Chief Physicist	N	0	4
Principal Chemist	N	0	4
Senior Superintending Geologist	N	0	1
Senior Superintending Surveyor	N	0	1
Principal Laboratory Technologist	N	0	6
Superintending Engineer (Materials)	M	1	11
Senior Physicist	M	2	4
Chief Chemist	M	1	4

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Superintending Geologist	M	0	1
Superintending Surveyor	M	0	1
Chief Laboratory Technologist	M	0	13
Chief Photogrammetric Assistant	M	1	1
Assistant Engineer II/I (Materials)	K/L	6	22
Physicist II/I	K/L	0	6
Chemist/ Senior Chemist	K/L	2	6
Assistant Geologist II/I	K/L	1	2
Assistant Surveyor II/I	K/L	0	2
Senior Laboratory Technologist	L	17	13
Senior Photogrammetric Assistant	L	3	1
Laboratory Technologist I	K	0	18
Photogrammetric Assistant I	K	0	1
Chief Laboratory Technician	K	3	11
Senior Laboratory Technician	J	11	20
Laboratory Technologist III/II	H/J	13	24
Photogrammetric Assistant III/II	H/J	0	1
Laboratory Technician II/I	G/H	10	32
Mechanic III/II/I/Chargehand Mechanic	D -K	2	6
Drillers	E/F/G	0	6
Knowledge Management Officer/Senior	L/M	0	2
ICT Officers	J/K	0	2
Supply Chain Management Officers	J/K	1	3
Human Resource Management Assistant II/I	H/J	3	2
Chief Accountant	M	0	1

A. NAIROBI HEADQUARTERS

DESIGNATION	J/G	IN POST	PROPOSED
Accountant II/I	J/K	3	2
Chief Assistant Office Administrator	M	0	1
Snr Assistant Office Administrator	L	0	2
Assistant Office Administrator I	K	1	3
Office Administrative Assistant III/II	G/H/J	2	4
Library Assistants/ Librarian	H/J	1	2
Records Management Assistants	H/J	1	4
Supply Chain Management Assistants IV/III	G/H	6	3
Chief Clerical Officer	J	0	5
Clerical Officer II/I/Snr	F/G/H	2	15
Artisans/Charge Hand	D/E/F/G/H	6	8
Telephone Operators	E/F/G	0	3
Driver III/II/I/Chief/Snr	D/E/F/G/H/J	14	30
Security Wardens	D/E/F/G/H/J	0	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	11	25
SUB TOTAL		137	379

B. REGIONAL LABORATORIES**R1. MOMBASA REGION**

DESIGNATION	J/G	I/P	P/E
Chief Superintending Engineer (Materials)	P	0	1
Chief Laboratory Technologist	M	0	1
Assistant Engineer II/I (Materials)	K/L	0	1
Chemist	L	0	1
Physicist	L	0	1
Senior Laboratory Technologist	L	1	1
Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	0	2
Laboratory Technologist III/II	H/J	0	2
Senior Laboratory Technician	J	2	4
Laboratory Technician II/I	G/H	1	6
Clerical Officer II/I/Snr	F/G/H	0	1
Office Administrative Assistant III/II	G/H/J	0	1
Drivers	D/E/F/G/H/J	0	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	0	2
SUB TOTAL R1		4	26

R2. NYERI REGION

DESIGNATION	J/G	I/P	P/E
Senior Superintending Engineer (Materials)	N	0	1
Chief Laboratory Technologist	M	0	1
Assistant Engineer II/I (Materials)	K/L	0	1
Chemist	L	0	1

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Physicist	L	0	1
Senior Laboratory Technologist	L	1	1
Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	0	2
Laboratory Technologist III/II	H/J	0	2
Senior Laboratory Technician	J	0	4
Laboratory Technician II/I	G/H	4	6
Drivers	D/E/F/G/H/J	0	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	0	1
Clerical Officer II/I/Snr	F/G/H	2	1
Office Administrative Assistant III/II	G/H/J	0	2
SUB TOTAL R2		7	26

R3. EMBU REGION

DESIGNATION	J/G	I/P	P/E
Chief Superintending Engineer	P	0	1
Chief Laboratory Technologist	M	0	1
Assistant Engineer II/I	K/L	0	1
Chemist	L	0	1
Physicist	L	0	1
Senior Laboratory Technologist	L	1	1
Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	0	2
Laboratory Technologist III/II	H/J	0	2
Senior Laboratory Technician	J	1	4
Laboratory Technician II/I	G/H	1	6

Capacity Building and Knowledge Management Study of MTRD Kenya

Clerical Officer II/I/Snr	F/G/H	0	1
Office Administrative Assistant III/II	G/H/J	0	1
Drivers	D/E/F/G/H/J	0	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	1	2
SUB TOTAL R3		4	26

R4. NAKURU REGION

DESIGNATION	J/G	I/P	P/E
Chief Superintending Engineer	P	0	1
Chief Laboratory Technologist	M	0	1
Assistant Engineer II/I	K/L	0	1
Chemist	L	0	1
Physicist	L	0	1
Senior Laboratory Technologist	L	1	1
Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	0	2
Laboratory Technologist III/II	H/J	0	2
Senior Laboratory Technician	J	1	4
Laboratory Technician II/I	G/H	1	6
Clerical Officer II/I/Snr	F/G/H	1	1
Office Administrative Assistant III/II	G/H/J	1	1
Drivers	D/E/F/G/H/J	1	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	2	2
SUB TOTAL R4		8	26

R5. KISUMU REGION

DESIGNATION	J/G	I/P	P/E
Chief Superintending Engineer	P	0	1
Chief Laboratory Technologist	M	0	1
Assistant Engineer II/I	K/L	0	1
Chemist	L	0	1
Physicist	L	0	1
Senior Laboratory Technologist	L	1	1
Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	1	2
Laboratory Technologist III/II	H/J	0	2
Senior Laboratory Technician	J	0	4
Laboratory Technician II/I	G/H	2	6
Clerical Officer II/I/Snr	F/G/H	0	1
Office Administrative Assistant III/II	G/H/J	0	1
Driver III/II/I/Chief/Snr	D/E/F/G/H/J	0	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	2	2
SUB TOTAL R5		6	26

R6. ELDORET REGION

DESIGNATION	J/G	I/P	P/E
Chief Superintending Engineer	P	0	1
Chief Laboratory Technologist	M	0	1
Assistant Engineer II/I	K/L	0	1
Chemist	L	0	1
Physicist	L	0	1

Capacity Building and Knowledge Management Study of MTRD Kenya

Senior Laboratory Technologist	L	0	1
Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	1	2
Laboratory Technologist III/II	H/J	1	2
Senior Laboratory Technician	J	0	4
Laboratory Technician II/I	G/H	2	6
Clerical Officer II/I/Snr	F/G/H	1	1
Office Administrative Assistant III/II	G/H/J	0	1
Driver III/II/I/Chief/Snr	D/E/F/G/H/J	0	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	1	2
SUB TOTAL R6		6	26

R7. GARISSA REGION

DESIGNATION	J/G	I/P	P/E
Chief Superintending Engineer	P	0	1
Chief Laboratory Technologist	M	0	1
Assistant Engineer II/I	K/L	0	1
Chemist	L	0	1
Physicist	L	0	1
Senior Laboratory Technologist	L	0	1
Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	0	2
Laboratory Technologist III/II	H/J	1	2
Senior Laboratory Technician	J	0	4
Laboratory Technician II/I	G/H	1	6
Clerical Officer II/I/Snr	F/G/H	0	1

Capacity Building and Knowledge Management Study of MTRD Kenya

Office Administrative Assistant III/II	G/H/J	0	1
Drivers	D/E/F/G/H/J	0	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	0	2
SUB TOTAL R7		2	26

R8. KAKAMEGA REGION

DESIGNATION	J/G	I/P	P/E
Chief Superintending Engineer	P	0	1
Chief Laboratory Technologist	M	0	1
Assistant Engineer II/I	K/L	0	1
Chemist	L	0	1
Physicist	L	0	1
Senior Laboratory Technologist	L	0	1
Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	1	2
Laboratory Technologist III/II	H/J	0	2
Senior Laboratory Technician	J	1	4
Laboratory Technician II/I	G/H	0	6
Clerical Officer II/I/Snr	F/G/H	1	1
Office Administrative Assistant III/II	G/H/J	0	1
Driver III/II/Chief/Snr	D/E/F/G/H	1	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	1	2
SUB TOTAL R8		5	26

R9. KISII REGION

DESIGNATION	J/G	I/P	P/E
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Capacity Building and Knowledge Management Study of MTRD Kenya

Senior Superintending Engineer	N	0	1
Senior Laboratory Technologist	L	1	1
Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	0	1
Laboratory Technologist III/II	H/J	0	2
Senior Laboratory Technician	J	0	2
Laboratory Technician II/I	G/H	2	2
Clerical Officer II/I/Snr	F/G/H	0	1
Office Administrative Assistant III/II	G/H/J	1	1
Drivers	D/E/F/G/H/J	2	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	2	1
SUB TOTAL R9		8	14

R10. BUNGOMA REGION

DESIGNATION	J/G	I/P	P/E
Senior Superintending Engineer	N	0	1
Senior Laboratory Technologist	L	0	1
Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	1	1
Laboratory Technologist III/II	H/J	0	2
Senior Laboratory Technician	J	1	2
Laboratory Technician II/I	G/H	1	2
Clerical Officer II/I/Snr	F/G/H	1	1
Office Administrative Assistant III/II	G/H/J	0	1
Drivers	D/E/F/G/H/J	1	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	1	1

SUB TOTAL R10		6	14
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R11. MACHAKOS REGION

DESIGNATION	J/G	I/P	P/E
Senior Superintending Engineer	N	0	1
Senior Laboratory Technologist	L	1	1
Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	0	1
Laboratory Technologist III/II	H/J	0	2
Senior Laboratory Technician	J	1	2
Laboratory Technician II/I	G/H	0	2
Clerical Officer II/I/Snr	F/G/H	0	1
Office Administrative Assistant III/II/I	G/H/J	0	1
Drivers	D/E/F/G/H/J	0	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	0	1
SUB TOTAL R11		2	14

R12. MURANG'A REGION

DESIGNATION	J/G	I/P	P/E
Senior Superintending Engineer	N	0	1
Senior Laboratory Technologist	L	0	1
Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	0	1
Laboratory Technologist III/II	H/J	0	2
Senior Laboratory Technician	J	0	2
Laboratory Technician II/I	G/H	1	2

Capacity Building and Knowledge Management Study of MTRD Kenya

Clerical Officer II/I/Snr	F/G/H	0	1
Office Administrative Assistant III/II	G/H/J	0	1
Drivers	D/E/F/G/H/J	0	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	0	1
SUB TOTAL R12		1	14

R13. KERUGOYA REGION

DESIGNATION	J/G	I/P	P/E
Senior Superintending Engineer	N	0	1
Senior Laboratory Technologist	L	1	1
Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	0	1
Laboratory Technologist III/II	H/J	0	2
Senior Laboratory Technician	J	0	2
Laboratory Technician II/I	G/H	0	2
Clerical Officer II/I/Snr	F/G/H	0	1
Office Administrative Assistant III/II	G/H/J	0	1
Drivers	D/E/F/G/H/J	0	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	0	1
SUB TOTAL R13		1	14

R14. KAPENGURIA REGION

DESIGNATION	J/G	I/P	P/E
Senior Superintending Engineer	N	0	1
Senior Laboratory Technologist	L	0	1
Laboratory Technologist I	K	0	1

Capacity Building and Knowledge Management Study of MTRD Kenya

Chief Laboratory Technician	K	0	1
Laboratory Technologist III/II	H/J	0	2
Senior Laboratory Technician	J	0	2
Laboratory Technician II/I	G/H	0	2
Clerical Officer II/I/Snr	F/G/H	0	1
Office Administrative Assistant III/II	G/H/J	0	1
Driver III/II/Chief/Snr	D/E/F/G/H	0	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	0	1
SUB TOTAL R14		0	14

R15. MARALAL REGION

DESIGNATION	J/G	I/P	P/E
Senior Superintending Engineer	N	0	1
Senior Laboratory Technologist	L	0	1
Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	0	1
Laboratory Technologist III/II	H/J	0	2
Senior Laboratory Technician	J	0	2
Laboratory Technician II/I	G/H	0	2
Clerical Officer II/I/Snr	F/G/H	0	1
Office Administrative Assistant III/II	G/H/J	0	1
Drivers	D/E/F/G/H/J	0	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	0	1
SUB TOTAL R15		0	14

R16. LAMU REGION

DESIGNATION	J/G	I/P	P/E
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Capacity Building and Knowledge Management Study of MTRD Kenya

Senior Superintending Engineer	N	0	1
Senior Laboratory Technologist	L	0	1
Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	0	1
Laboratory Technologist III/II	H/J	0	2
Senior Laboratory Technician	J	0	2
Laboratory Technician II/I	G/H	0	2
Clerical Officer II/I/Snr	F/G/H	0	1
Office Administrative Assistant III/II	G/H/J	0	1
Drivers	D/E/F/G/H/J	0	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	0	1
SUB TOTAL R16		0	14

R17. ISIOLO REGION

DESIGNATION	J/G	I/P	P/E
Senior Superintending Engineer	N	0	1
Senior Laboratory Technologist	L	0	1
Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	0	1
Laboratory Technologist III/II	H/J	0	2
Senior Laboratory Technician	J	0	2
Laboratory Technician II/I	G/H	0	2
Clerical Officer II/I/Snr	F/G/H	0	1
Office Administrative Assistant III/II	G/H/J	0	1
Drivers	D/E/F/G/H/J	0	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	0	1

SUB TOTAL R17		0	14
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R18. LODWAR REGION

DESIGNATION	J/G	I/P	P/E
Senior Superintending Engineer	N	0	1
Senior Laboratory Technologist	L	0	1
Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	0	1
Laboratory Technologist III/II	H/J	0	2
Senior Laboratory Technician	J	0	2
Laboratory Technician II/I	G/H	0	2
Clerical Officer II/I/Snr	F/G/H	0	1
Office Administrative Assistant III/II	G/H/J	0	1
Drivers	D/E/F/G/H/J	0	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	0	1
SUB TOTAL R18		0	14

R19. VOI REGION

DESIGNATION	J/G	I/P	P/E
Senior Superintending Engineer	N	0	1
Senior Laboratory Technologist	L	0	1
Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	0	1
Laboratory Technologist III/II	H/J	0	2
Senior Laboratory Technician	J	0	2
Laboratory Technician II/I	G/H	0	2
Clerical Officer II/I/Snr	F/G/H	0	1

Capacity Building and Knowledge Management Study of MTRD Kenya

Office Administrative Assistant III/II	G/H/J	0	1
Drivers	D/E/F/G/H/J	0	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	0	1
SUB TOTAL R19		0	14

R20. WAJIR REGION

DESIGNATION	J/G	I/P	P/E
Senior Superintending Engineer	N	0	1
Senior Laboratory Technologist	L	0	1
Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	0	1
Laboratory Technologist III/II	H/J	0	2
Senior Laboratory Technician	J	0	2
Laboratory Technician II/I	G/H	0	2
Clerical Officer II/I/Snr	F/G/H	0	1
Office Administrative Assistant III/II	G/H/J	0	1
Driver III/II/I/Chief/Snr	D/E/F/G/H	0	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	0	1
SUB TOTAL R20		0	14

R21. KITUI REGION

DESIGNATION	J/G	I/P	P/E
Senior Superintending Engineer	N	0	1
Senior Laboratory Technologist	L	0	1
Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	0	1
Laboratory Technologist III/II	H/J	0	2

Capacity Building and Knowledge Management Study of MTRD Kenya

Senior Laboratory Technician	J	0	2
Laboratory Technician II/I	G/H	0	2
Clerical Officer II/I/Snr	F/G/H	0	1
Office Administrative Assistant III/II	G/H/J	0	1
Driver III/II/I/Chief/Snr	D/E/F/G/H/J	0	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	0	1
SUB TOTAL R21		0	14

R22. MARSABIT REGION

DESIGNATION	J/G	I/P	P/E
Senior Superintending Engineer	N	0	1
Senior Laboratory Technologist	L	0	1
Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	0	1
Laboratory Technologist III/II	H/J	0	2
Senior Laboratory Technician	J	0	2
Laboratory Technician II/I	G/H	0	2
Clerical Officer II/I/Snr	F/G/H	0	1
Office Administrative Assistant III/II	G/H/J	0	1
Driver III/II/I/Chief/Snr	D/E/F/G/H	0	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	0	1
SUB TOTAL R22		0	14

R23. KAJIADO REGION

DESIGNATION	J/G	I/P	P/E
Senior Superintending Engineer	N	0	1
Senior Laboratory Technologist	L	0	1

Capacity Building and Knowledge Management Study of MTRD Kenya

Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	0	1
Laboratory Technologist III/II	H/J	0	2
Senior Laboratory Technician	J	0	2
Laboratory Technician II/I	G/H	0	2
Clerical Officer II/I/Snr	F/G/H	0	1
Office Administrative Assistant III/II	G/H/J	0	1
Drivers	D/E/F/G/H/J	0	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	0	1
SUB TOTAL R23		0	14

R24. NAROK REGION

DESIGNATION	J/G	I/P	P/E
Senior Superintending Engineer	N	0	1
Senior Laboratory Technologist	L	0	1
Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	0	1
Laboratory Technologist III/II	H/J	0	2
Senior Laboratory Technician	J	0	2
Laboratory Technician II/I	G/H	0	2
Clerical Officer II/I/Snr	F/G/H	0	1
Office Administrative Assistant III/II	G/H/J	0	1
Drivers	D/E/F/G/H/J	0	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	0	1
SUB TOTAL R24		0	14

R25. KERICHO REGION

DESIGNATION	J/G	I/P	P/E
Senior Superintending Engineer	N	0	1
Senior Laboratory Technologist	L	0	1
Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	0	1
Laboratory Technologist III/II	H/J	0	2
Senior Laboratory Technician	J	0	2
Laboratory Technician II/I	G/H	0	2
Clerical Officer II/I/Snr	F/G/H	0	1
Office Administrative Assistant III/II	G/H/J	0	1
Drivers	D/E/F/G/H/J	0	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	0	1
SUB TOTAL R25		0	14

R26. KABARNET REGION

DESIGNATION	J/G	I/P	P/E
Senior Superintending Engineer	N	0	1
Senior Laboratory Technologist	L	0	1
Laboratory Technologist I	K	0	1
Chief Laboratory Technician	K	0	1
Laboratory Technologist III/II	H/J	0	2
Senior Laboratory Technician	J	0	2
Laboratory Technician II/I	G/H	0	2
Clerical Officer II/I/Snr	F/G/H	0	1
Office Administrative Assistant III/II	G/H/J	0	1

Capacity Building and Knowledge Management Study of MTRD Kenya

Drivers	D/E/F/G/H/J	0	1
Support Staff /Cleaning Supervisors	A/B/C/D/E/F/G	0	1
SUB TOTAL R26		0	14
TOTAL		60	460

Annex D: Immediate Required Equipment List

PROPOSED EQUIPMENT FOR SUPPORT

1. BITUMEN LABORATORY

1. Rotary evaporator/vacuum viscometer
2. Distillation apparatus for Bitumen Emulsion
3. Automatic Marshall triple mechanical compactor with rotating base
4. Void content apparatus for coarse and fine aggregates
5. Analytical balance to 0.0001g
6. Pavement core drilling machine

2. CHEMISTRY LABORATORY

1. pH and Conductivity meter with ion selective electrodes
2. Turbidimeter
3. Furnace heating up to 1400°C
4. Hot plate (size 460 x 330)
5. Analytical weighing balance (accuracy 0.0001g)
6. ICP- MS Spectrometer
7. FT-IR spectrophotometer

3. CONCRETE LABORATORY

1. Compression and Flexural testing Machine for cement and concrete
2. Portable slump cone test set
3. Concrete mixer of 115 litres capacity
4. Concrete Cube moulds of 150 mm
5. Water bath with cooler unit
6. Tensile Testing Machine -

4. FOUNDATION/ DRILLING LABORATORY

1. Direct Shear machine
2. Consolidation apparatus (Odometer)
3. Hoek cell

5. PAINTS

1. Precision weighing balance (0.0001gms and 0.1gm)
2. Weighing balance (0.1gms)
3. Electric furnace (Temp. range 0—1400°C)
4. Retro-reflectometer for cat eyes (portable)
5. Retro-reflectometer for road signs (portable, gun)
6. Retro-reflectometer for road marking paints

6. PHYSICS

1. Steel rebar locator
2. Survey meter for X- Ray, Beta and Gamma Radiation Detection
3. Heavy duty bench type Pillar drilling machine
4. Force calibration

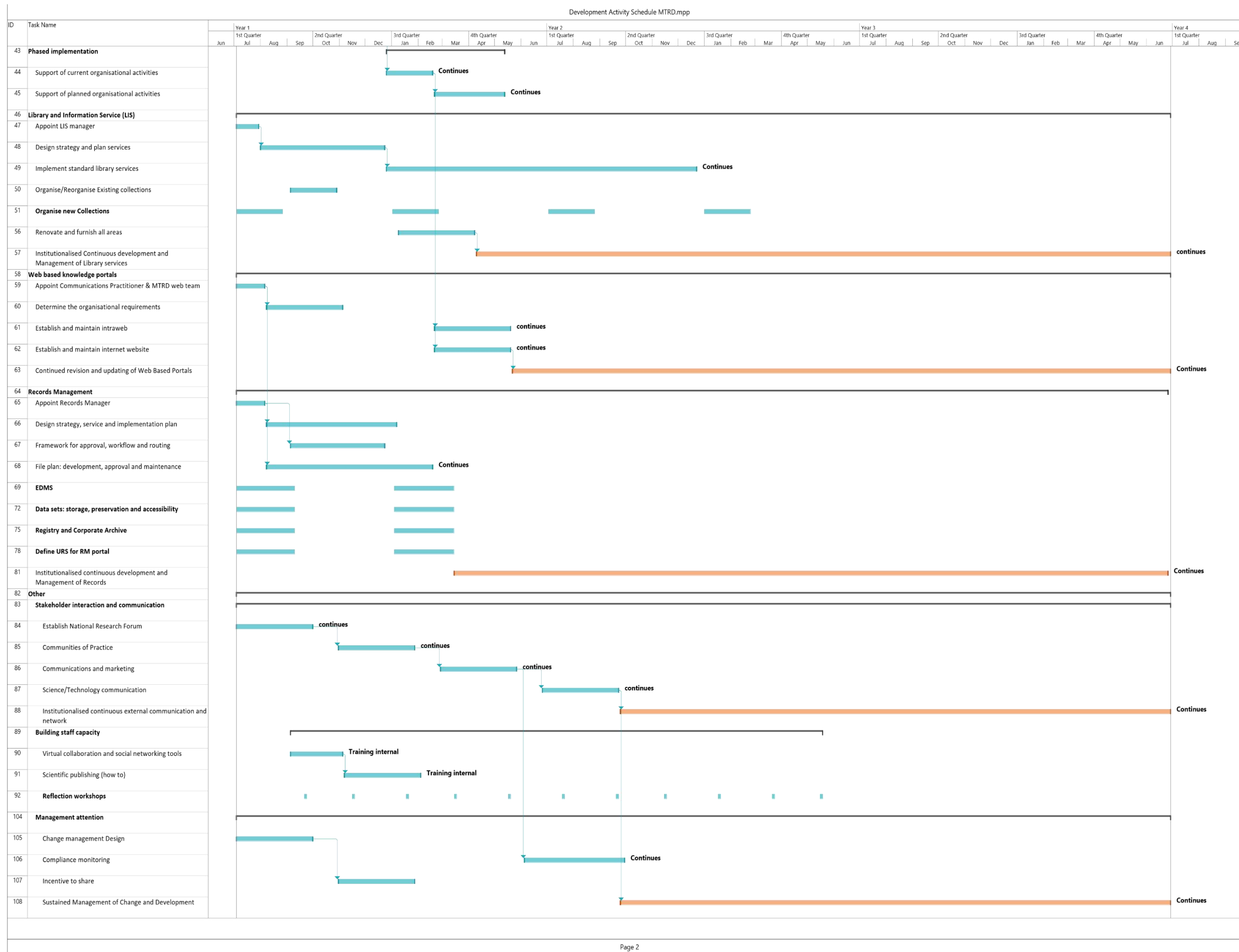
7. SOILS

1. Automatic Soil compactors (complete with all accessories)
2. Digital Universal tests for CBR and UCS
3. Digital Cone penetrometers
4. Electronic Heavy duty Sieve shakers complete with sieves

8. REGIONAL LABORATORIES

1. Aggregate Impact Value testing machine
2. Balances (Electronic of assorted accuracy e.g. 0.0001g, 0.01g, 0.1g, up to 20kg)
3. Bitumen recycler
4. Buoyancy balance 6000gx0.1g supplied complete with frame water tank and suspension hook for 220-240VAC,50-60Hz,1pH
5. Centrifuge extractor–for Bitumen extraction
6. Chippings spread/ spray rate apparatus
7. Cone penetrometer (digital)
8. Core cutter and barrels
9. Field thermometers
10. Moulds with rammers (A/C, CBR, UCS, PRD, Concrete cube, Proctor)
11. Oven capacity 225 litres, with temperature up to 200°C display
12. Schmidt hammer
13. Sieves 200mm diameter (assorted)
14. Sieve shaker (mechanical)
15. Specific gravity Frame for coarse aggregates
16. Universal testing Machine for CBR and UCS with dial gauges
17. Vibrating Hammer
18. Water bath

Annex E: Schedule of Development Activities
Combined Capacity Building and Knowledge Management



Annex F: Financial Estimate

COST OVERVIEW

MON 04/07/16 FRI 28/06/19

COST

£10,056,640.00

REMAINING COST

£10,056,640.00

% COMPLETE

0%

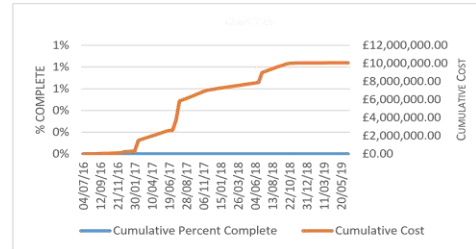
COST STATUS

Cost status for top level tasks.

Name	Actual Cost	Remaining Cost	Baseline Cost	Cost	Cost Variance
Institutional Reform To National Roads Research and Testing Agency	£0.00	£500,000.00	£0.00	£500,000.00	£500,000.00
Develop Appropriate Facilities	£0.00	£2,459,000.00	£0.00	£2,459,000.00	£2,459,000.00
Establish appropriate Agency Equipment	£0.00	£5,655,000.00	£0.00	£5,655,000.00	£5,655,000.00
Build Staffing Capacity	£0.00	£1,040,500.00	£0.00	£1,040,500.00	£1,040,500.00
Content management solution including ICT capacity	£0.00	£76,200.00	£0.00	£76,200.00	£76,200.00
Phased implementation	£0.00	£11,000.00	£0.00	£11,000.00	£11,000.00
Library and Information Service (LIS)	£0.00	£29,300.00	£0.00	£29,300.00	£29,300.00
Web based knowledge portals	£0.00	£105,200.00	£0.00	£105,200.00	£105,200.00
Records Management	£0.00	£22,440.00	£0.00	£22,440.00	£22,440.00
Other	£0.00	£158,000.00	£0.00	£158,000.00	£158,000.00

PROGRESS VERSUS COST

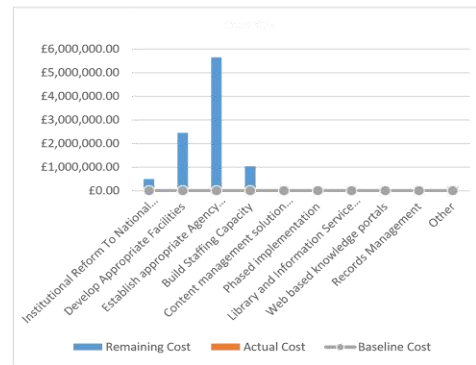
Progress made versus the cost spent over time. If % Complete line below the cumulative cost line, your project may be over budget.



COST STATUS

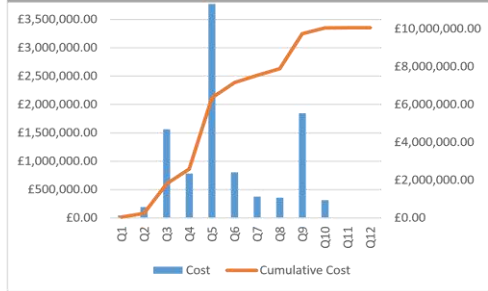
Cost status for all top-level tasks. Is your baseline zero?

[Try setting as baseline](#)



CASH FLOW

Actual Cost	Baseline Cost	Remaining Cost	Cost Variance
£0.00	£0.00	£10,056,640.00	£10,056,640.00



Name	Remaining Cost	Actual Cost	Cost	ACWP	BCWP	BCWS
Institutional Reform To National Roads Research and Testing Agency	£500,000.00	£0.00	£500,000.00	£0.00	£0.00	£0.00
Develop Appropriate Facilities	£2,459,000.00	£0.00	£2,459,000.00	£0.00	£0.00	£0.00
Establish appropriate Agency Equipment	£5,655,000.00	£0.00	£5,655,000.00	£0.00	£0.00	£0.00
Build Staffing Capacity	£1,040,500.00	£0.00	£1,040,500.00	£0.00	£0.00	£0.00
Content management solution including ICT capacity	£76,200.00	£0.00	£76,200.00	£0.00	£0.00	£0.00
Phased implementation	£11,000.00	£0.00	£11,000.00	£0.00	£0.00	£0.00
Library and Information Service (LIS)	£29,300.00	£0.00	£29,300.00	£0.00	£0.00	£0.00
Web based knowledge portals	£105,200.00	£0.00	£105,200.00	£0.00	£0.00	£0.00
Records Management	£22,440.00	£0.00	£22,440.00	£0.00	£0.00	£0.00
Other	£158,000.00	£0.00	£158,000.00	£0.00	£0.00	£0.00

Annex G: Library and Information Services

Library and information services associated with research centres normally range between the following three options:

- Traditional library service focussed on the library as a structured information and documentation management and storage facility providing “just-in-case” and reactive information services
- A hybrid service where the library not only provides the traditional services but also participates in the information access and retrieval as well as the knowledge management and preservation activities of its user
- A fully digitised platform for innovation, embedded in the activities of the research centre and focussed on pro-active support

Whereas the three options mentioned above should be seen as markers on a sliding scale the final choice of library and information service will be determined by user requirements, the funding available as well as the associated infrastructure. Taking into consideration the current and future activities of the Division as well as the infrastructure available the hybrid information service will in all probability be the option that would be most useful. It is therefore this option which is planned for in more detail below.

Service streams

As the LIS will be required to provide thought leadership and services in matters directly linked to its **mandate**, it is import for the management structures of the Division to, as a first step, confirm the mandate of the LIS. It is foreseen that the LIS will support and enable the Division through the provision of relevant information and knowledge management services that allow access to information, facilitate knowledge creation and sharing, and contribute to the preservation of the organisation's intellectual assets. If that is the case, the activities of the LIS should be structured around four core service streams:

Service stream 1: Negotiating and providing access to reliable information resources (both commercial and open access content) through subscription, document ordering and inter library loan services

Researchers typically require access to the primary published literature in their field. To ensure efficiency, simultaneous access and ease of retrieval it is advised that the information resources strategy should focus on the acquisition of electronic products. In general the acquisition policy should consider commercially available information resources (i.e. electronic journal platforms and databases; standalone journals; books, standards³⁰; conference proceedings and publications from professional societies) as well as open access resources (i.e. portals and report collections from other research organisations and government agencies; technical specifications; datasets; codes of practice; and publications from aid organisations). Ideally, access to these LIS resources should be provided through a well-planned and structured **library portal** or alternatively an Online Public Access Catalogue (**OPAC**). Standard library technical services to manage these collections, such as acquisitions, inter library loan services, lending and circulation, cataloguing and indexing will be

³⁰ The Division uses Kenyan Standards (KS), British Standards (BS), American standards (AASHTO and ASTM), South Africa (SANS), Japanese (JS) and Indian (IS) and Regional Standards i.e. East African (EAS), European Union (EN), and International Standards (ISO).

required. These services are generally provided through an online **Library Management System (LMS)** which make use of the ICT infrastructure, electronic delivery mechanisms and associated work flow processes. (More details on the LMS are provided under the [LIS infrastructure](#) heading below.)

Price negotiation should consider the most efficient and cost-effective way of delivering commercially available information resources and high quality services. In this regard the Division will benefit from participation in existing national and international library consortia which negotiate access to commercially available information resources on behalf of its members. As a start joining the following consortia should be considered:

- **Kenya Library and Information Services Consortium (KLISC).** KLISC was established in 2003 with the main objective of collective subscription to electronic resources to cope with the increasing cost of information resources. It draws its membership from university libraries, research institutions and public/national Libraries.
- **International Network for the Availability of Scientific Publications (INASP).** INASP is an international development charity working with a global network of partners to improve access, production and use of research information and knowledge. It negotiates with international publishers to secure national licenses on behalf of library consortia for free or significantly discounted online access to journals and books.
- **Electronic Information for Libraries (EIFL).** EIFL works with libraries to enable access to knowledge for education, learning, research and sustainable community development

In the interim, until the LIS is in the position to provide access to the proposed electronic resources, corporate membership of the library of the University of Nairobi should be negotiated. Such membership will allow MTRD visitors access to the paper and electronic resources (e-books and e-journals) of the University library during staffed service hours. This should not be seen as a long term solution as remote access, e.g. from the MTRD offices, to the University's electronic resources is not permitted due to license agreements with electronic resources vendors.

Given the context of the research focus areas information, both commercially available and open access resources, may be sourced in paper format but provision should be made to transfer pertinent items to electronic format so that the items could be made available to multiples users (research staff and clients) simultaneously. This does not negate the need to ensure ethical conduct and adherence to international copyright law.

The LIS will be required to maintain a **grey literature collection** consisting of relevant reports and publications from other MOTIHUD divisions and agencies as well as national, regional and international research centres. (This includes roads pavement information that is supposed to be transferred to MTRD from the roads agencies.). The collection should be restricted to publications which cannot be sourced from the websites of these organisations or through conventional channels such as publishers. Agreements with these agencies should be put into place to ensure that publications relevant to MTRD staff are received regularly. Currently the grey literature collection is in disarray and it is important to ensure the indexing and archiving of the current collection of reports from other MOTIHUD agencies as, in many cases, these are the only remaining copies within the Ministry. (Many report collections were abandoned when the organisational structure of the Ministry was changed in 2007.) Policies, procedures, guidelines and training need to be put in place to develop

a suitable database and to fast track the organisation of the grey literature collection. Aspects to consider include:

- Review and define the existing grey literature collection to determine and define:
 - report categories
 - report value in terms of retention or disposal
- Assess the adequacy of existing storage capacity and improve if needed
- Establish an electronic database and implement metadata and indexing standards
- Manage paper copies in a suitable environment. Climate control of storage spaces in terms of humidity and dust should be considered. Due to the high cost associated with conversion of paper records to electronic format, scanning of pertinent records should be done on demand only
- Consider collection gaps. Appeal to MTRD staff to return all reports in their possession, especially reports related to geological foundations
- Provide electronic access to the grey literature database through the library portal
- Establish policy and procedures for future collections and collection development
- See what is available elsewhere, e.g. at MOTIHUD or Authorities. In light of future collaboration a centralised database for the Ministry should be investigated at a later stage. However, intellectual ownership of all reports should remain that of the individual institution.

Service stream 2: Information specialist intermediary services focussed on the detailed scientific, business and management information requirements of the staff as well as user enablement through training

The practices of information specialists are far removed from traditional collection management roles as they adopt a much more proactive approach, working in partnership with their user communities. Information specialists are frequently involved in aiding researchers as they navigate information resources. This aid is often at the information seeking stage, when researchers have difficulty tracking down references, or need expert help formulating search strategies³¹. They understand and speak the language of the subject areas they support. They often take up an embedded position where support is required and operate as consultants to identify and solve problems, and trainers to improve skills and understanding. Better links with clients will help the Information Centre to position itself in a changing environment, to take advantage of new opportunities, and to respond to researchers' evolving needs and behaviours³².

Value-added information services should be provided to Division staff on both a pro-active and reactive basis. The information specialist will be responsible for building and maintaining relationships with the various operational units to ensure continued awareness of researchers' information related needs as well as to improve service delivery. Supporting services offered should focus on the retrieval of published information, current awareness and alerting services, management of personal information collections through reference management programmes, assistance with the publication of research outputs as well as measuring and monitoring of research impact.

The enablement of researchers through training in the use of electronic information resources as well as the critical evaluation and selection of authoritative information resources should be prioritised.

³¹ Shorish Y. 2015. The library as research partner. *ACRL TechConnect Blog*, 23 Nov.

³² Research Information Network (RIN) and Research Libraries UK (RLUK). 2011. *The value of libraries for research and researchers: a RIN RLUK report*.

Involving product suppliers as expert trainers as well as capitalising on the available on-line training material should be considered.

Service stream 3: Preserving and making accessible (both internally as well as externally to the organisation) the intellectual property created by the MTRD.

Services should focus on the management of research records. Policies and procedures should be established to allow for the systematic and reliable collection and management of internally generated information.

The LIS will ensure that all MTRD generated research publications are collected, captured, managed, preserved and made accessible based on acceptable meta-data standards and according to MTRD policies and procedures. It will establish and maintain the [research outputs database](#) which will act as a repository for all research and consultancy project outputs and related material such as MTRD project proposals, progress reports, research and consultancy reports, safety documents, laboratory reports, technical manuals as well as information published externally by MTRD staff, e.g. conferences papers and posters, journal articles, books, chapters in books and training material. A suitable database platform should be deployed with automated routing/approval procedures in support of document submittal. Once the required infrastructure is put into place, indexing of backlog documents should be prioritised. Procedures also need to be established to fast track the organisation of the MTRD reports collection. Aspects to consider include:

- The report collection should be sorted to determine publication categories.
- Storage space should be evaluated and upgraded if required. To ensure long term preservation of paper copies climate and access control will be necessary.
- A basic index to the collection exists in the form of a paper register which is used to allocate MTRD publication numbers. This register should form the basis of the proposed research outputs database. The database will require suitable software and the establishment of metadata and indexing standards. As an interim measure, until suitable database software is available, the paper register should be converted into an electronic index to enable search and retrieval. The electronic index can be created using available software, e.g. Excel or any other software that will allow the records to be exported to the future database in ASCII or CSV format. (More details on the required database software are provided under the LIS infrastructure heading below.)
- To optimise storage space the existing collection should be organised and shelved according to the electronic index.
- The paper register (or the electronic index, once it is created) should be used to establish collection gaps as many documents/reports for which publication numbers were issued were not submitted to the library. Collection gaps could be minimised by recalling reports currently residing in the various laboratories and offices or on the file servers. As the long term archival of electronic records is still problematic it is advisable to (also) store paper copies. Due to the high cost associated with the conversion of paper records to electronic format, scanning of pertinent records should be done on demand only.
- Electronic access to the research outputs database should be provided through the library portal.
- Policy and procedures for future collections should be established.

Date	Report No.	Subject	Prepared by	Section	Status	No. of Copies
24/11/13	1229	Research Tools Section - Kenya Road (0577) Income Monitoring Report	Dr. Mwangi	Research	Done	1
24/11/13	1230	Geotechnical Report for Prosper Apartments in Meru	I. Njuganangi	FSD	Done	1
12/11/13	1231	Geotechnical Investigation Final Report for Prosper Apartments in Meru River	I. Njuganangi	FSD	Done	1

Figure 22: Paper registry currently used to allocate MTRD publication numbers

Metadata of selected publications captured in the research outputs database should be exported to a web-based [institutional repository](#) through which MTRD publications can be made accessible to external stakeholders. The LIS will be responsible for the establishment and maintenance of the institutional repository. Through routing processes newly produced research output can be added to the repository on a continuous basis. The repository should categorise research publications into logical collections and topics of interest and should include (but not be limited to):

- selected non-confidential MTRD research reports and research data
- publisher approved versions of external publications (journal articles, book and book chapters, conference papers) authored by MTRD staff
- manuals, guidelines, standards and/or specifications as well as amendments thereto
- research outputs transformed into targeted information products such as technical and policy briefs
- annual reports and other stakeholder reports

The following steps are required to establish an institutional repository:

- Identify suitable institutional repository software based on desired functionality that will be compatible with the ICT infrastructure. Consultation with similar established services is advisable. (Both KLISC and INASP provide support to libraries wishing to develop their own institutional repositories in line with international standards. The University of Nairobi has also successfully established an institutional repository and should therefore be able to provide guidance in this regard.)
- Installation of software and a trial project to identify problem areas especially in terms of the routing, editing and deletion as well as statistical records.
- Establish work flows, policies and procedures and assign roles & responsibilities in terms of submissions and final approval, mapping to collections, embargo periods and version control.
- Branding options in terms of a collaborative repository is essential.

Service stream 4: Facilitation of knowledge exchange, scientific interaction and networking within the organisation through dedicated spaces where staff and external stakeholders can interact on both a formal and informal basis.

The library area should provide the three types of [knowledge spaces](#) where staff can meet, think together, have conversations and dialogues, collaborate and promote science and research not only within MTRD, but also within their networks and across organisational boundaries. LIS staff will be responsible for the conceptualisation, planning, and implementation of an **events plan** and talks, lectures and presentations by MTRD staff and external speakers should be scheduled on a regular basis. Topics can typically vary between those with a strictly work related focus and those with a more general or actuality theme.

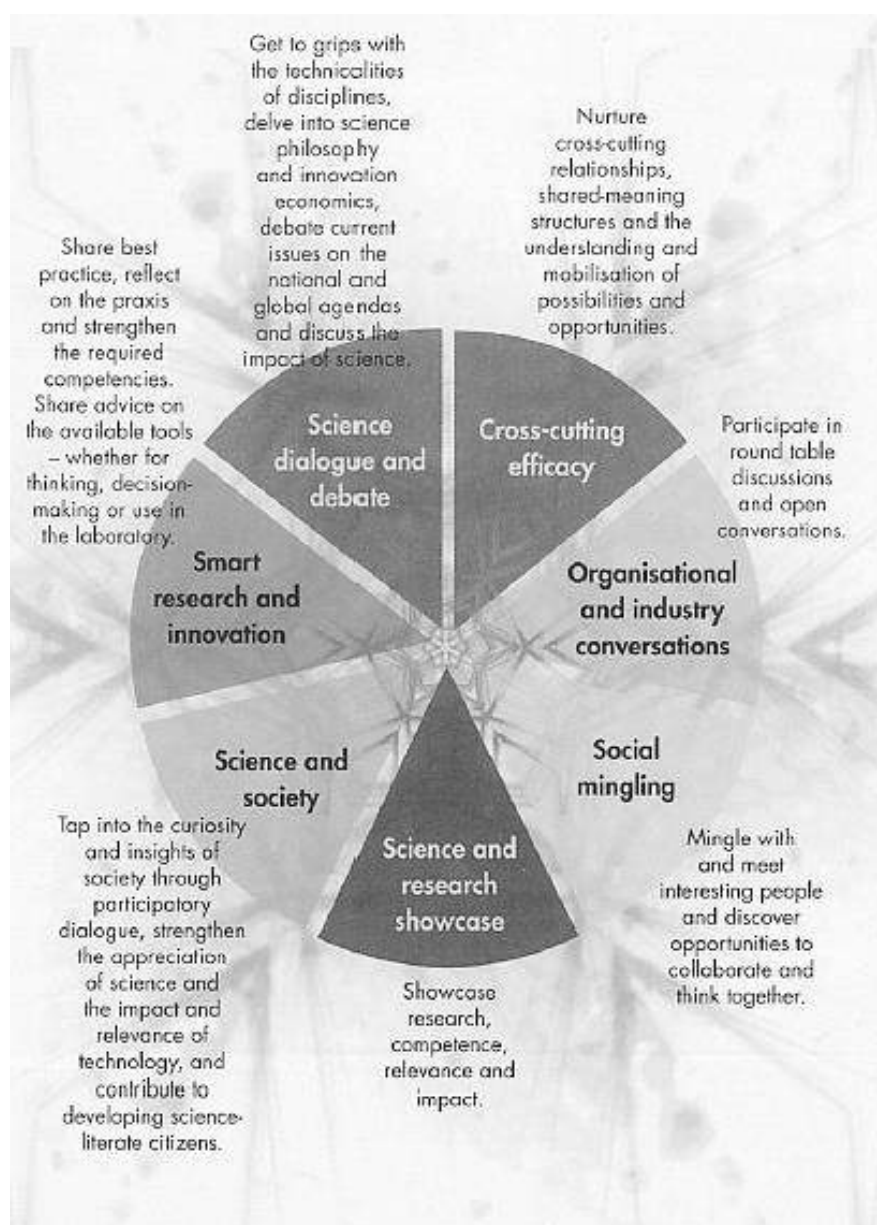


Figure 23: Example of events types that could be considered as part of the events plan (Source: CSIR Knowledge Commons pamphlet)

Details of the physical spaces proposed are provided under the LIS infrastructure heading below.

Human resources

For an organisation the size of the envisaged CoE and to support the proposed four service streams, it is estimated that the LIS will require a minimum of 5 full time staff members with key tasks as discussed below.

LIS manager:

- Conceptualise and establish the service and necessary infrastructure, systems, policies and procedures
- Recruit and manage the staff compliment
- Negotiate access to electronic information resources, preferably through consortium participation
- Strategically direct the operational aspects of archival activities at organisational level and oversee record management activities
- Develop and lead knowledge management programmes that encourage innovation and the promotion of a culture of knowledge sharing, dialogue and science communication
- Manage relationships with several key stakeholders and suppliers

Information resources specialist:

- Manage and ensure that electronic and paper-based resources are readily accessible to all staff
- Provide specialist guidance to the Division in terms of the availability of commercial and open access information products and their content
- Maintain the library portal
- Catalogue/make accessible commercial monographs (books), journals and multi-media library material according to international standards

Information specialist:

- Empower line staff through training in the use of electronic information resources as well as the critical evaluation and selection of authoritative information resources
- Advise research staff on the international requirements linked to research data management
- Liaise with clients regarding their information requirements and translating this into suitable search strategies that allow for accurate retrieval of relevant information on the subjects. Search results are evaluated before compilation into literature review reports.
- Provide selective alerting services to enable researchers to stay abreast of the latest developments in their areas of specialisation
- Build and maintain relationships with the Division units to ensure continued awareness of researchers' needs as well as to improve service delivery

Librarians (x2):

- Provide routine library technical services such as document delivery, inter library loans, circulation services and shelving
- Index the data and documented research output of the Division through analyses and extraction of relevant metadata so that these could be captured reliably in the research outputs
- Populate the web-based institutional repository with selected internal (as well as external publications) and ensure that copyright requirements are adhered to
- Index and Manage the grey literature collection.

The final staff equivalent, responsibilities, qualifications and skill levels will however be determined by the service solution implemented. This should be finalised as an action under the LIS implementation plan.

As the LIS strategy would need to focus on electronic products and systems for both items created internally and items sourced from outside the organisation, it is advisable to contract-in the services of an experienced systems librarian during the inception phase to assist the manager with the design and implementation of the required library systems. In addition cloud based solutions could be considered. The LIS will be highly reliant on the Division's ICT department for both system support and the implementation and development of services. Cloud services will, in the longer term, require a lower ICT skills set within the organisation.

Due to the state of the collections and the backlog of reports the volume of work will initially be beyond the capacity of the proposed staff equivalent and interim expert assistance will be required. Spare capacity should be sourced from either other units within the Division or from external contractors. The appointment of newly qualified professionals as LIS interns should also be considered as a solution.

Continuous skills development of LIS staff should be included in the general capacity building initiatives of the Division. Should the required skills not be available at the start of the implementation phase a fast-track staff development programme should be prioritised. Training offered by professional associations such as the Kenya Library Association (KLA) should be considered as well as external attachment/secondment programmes to libraries from local universities such as the University of Nairobi and international research organisations.

Infrastructure

There is a bare minimum infrastructure essential to ensure that a library and information service is possible no matter what the size of the client grouping is. To support the proposed service streams the infrastructure needs to make provision for access to the internet with sufficient bandwidth and a reliable supply of electricity is an essential prerequisite for a sustainable service.

As both externally acquired information resources as well as research publications generated internally by the Division need to be managed and made accessible to staff and external stakeholders, functionality provided by the following systems will be required:

Library Management System: Externally acquired information resources (such as books, standalone journals, electronic journal platforms and databases, standards and technical specifications, conference proceedings and publications from professional societies, other research organisations and government agencies) managed by the LIS will need to be organised and made accessible to staff. This will require the functionality provided by a Library Management System (LMS). To operate effectively the library will require an integrated LMS which comprises a relational database, software to interact with that database, and graphical user interfaces for patrons and library staff. Functionality offered by an LMS includes as a minimum acquisitions (ordering and receiving materials), library network services (borrowing from and supplying material to peer institutions nationally and internationally), cataloguing (classifying and indexing materials), circulation (lending materials to patrons), serials management (tracking journal holdings) and access functionality (library portal/user interface).

Both proprietary and open source systems are available, ranging from standalone library systems (e.g. InMagic Presto or STAR) to internationally shared library management applications (e.g. Polaris or Apollo) and services built on cloud-based platforms (e.g. WorldShare, Alma or Sierra). A cloud-based platform will be the preferred option especially if experienced ICT staff is not readily available to provide support to the LIS staff. These platforms could however be expensive. Should adequate ICT support be available, a cheaper option will be the implementation of Koha, an Open Source integrated LMS.

Should an integrated LMS not be implemented, individual manual systems will have to be put in place to address the standard library technical services. This is not the ideal but as an interim measure the following systems can be implemented at very little cost:

- Ordering and receiving materials: A Microsoft Excel spreadsheet used in conjunction with the Division's existing financial system
- Library network services: Negotiate external service provision, e.g. by the University of Nairobi
- Cataloguing: Use a relational database, e.g. Microsoft Access or Q&A
- Circulation: A Microsoft Access database could be used
- Serials management: A Microsoft Excel spreadsheet will provide the minimum functionality required
- LIS resources and services user interface (library portal): Free versions of blog software, e.g. WordPress or Drupal

Databases: Database functionality will be required to manage the grey literature collection consisting of relevant reports and publications from other MOTIHU agencies as well as national, regional and international research centres. It will also be required for the management of the Division's research outputs database. It should be noted that many LMS now offer single platforms for the integrated management of different information collections, including closed/confidential collections such as the research outputs collection. The implementation of such a LMS will allow the Division to manage its library collections, the grey literature collection as well as the confidential research outputs database within a single application. If an integrated LMS will not be implemented a standalone library system like InMagic Presto will also provide the required database functionality. Alternatively a relational database such as Microsoft Access or Q&A could be used.

Institutional repository software³³: An institutional repository³³ is a web-based database intended to provide access to scholarly material which is institutionally defined; cumulative and perpetual; and open and interoperable³⁴. Software (e.g. DSpace, EPrint, Fedora, Islandora) providing the following functionality should be considered:

- Technical: ICT Infrastructure, including hardware, software
- Front-end design for ease of use
- Content organisation and control
- Content discovery
- Publication tools
- Reporting

³³ Open Society Institute. 2004. *A guide to institutional repository software*.
http://www.budapestopenaccessinitiative.org/pdf/OSI_Guide_to_IR_Software_v3.pdf.

³⁴ Ware M. 2004. *Pathfinder research on web-based repositories: final report*.
<http://www.markwareconsulting.com/wordpress/wp-content/uploads/2008/12/pals-report-on-institutional-repositories.pdf>

- Multimedia support
- Social features and notifications
- Interoperability
- Authentication
- Accessibility including metadata (e.g. Dublin core) standards support
- Preservation

Although the institutional software mentioned above is Open Source, implementation will require substantial support from the ICT unit. Implementation of institutional repository software, however, allows the content of the repository to be harvested by other sector electronic repositories such as the ReCAP Rural Access Library³⁵. (AFCAP's knowledge management strategy³⁶ focuses, among others, on the improvement of access to and dissemination of rural road and transport services research evidence. It is for this purpose that the freely accessible ReCAP Rural Access Library has been put in place.)

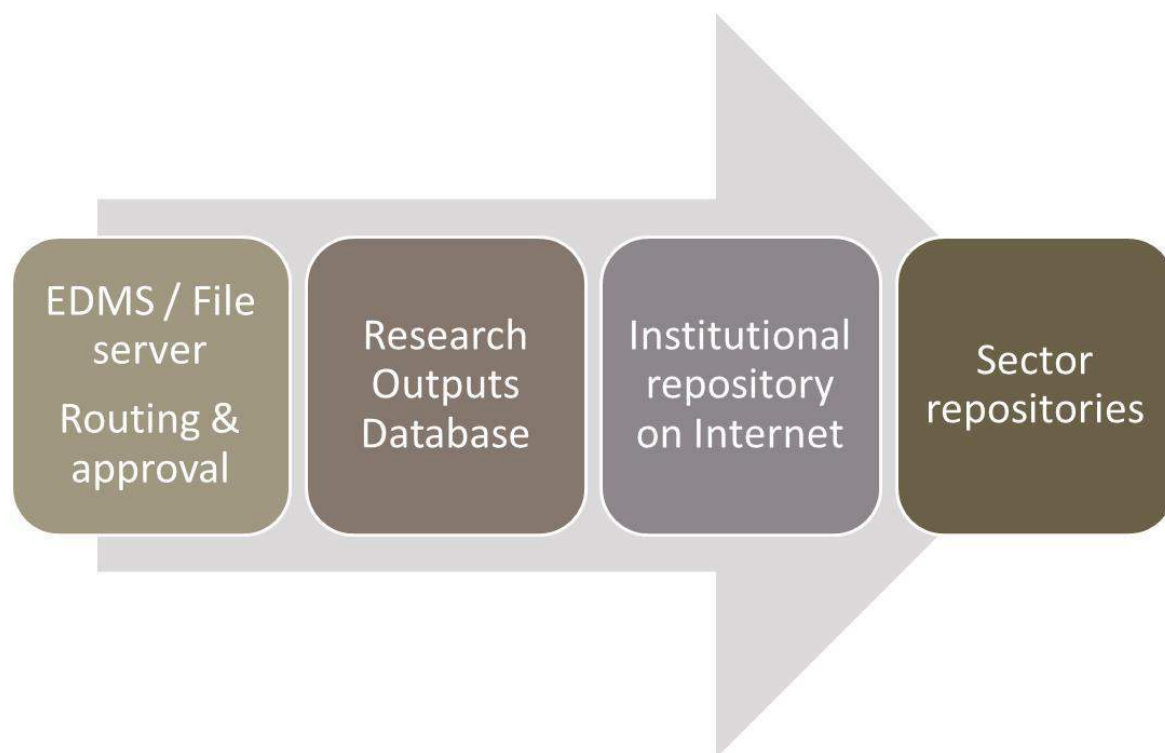


Figure 24: MTRD publication workflow

A less ideal option would be to use searchable internet website / blog software, e.g. WordPress, to create subject categories with alphabetical publication lists and additional metadata.

Various physical spaces required by knowledge workers and LIS staff, including:

- Office space for the information centre staff
- Storage facilities with appropriate shelving for the library, research publications and grey literature collections
- A library reading area with work stations and study cubicles

³⁵ www.research4cap.org

³⁶ *ReCAP Knowledge Management and Communications Strategy*. Sep 2015. Cardno Emerging Markets (UK).

- An auditorium, a conference room as well as a smaller meeting room
- A small social area to encourage Divisional staff interaction and informal knowledge exchange. If possible the social area should include a small coffee shop / restaurant / staff canteen.

Existing floor areas in the main MTRD building will have to be utilised for the spaces mentioned above. It is proposed that the following two areas are used:

- Current library area: At present the library occupies an area of approximately 358m² on the first floor of the main MTRD building. This floor space will be adequate to host the MTRD research outputs collection as well as the grey literature collection. Storage space should be evaluated and upgraded if required although it is estimated that the existing shelves will be sufficient for the current collections. As the collections grow the shelves could be replaced with a compact shelving solution. To ensure long term preservation of the paper records climate and access control will be necessary. The available office space could be occupied by a portion of the LIS staff, e.g. the LIS manager and the two librarians responsible for the maintenance of the research outputs and grey literature collections.
- Larger vacant area on the ground floor: Some additional room will be required for the library collection as well as for the proposed knowledge spaces. At present there is available a large area on the ground floor (m² not available at the time of writing this report) which is occasionally utilised for training purposes. At some stage it also served as staff canteen. This area could be repurposed to host the library and the knowledge spaces.

As information resources should as far as possible be provided in electronic format, the physical library collection will not occupy a significant portion of the floor area. It should however make provision for newspapers and some paper resources. A library reading area with work stations and, if space allows, study cubicles, should also be provided. LIS staff members directly responsible for interaction with MTRD staff (i.e. the resources specialist and the information specialist) will require office space here.

The remainder of the area should be dedicated to the knowledge spaces. A fully functional auditorium might not be feasible initially and it is proposed that a less formal staff meeting area is provided instead. This could be combined with the proposed canteen to also function as a social area. Any remaining space could be utilised for conference and/or meeting rooms. The facility should be well equipped and have a welcoming ambiance to encourage usage and to facilitate knowledge exchange, scientific interaction and networking. As staff needs will vary from time to time, these areas should ensure flexibility through the use of modular furniture. Spaces should also be equipped with appropriate audio visual and video conferencing equipment to allow the venues to be multifunctional.

Recommendation: It is recommended that the services of an architect are obtained to ensure optimal usage of the various physical spaces.

Computers, office and audio visual equipment: Standard equipment required will include furniture and computers for staff offices and reading areas; a printer/scanner/photocopier; and audio visual equipment for the conference/meeting areas.

Finances

Sustainable funding will in all probability be the most important resource to negotiate. Access to reliable information resources is expensive and ongoing (although Kenya is eligible to several very good discounts through initiatives from organisations such as EIFL and INASP as well as active library consortia) and access has to be dependable. In larger institutions the usual library maintenance formula for funding is 50% for resources and 50% for HR costs. In this case the above will in all probability not provide sufficient sustainable funding. It will be of little use if single year electronic subscriptions are purchased and hence both archives and access licences need to be taken into consideration as a continuous cost/investment. Similarly the itemised annual budget would need to make provision for a library system licence as well as a maintenance agreement.

As mentioned above, there is a bare minimum infrastructure essential to ensure that a library service is possible no matter what the size of the client grouping is. Once the infrastructure has been put in place there usually are no (or very little) additional costs to further expand the client grouping. It is essential to decide up front whether the clients to be served will be employed from a number of different, independent institutions (e.g. From other MOTIHUD divisions) or affiliated with only one institution as this aspect has serious implications on the access licences to be negotiated.

The high level LIS implementation plan is provided below.

Library & Information Service (LIS)	Year 1												Year 2												Year 3											
	Q1			Q2			Q3			Q4			Q1			Q2			Q3			Q4			Q1			Q2			Q3			Q4		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Confirm mandate of LIS & appoint LIS manager	■																																			
Design strategy & plan services																																				
Establish services & collection policies		■	■	■	■																															
Review required ICT infrastructure				■	■	■																														
Determine final staff equivalent and skills				■	■	■																														
Plan & upgrade physical spaces				■	■	■																														
Implement standard library services																																				
Appointment of LIS team				■	■	■																														
URS of LMS & implementation				■	■	■																														
Library collection & subscription development				■	■	■																														
Library portal (User interface for all services)				■	■	■																														
Databases (Grey literature, Research Outputs, Institutional Repository)																																				
Grey literature database																																				
Define collection: retention, acquisition, access procedures				■	■	■																														
URS of database (incl required metadata standards) and implementation				■	■	■																														
Address collection backlog				■	■	■																														
Future collections: Collection & subscription development				■	■	■																														
Research Outputs Database																																				
Define collection: retention, acquisition, access procedures				■	■	■																														
URS of database (incl required metadata standards) and implementation				■	■	■																														
Address collection backlog				■	■	■																														
Future collections				■	■	■																														
Define work flow / routing procedures				■	■	■																														
Collection development: ongoing data capturing and collection shelving				■	■	■																														
Institutional Repository (subset of Research Outputs Database)																																				
Define collection & work flow procedures				■	■	■																														
URS of IR (incl required metadata standards) and implementation				■	■	■																														
Select suitable items from existing collections				■	■	■																														
Collection development: ongoing population of IR				■	■	■																														
Furnish & equip all LIS spaces																																				

Legend	
Planning & implementation activities	■
Ongoing / routine activities after implementation	■
Comprehensive content management solution, input required	■

Annex I: Other International Models to Compare too

CSIR South Africa Model

The CSIR is one of the leading scientific and technology research, development and implementation organisations in Africa. Constituted by an Act of Parliament in 1945 as a science council, the CSIR undertakes directed and multidisciplinary research, technological innovation as well as industrial and scientific development to improve the quality of life of the country's people.

The CSIR is committed to supporting innovation in South Africa to improve national competitiveness in the global economy. Science and technology services and solutions are provided in support of various stakeholders, and opportunities are identified where new technologies can be further developed and exploited in the private and public sectors for commercial and social benefit.

The CSIR's main shareholder is the South African Parliament, held in proxy by the Minister of Science and Technology. The CSIR receives an annual grant from Parliament, through the Department of Science and Technology (DST), which accounts for close to 40% of its total income. The remainder is generated from research contracts with government departments at national, provincial and municipal levels, the private sector and research funding agencies in South Africa and abroad. Additional income is derived from royalties, licences and dividends from IP management and commercial companies created by the CSIR. The parliamentary grant is focused on the knowledge base and facilities in the CSIR to ensure these stay at the leading edge of technological development. It is invested in developing new areas of expertise, undertaking 'pre-competitive' research too risky for the private sector to fund and for training young researchers.

The CSIR liaises closely with tertiary education institutions. With a strong emphasis on relevant and developmental work, it also has strong roots in various communities, and collaborates with a wide range of donors and funding agencies.

ARRB Model (Australia)

The Australian Road Research Board was formed in 1960 and incorporated as a private limited fully commercial company in 1965. ARRB Group Ltd (ARRB) provides research, consulting and information services to the road and transport industry. ARRB applies research outputs to develop equipment that collects road and traffic information, and software that assists with decision-making across road networks. ARRB is the leading provider of road research and best practice workshops in Australia.

ARRB's member organisations include federal, state and local government bodies responsible for managing the nation's transport and road networks and the New Zealand Transport Agency. ARRB and its members, both individually and collectively as Austroads, recognise the critical role that they play in supporting one another to improve productivity, safety, sustainability and amenity outcomes for the community. The members of the company are the state, territory and federal government road agencies in Australia, who established the organisation as a means of cooperating to undertake research of national importance that they could not justify carrying out individually.

25 ARRB headquarters Australia



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

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

ARRB operates as a commercially viable and sustainable business and manages a \$10 million research investment portfolio on behalf of road agencies, who solicit, allocate and provide the funds.

TRL Model

Originally established in 1933 as part of the UK government, TRL privatised in 1996 to become a fully independent private company. TRL is wholly owned by the Transport Research Foundation (TRF), an independent non-profit-distributing foundation, limited by guarantee and with no shareholders. Some 1/3rd of the Company's business is driven by international clients, with some 1/3rd relating to UK private sector clients, and only 1/3rd relating to the UK public sector.

In 1933 the Road Research Laboratory (RRL) was formally established at Harmondsworth near London. Early research was mainly on road materials and design, with some work on safety.

By 1939 the increase in road accidents was causing concern but moves to establish a road safety research board were postponed due to the outbreak of World War 2. Subsequently, in 1945 agreement was reached to add research into road traffic and safety to the work of RRL.

The Laboratory's new facilities in Crowthorne in Berkshire were formally opened in June 1967. Five years later, RRL changed its name to the Transport and Road Research Laboratory (TRRL), reflecting the wider nature of the work conducted, including freight, traffic and environmental studies.

TRRL continued to grow with staff numbers reaching a peak of just over 1,000 in 1978. In April 1992, TRRL was renamed as TRL (Transport Research Laboratory) and became an Executive Agency of the Department of Transport. It remained so until April 1996, when it was successfully transferred into

the private sector under a management bid, led by the Transport Research Foundation. 2004 saw its move to bespoke office and test facilities on another part of the Crowthorne site.

The TRL of today is internationally recognised as a centre of excellence, providing research, consultancy, advice and solutions across a broad range of current transport issues that reflect the needs of public and private sector clients. Commercially independent, with a vast compendium of knowledge and experience embedded in history; TRL continues to provide leading edge expertise, supported by a range of test facilities.