



AfCAP
Africa Community Access Partnership



Technical Assistance to Mozambique Road Research Centre (Interim Phase)

Progress Report 3: Knowledge Management Study



Authors: M van Heerden, B Verhaeghe
Council for Scientific and Industrial Research (CSIR), South Africa

CONTRACT REF NO. AfCAP/MOZ/2045A

August 2016



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Cover photo: New building construction, ANE Head Office in Maputo, Mozambique

Quality assurance and review table			
Version	Author(s)	Reviewer(s)	Date
1.0	M van Heerden, B Verhaeghe	N Leta (ReCAP/AfCAP)	25.08.16
		C Visser (ReCAP)	

ReCAP Project Management Unit
Cardno Emerging Market (UK) Ltd
Oxford House, Oxford Road
Thame
OX9 2AH
United Kingdom



Abstract

The Mozambican Roads Administration (Administração Nacional de Estradas, ANE) is in the process of setting up a Road Research Centre (RRC) in Maputo with the objective to provide the basis for improving the long-term capacity in Mozambique to undertake relevant, high quality research relating to its road sector. The RRC business plan indicates, as one of its strategic objectives, the generation and transfer of relevant knowledge. This study aims to support this strategic objective through the application of knowledge management principles.

The RRC business plan also specifically refers to the establishment of an Information Centre to house, inter alia, books, local and international conference proceedings and journals, research reports, technical guidelines, norms and standards. In response, this study considers the services, associated resources and infrastructure of the future Information Centre.

The study process consisted of a review of relevant material including the draft RRC business plan, AfCAP technical assistance progress reports and various knowledge management publications; an appraisal of internal ANE processes and procedures pertinent to information generation, analysis, storage and dissemination and; a series of in depth interviews with stakeholders from ANE to gain an understanding of their expectations.

Study results are presented according to a knowledge management framework focused on three highly interdependent initiatives, i.e. the enhancement of research capability by strengthening the knowledge creation and evaluation processes of the organisation; optimisation of knowledge dissemination to stakeholders and the enablement of a knowledge sharing culture; and enablement of the core services associated with research and development, materials testing, quality assurance and capacity building through good data and information management practices.

Specific recommendations in support of these knowledge management initiatives include:

- Establishment of a library and information service to negotiate and provide access to reliable information resources; to provide specialist intermediary services; to preserve and make accessible the intellectual property created by the RRC; and to facilitate knowledge exchange, scientific interaction and networking
- Provision of virtual collaboration platforms in support of collaborative research activities
- Development of internal and external web based knowledge portals to enhance knowledge dissemination, both inside as well as outside the organisation
- Establishment of and participation in 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
- Formulation of a publication strategy to increase the visibility and impact of the organisation's research output
- Strengthening and fostering an organisational culture of knowledge creation and sharing
- 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.

The study is concluded with a high level implementation schedule for these activities.

Key words

Road Research Centre, ANE, Mozambique, knowledge management, capacity building, Research & Development, information centre, knowledge dissemination

AFRICA COMMUNITY ACCESS PARTNERSHIP (AfCAP)

Safe and sustainable transport for rural communities

AfCAP is a research programme, funded by UK Aid, with the aim of promoting safe and sustainable transport for rural communities in Africa. The AfCAP partnership supports knowledge sharing between participating countries in order to enhance the uptake of low cost, proven solutions for rural access that maximise the use of local resources. AfCAP is brought together with the Asia Community Access Partnership (AsCAP) under the Research for Community Access Partnership (ReCAP), managed by Cardno Emerging Markets (UK) Ltd.

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Acronyms

AfCAP	:	Africa Community Access Partnership
ANE	:	Administração Nacional de Estradas
ARTReF	:	African Road and Transport Research Forum
COP	:	Community of Practice
CSIR	:	Council for Scientific and Industrial Research
DIAFI	:	Direcção de Administração e Finanças
DIMAN	:	Direcção de Manutenção
DIPLA	:	Direcção de Planificação
DIPRO	:	Direcção de Projectos
EDMS	:	Electronic Document Management System
EIFL	:	Electronic Information for Libraries
FEHRL	:	Forum for European Highway Research Laboratories
ICT	:	Information and Communication Technology
IEC	:	International Electrotechnical Commission
INASP	:	International Network for the Availability of Scientific Publications
INATTER	:	National Institute of Surface Transport
IPQ	:	Instituto Português da Qualidade
ISO	:	International Organisation for Standardisation
ISUTC	:	Instituto Superior de Transportes e Comunicações
IT	:	Information Technology
KLC	:	Knowledge Life Cycle
LEM	:	Laboratório de Engenharia de Mozambique
LMS	:	Library Management System
LNEC	:	Laboratório Nacional de Engenharia Civil
MOPH	:	Ministry of Public Works and Housing
NGO	:	Non-Governmental Organisation
OJS	:	Open Journal Systems
OPAC	:	Online Public Access Catalogue
OSF	:	Open Science Framework (OSF)
ReCAP	:	Research for Community Access Partnership
RRC	:	Road Research Centre
RRSC	:	Road Research Steering Committee
RRTC	:	Road Research Technical Committee
SATCC	:	Southern Africa Transport and Communications Commission

SHEQ	:	Safety, Health, Environment and Quality
SNAE	:	Sistema Nacional de Arquivos do Estado
TRL	:	Transport Research Laboratory
UEM	:	Universidade Eduardo Mondlane
VPN	:	Virtual Private Network

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1 Executive summary

The Mozambican Roads Administration (Administração Nacional de Estradas, ANE) is in the process of setting up a Road Research Centre (RRC) in Maputo with the objective to provide the basis for improving the long-term capacity in Mozambique to undertake relevant, high quality research relating to its road sector. The RRC business plan indicates, as one of its strategic objectives, the generation and transfer of relevant knowledge. This study aims to support this strategic objective through the application of knowledge management principles.

The RRC business plan also specifically refers to the establishment of an Information Centre to house, inter alia, books, local and international conference proceedings and journals, research reports, technical guidelines, norms and standards. In response, this study considers the services, associated resources and infrastructure of the future Information Centre.

The study process consisted of a review of relevant material including the draft RRC business plan, AfCAP technical assistance progress reports and various knowledge management publications; an appraisal of internal ANE processes and procedures pertinent to information generation, analysis, storage and dissemination and; a series of in depth interviews with stakeholders from ANE to gain an understanding of their expectations.

1.1 Current status

The 3-day site visit to Maputo during July 2016 afforded the opportunity to assess ANE infrastructure, procedures and working milieu as environment in which the RRC will be established.

The RRC will be physically located on the premises of ANE in Maputo. Existing ANE **facilities and buildings** are well maintained and equipped. At present, it is envisaged that the RRC will share offices with the Directorate on Maintenance (DIMAN) staff.

A new building currently under construction makes provision for an ANE Archive, the planned Information Centre, office space and ICT server rooms. A main feature is the fixed-seat auditorium which will be able to host up to 130 people. The Archive will be managed by the Document Management Department. It will hold all ANE records, including that of support services such as HR, Legal, Procurement and Finance as well as the records of the directorates. An area on the ground floor is dedicated to the planned Information Centre.

ANE presently has the required **ICT infrastructure** in place to support the RRC. The main data centre has application, web and database servers but budget is required for offsite backup. A basic external website was established but an internal website/Intraweb is still under development. ANE does not currently have an electronic work flow system but the customisation of an off-the-shelf system from Spain is planned. The DIMAN building allocated to the RRC currently has no network connections and will have to be rewired as a matter of urgency. Wi-Fi functionality is not planned for this building.

ANE has a well administered centralised **Document Management Department** with 5 staff members responsible for the scanning and indexing of official documents. A document management system is used to manage scanned copies of contracts, project reports and correspondence. However, an electronic document management system (EDMS) is not yet available. The Document Management Department is housed in a temporary facility but it, together with all its records, will be relocated to the Archive in the new building.

The **Information Centre** will be expected to serve the information needs of the RRC researchers, ANE and the roads sector in Mozambique as a whole. It will also play a key role in knowledge and expertise transfer to road sector stakeholders and thereby increase the visibility and reputation of the RRC. The draft business plan of the RRC indicates that the Information Centre will be established in the structures of the RRC within DIMAN, however, it emerged from interviews held with ANE staff during the 3-day Maputo site visit that the Information Centre will be managed by the Head of the Document Management Department which falls under the Directorate Administration and Finances (DIAFI).

In terms of service provision, resource sharing, document exchange and library skills development, it is advisable that the ANE Information Centre works closely together with the libraries of local academic institutions as well as those of other institutions in the roads sector. This will include the libraries of the Universidade Eduardo Mondlane (UEM), the Instituto Superior de Transportes e Comunicações (ISUTC) and that of the Laboratório de Engenharia de Mozambique (LEM). These activities will further strengthen the planned cooperation between Mozambican academic institutions and the RRC which will focus on capacity building and training, as well as the development of projects of common interest.

Currently there is no Mozambican library consortium through which cheaper access to information resources could be negotiated but this should change soon with approximately 40 potential consortium partners from universities, polytechnics and research institutes already identified.

Some **learning and knowledge sharing** activities are already in place. Internal workshops and information sharing sessions are hosted from time to time in the existing ANE Conference Room which can seat up to a hundred people. The auditorium in the new building will also be used to hold seminars. ANE further has a Training Officer who is responsible for identifying the training needs of the ANE Directorates, formulating training interventions and negotiating funding and sponsorships for these training interventions. The ANE Communications Department is responsible for the content of the ANE webpage. It is also in the process of developing an Intra web page using a free version of WordPress.

The RRC will rely on available **laboratory** equipment and services rendered by ANE and LEM to support its initial research activities. The laboratories of LEM will act as a reference laboratory. Field testing equipment will also play a key role in the RRC activities and it is expected that ANE and LEM's field testing equipment located in their provincial laboratories should be made available to support the RRC activities. The laboratories will require interfaces and software to collect, store and process test results as necessary. The software should be such that processed results, as well as the raw data, are directly accessible to all of the researchers through the local area network. Data sets created as part of research activity should be preserved as it will be important for on-going research as well as for verification of research results.

1.2 Knowledge management framework and initiatives

Study results are presented according to a knowledge management framework focused on three highly interdependent initiatives, i.e. the enhancement of RRC research capability by strengthening the knowledge creation and evaluation processes of the organisation; optimisation of knowledge dissemination to stakeholders and the enablement of a knowledge sharing culture; and enablement of the core services associated with research and development, materials testing, quality assurance and capacity building through good data and information management practices.

Knowledge management activities considered in support of the abovementioned initiatives are summarised below:

- **Establishment of an Information Centre to provide library and information services**

The Information Centre will be a repository for, inter alia, text books, local and international conference proceedings and journals, research reports, technical guidelines, norms and standards. Initially information resources will focus on road engineering. However, resources and services will be expanded as the spectrum of research activities is broadened. To afford its distributed client base ease of access to its information resources, it is suggested that the collection development strategy should focus on electronic products which should be negotiated for the entire ANE through participation in library consortia. In terms of skills development, resource sharing and service improvement, it is advisable that the Information Centre works closely together with the libraries of local academic institutions as well as those of other institutions in the roads sector.

The Information Centre will be required to maintain a grey literature collection consisting of relevant reports and publications from agencies other than ANE as well as from national, regional and international research centres. It will also establish a centralised knowledge database which will provide access to previous research undertaken by national and international institutions and agencies on the roads sector in Mozambique. This database will be accessible online by all stakeholders including current and future researchers, practitioners, academia, road policy and decision makers, and the general public.

Information specialist intermediary services focussed on the detailed scientific, business and management information requirements of the RRC staff as well as researcher enablement through training should be provided.

Information Centre staff will be responsible for the preservation of and provision of access to the intellectual property created by the RRC through services focused on the management of research records. As such it will establish and maintain a Research Outputs Database which will act as a repository for all research and consultancy project outputs. Selected publications captured in the database will be exported to a web-based institutional repository through which RRC publications can be made accessible to external stakeholders.

The use of 'knowledge spaces' should form an important part of the ANE and the RRC'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 meet, think together, have conversations and dialogues, collaborate and promote science and research on both a formal and informal basis. Ideally these knowledge spaces should have formed part of the Information Centre infrastructure. However, as the venue for and layout of the Information Centre have already been decided, the use of existing spaces within ANE should be optimised. To ensure optimum utilisation of these spaces the Information Centre staff will be responsible for the conceptualisation, planning, and implementation of an events plan and the scheduling of talks, lectures and presentations by ANE staff and external speakers on a regular basis.

An Information Centre Manager should be appointed to establish, manage and operate the Information Centre. As the demand for information increases, both from the perspective of ANE and the RRC researchers, an Information Specialist could be appointed at a later stage. The Information Centre will be highly reliant on the ICT Department for both systems implementation and support. Access to the internet with sufficient bandwidth and a reliable supply of electricity is an essential

prerequisite for a sustainable service. The Information Centre infrastructure needs to make provision for a Library Management System, database and institutional repository software.

- **Provision of virtual collaboration platforms in support of collaborative research activities**

Research is increasingly done collaboratively in teams, both within the organisation and between organisations, and is often interdisciplinary of nature. It is foreseen that RRC 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 Research Outputs Database, access to web based collaboration platforms will be required to allow file sharing and collaborative report writing between team members during project duration.

- **Development of internal and external web based knowledge portals to enhance knowledge dissemination, both inside as well as outside the organisation**

Both internal and external web portals are required. An intraweb will serve as a portal for staff to find organisational information and to learn about developments and news about the organisation. It will afford staff quick and efficient access to the information and operational systems. The external website will provide a snapshot of the organisation to the outside world and will contribute to its knowledge dissemination efforts. A sustainable, easily accessible knowledge portal providing a clear description of the Research Centre's purpose and services will assist it in building a strong reputation in the roads sector. It will also make research output accessible to external stakeholders through the institutional repository and thereby support research uptake. As such it is an important marketing and communication tool for the organisation.

- **Establishment of and participation in Communities of Practice**

A Community of Practice (COP) is 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 practice. The RRC 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 groups. 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.

- **Formulation of a publication strategy to increase the visibility and impact of RRC research output**

To establish the RRC as a reputable research organisation and to promote knowledge dissemination and uptake its researchers should be supported to publish their research in high standing, peer-reviewed journals and to present their research at conferences. Publishing further provides the opportunity to influence policy and practice through academic channels. The RRC should however ensure a balance between academic publication and information intended for decision makers. The organisation's communication strategy should also consider newsletters and website content in which research outputs are transformed 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.

- **Strengthening and fostering an organisational culture of knowledge creation and sharing**

The organisational culture of the RRC 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. A knowledge culture should be promoted through management attention, compliance requirements and incentives to share.

- **Records management activities**

The RRC will have 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. This will require a sustainable records management system for both records relevant to its research and consulting services as well as to its support services.

As the RRC falls within the structures of ANE, it should comply with the ANE records management procedures implemented by the Document Management Department. The RRC's research activities may however result in additional records management requirements not currently addressed by the Document Management Department.

The Research Outputs Database will be used to record research and consultancy project outputs and related material such as project proposals, progress reports, research reports, learning briefs, safety documents, laboratory reports, technical manuals and guidelines as well as information published externally by RRC staff, e.g. conferences papers and posters, journal articles, books, chapters in books and training material. In addition to file servers, which are useful for day to day research or laboratory activity, an Electronic Document Management System (EDMS) is proposed for research document and content management, collaborative writing, version and access control. Other project specific records such as risk assessments; contracts and proof of delivery of contracts; project management plans; relevant protocols and standards; research ethics approvals; equipment calibration reports and operating procedures; laboratory workbooks; project finances and records of client interaction should be stored in project files which should be managed by the Document Management Department. Research data sets created as part of the research activity form part of the research outputs of the Research Centre 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 context giving documentation, research reports and results.

1.3 Implementation schedule and resource requirements

The proposed implementation schedule is discussed in detail in [Section 7](#). The degree to which the proposed knowledge management initiatives are put into practice will be determined by organisational priorities as well as enabling factors such as funding, ICT infrastructure and support, along with staff capacity and skill levels. The proposed high level schedule for the implementation of recommended knowledge management initiatives is available in graphic format in [Annex E](#). This implementation schedule was created with the RRC institutionally located within ANE. Should the RRC become an independent organisation outside of the structures of ANE, it will be required to develop its own infrastructure. In such a case the knowledge management implementation schedule proposed in this study will have to be reviewed extensively.

- **Start-up actions**

An RRC Working Group comprising members from ANE and LEM has been formed which, together with the Road Research Technical Committee (RRTC) and the Road Research Steering Committee

(RRSC), furthers the establishment of the RRC. It is the objective that these staff members would be incorporated in the structures of the RRC once current constraints have been resolved. In the meantime, the RRC will rely on partnerships between ANE, LEM and local academic institutions to execute projects. To support these initial research activities and to ensure preservation of the research project outputs it is necessary to fast-track the establishment of the Information Centre and its service streams.

Start-up actions for the establishment of the **Information Centre** and its services will entail the following: the confirmation of the Information Centre mandate; the appointment of the Information Centre Manager to conceptualise and establish the service, its infrastructure, systems, policies and procedures; the planning and lay-out of the space allocated to the Information Centre in the new ANE building; procurement of furniture, equipment and shelving for the office that will serve as temporary Information Centre; planning and establishment of the initial as well as future ICT infrastructure required by the Information Centre (including the rewiring of the DIMAN building currently partially allocated to the RRC); provision of individual manual library systems to address the required standard technical library services; and provision of information resources and database functionality.

RRC records relevant to its research and consulting services as well as to its support services will need to be managed and an interim **records management** solution is proposed to address research records which are currently not provided for by the ANE records management procedures.

The infrastructure required to establish the interim Information Centre and records management functions is provided in graphical format in **Annex F**.

- **Medium to longer term actions**

The expected growth in RRC research activities and staff compliment as well as the completion of the new building will require the following additional actions:

- Optimisation of the various physical spaces available in both the new and existing ANE buildings as well as the implementation of a knowledge sharing events plan
- Expansion of the Information Centre's information resources in line with the broadening spectrum of RRC research activities
- Negotiation of access to electronic journal platforms and databases through library consortia to ensure the most cost-effective way of delivering commercially available information resources
- Implementation of a Library Management System (LMS) to ensure efficient management of collections and library functions
- Establishment of an institutional repository to increase visibility of the RRC outputs
- Appointment of an Information Specialist to assist with the increased demand for information
- Improvement of the existing external ANE website and development of an Intra web to ensure that both websites are sustainable knowledge portals
- Enhancement of records management efforts by the implementation of an electronic document management system (EDMS)

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 RRC starts functioning as a fully-fledged research centre.

2 Introduction

The Mozambican Roads Administration (Administração Nacional de Estradas, ANE) is in the process of setting up a Road Research Centre (RRC) in Maputo with the objective to provide the basis for improving the long-term capacity in Mozambique to undertake relevant, high quality research relating to its road sector. The RRC business plan¹ indicates, as one of its strategic objectives, the generation and transfer of relevant knowledge. This study aims to support this strategic objective through the application of knowledge management principles.

The RRC business plan also specifically refers to the establishment of an information resource centre to house, inter alia, books, local and international conference proceedings and journals, research reports, technical guidelines, norms and standards. This study will consider the services and associated resources and infrastructure of the future Information Centre.

2.1 The role of Information Centres

As indicated in the minutes of the 3rd meeting of the Road Research Technical Committee (RRTC)² the establishment of an Information Centre is perceived to be key to providing visibility to the RRC. This view is supported in literature and the contribution that information centres (libraries) make to institutional research performance is well documented³:

- **Repositories increase the visibility of the institution and raise its research profile.** In general libraries manage institutional repositories which store and make available institutional assets such as research publications. These repositories increase the visibility of the institution's outputs and thereby raise its research profile.
- **Good libraries help institutions to recruit and retain top researchers.** There is global competition for top researchers, and institutional reputation is key to attracting them. Many factors contribute to a good institutional reputation, including the quality, nature, and extent of the library's collections, its staff and the services they provide.
- **Libraries promote and exploit new technologies and new models of scholarly communications.** Libraries are critically important in helping researchers to exploit the full benefits and opportunities of the networked world, including such developments as open access and social media.
- **Outward-facing libraries contribute to institution-wide initiatives.** In recent years, many libraries have demonstrated that they can seize opportunities to help institutions respond to changes in the research environment. Recent research data management initiatives undertaken by libraries are but one example.
- **Specialist staff work in partnership with research departments.** Information specialists work in partnership with researchers and act as consultants. This contributes to an increased understanding of researchers' needs and subsequent improved service delivery.

¹ Verhaeghe B, Antunes ML, Paige-Green P. 2014. *Establishment of a Road Research Centre in Mozambique: draft business plan for first five years of operation*, Project AfCAP/MOZ/092/B, Crown Agents (UK).

² Verhaeghe B. 2016. *Technical Assistance to Mozambique Road Research Centre (Interim Phase): Progress Report: January to March 2016*, Project AfCAP/MOZ/2045A, Cardno Emerging Markets (UK).

³ Research Information Network (RIN) and Research Libraries UK (RLUK). 2011. *The value of libraries for research and researchers: a RIN RLUK report*.

- **Dedicated spaces provide a better work environment for researchers.** For some researchers the physical library is valued as a place to work and study, particularly if they do not have their own departmental space or if they rely for their research on printed or manuscript content held in the library.
- **Easy access to high-quality content is a key foundation for good research.** Access to high-quality content remains crucial to research, and its value is recognised by researchers and senior managers alike.

2.2 Knowledge management

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 knowledge. The knowledge capital they accumulate in their activities therefore is a strong strategic issue and the management of these assets has become crucial⁴.

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.

Knowledge is produced and optimised in organisations through individual and shared processes which can be represented by the following **Knowledge Life Cycle (KLC)**, a simplification of the framework originally developed by McElroy and Firestone⁸.

⁴ Ermine J. 2010. Methods and tools for knowledge management in research centres. *Electronic Journal of Knowledge Management*, vol. 8(3), p.293-306.

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).

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

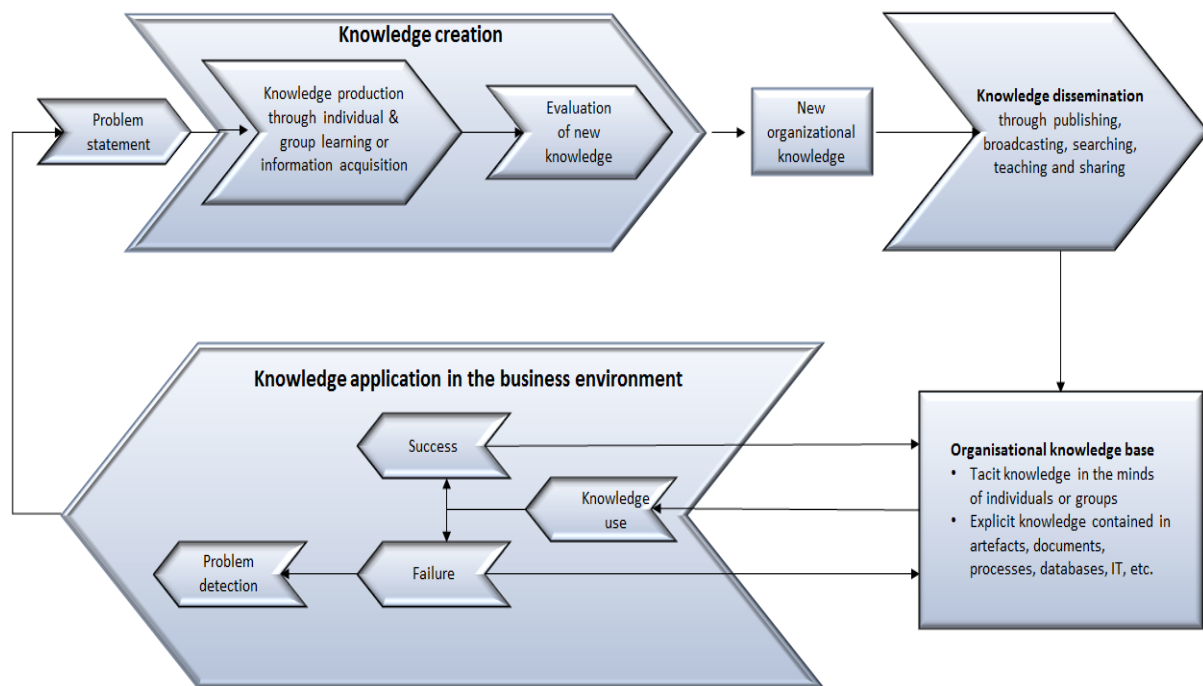


Figure 1: The Knowledge Life Cycle (KLC)

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

These are the knowledge management topics and issues that the study will consider and make recommendations towards. The establishment of a fully functional research centre will require concerted managerial activity aimed at enhancing the ANE RRC’s capability of creating, managing and integrating its information and knowledge in support of its business strategy.

3 Study process

The study was undertaken to map the knowledge management requirements of the RRC and to schedule the recommended activities in support of setting up a RRC Information Centre.

It consisted, firstly, of a review of relevant material including the draft RRC business plan, AfCAP progress reports and knowledge management publications and, secondly, of a series of interviews with stakeholders to gain an understanding of:

- the internal ANE processes and procedures pertinent to information generation, analysis, storage and dissemination
- stakeholder expectations in terms of the client groups and the service scope of the proposed Information Centre
- the known information requirements of the future users of the Information Centre
- policy makers and stakeholders that would be influenced by the research outcomes of the RRC
- how research outcomes will be translated for and disseminated to specific target audiences
- the knowledge culture of the organisation
- required databases (e.g. of ANE research outputs)
- similar functions already in place (library / information services; archival and records management services) and relevant policies currently existing within ANE
- the ICT infrastructure and support available within ANE, including internet connectivity; existing and planned internal and external websites; content management solutions; and virtual collaboration platforms

Abovementioned interviews took place in Maputo from 11 to 13 July 2016. A list of persons consulted is attached to this report as [Annex A](#).

The results of this assignment will feed into the Terms of Reference of a longer term technical assistance project aimed at making progress with priority activities for the establishment and operationalisation of the RRC and at achieving the key performance indicator targets set out in its draft Business Plan for the first year of operation. This interim phase of technical assistance is intended as a bridge between the initial formulation stages of the RRC and the longer term technical assistance that is expected to be provided under AfCAP.

4 Present situation

The 3-day site visit to Maputo during July 2016 afforded the opportunity to assess the ANE infrastructure, procedures and working milieu as environment in which the proposed RRC will be established. It also initiated the mapping of RRC knowledge management requirements and the determination of general expectations for its proposed Information Centre.

ANE is organised into four Directorates namely Planning (DIPLA); Projects (DIPRO); Maintenance (DIMAN); and Administrative & Financial (DIAFI). The RRC business plan⁹ indicates that, institutionally, the RRC will be located in DIMAN as one of its line departments but that it will operate as an entity that will support all Directorates of ANE on an equitable basis. The January-March 2016 Progress Report¹⁰, on the other hand, reported that a budget in excess of USD 1 million was submitted for approval to the Ministry and to the Roads Fund to activate the RRC as a new Directorate under ANE. This matter has not yet been concluded but, provided that the RRC remains within ANE, the final institutional set-up should not significantly influence the RRC knowledge management initiatives implemented.

4.1 Facilities

The RRC will be physically located on the premises of ANE in Maputo. Existing ANE buildings are well maintained and equipped. At present, it is envisaged that the RRC will share offices with DIMAN staff. The RRC may also take over the current office space of DIMAN should the decision be made that the Directorate will move to new premises.

The new building makes provision for an ANE Archive, the planned Information Centre, office space and ICT server rooms. A main feature is the fixed-seat auditorium which will be able to host up to 130 people. The auditorium will be available for use to all ANE directorates as well as to external entities such as the Ministry, local universities and stakeholders from the transport sector. The auditorium foyer will be used for exhibitions and catering purposes. Catering will be provided by the company responsible for the operation of the ANE canteen.



Figure 2: Auditorium foyer (under construction)

⁹ Verhaeghe B, Antunes ML, Paige-Green P. 2014. *Establishment of a Road Research Centre in Mozambique: draft business plan for first five years of operation*, Project AfCAP/MOZ/092/B, Crown Agents (UK).

¹⁰ Verhaeghe B. 2016. *Technical Assistance to Mozambique Road Research Centre (Interim Phase): Progress Report: January to March 2016*, Project AfCAP/MOZ/2045A, Cardno Emerging Markets (UK).

The Archive will be managed by DIAFI's Document Management Department. It will hold all ANE records, including that of support services such as HR, Legal, Procurement and Finance as well as the records of the directorates.

An area on the ground floor is dedicated to the planned Information Centre. It will be fitted with bookshelves and working tables. The furniture schedule has already been finalised.



Figure 3: Area in new building allocated to the Information Centre

4.2 ICT infrastructure

ANE presently has the required ICT infrastructure in place to support the RRC. The present setup is also sufficient for the interim knowledge management solution proposed by this study. A summary (in Portuguese) of ANE's existing ICT infrastructure is available in **Annex B**. In short:

- Two internet access systems are installed: GovNet (3Mbps/3Mbps), the primary system, and Cable TV (6Mbps/4Mbps) as back-up system.
- The main Data Centre has application, web and database servers in place. The Data Centre recently experienced problems with the Symantec Backup system but a new system is being procured. Budget is required for offsite backup.
- The NOD32 antivirus solution is used.
- The Government e-mail system is used for official communication.
- The ICT Department supports 200 staff PCs.
- ANE does not currently have an electronic work flow system but plans are in place to customise an off-the-shelf system from Spain.
- The existing document management system, I+DOC SCN, is used to manage scanned copies of contracts and project reports but an electronic document management system (EDMS) is not yet available.
- ANE has a basic external website¹¹ through which regional offices can access the I+DOC system as well as the Highway Information Management System (HIMS).
- An internal website/Intraweb is still under development. It is foreseen that the RRC website will form part of the ANE website.

¹¹ <http://www.ane.gov.mz>

The DIMAN building allocated to the RRC currently has limited network connections. The building will be rewired but will not have Wi-Fi functionality. Wi-Fi functionality is also not planned for the new building currently under construction on the ANE site.

4.3 Records management

ANE has a well administered centralised Document Management Department with 5 staff members responsible for the scanning and indexing of official documents. The Document Management Department is housed in a temporary facility but it, together with all its records, will be moved to the Archive in the new building currently under construction (see [Section 4.1](#)).



Figure 4: Document Management Centre



Figure 5: Project dossiers

The existing document management system, I+DOC, is used to manage scanned copies of contracts and project documentation but neither an electronic document management system (EDMS) nor a workflow system is currently in place. I+DOC is also used for storage of all correspondence. The file plan (*Sistema Nacional de Arquivos do Estado*), developed by the National State Archives¹² is implemented together with its retention schedules.

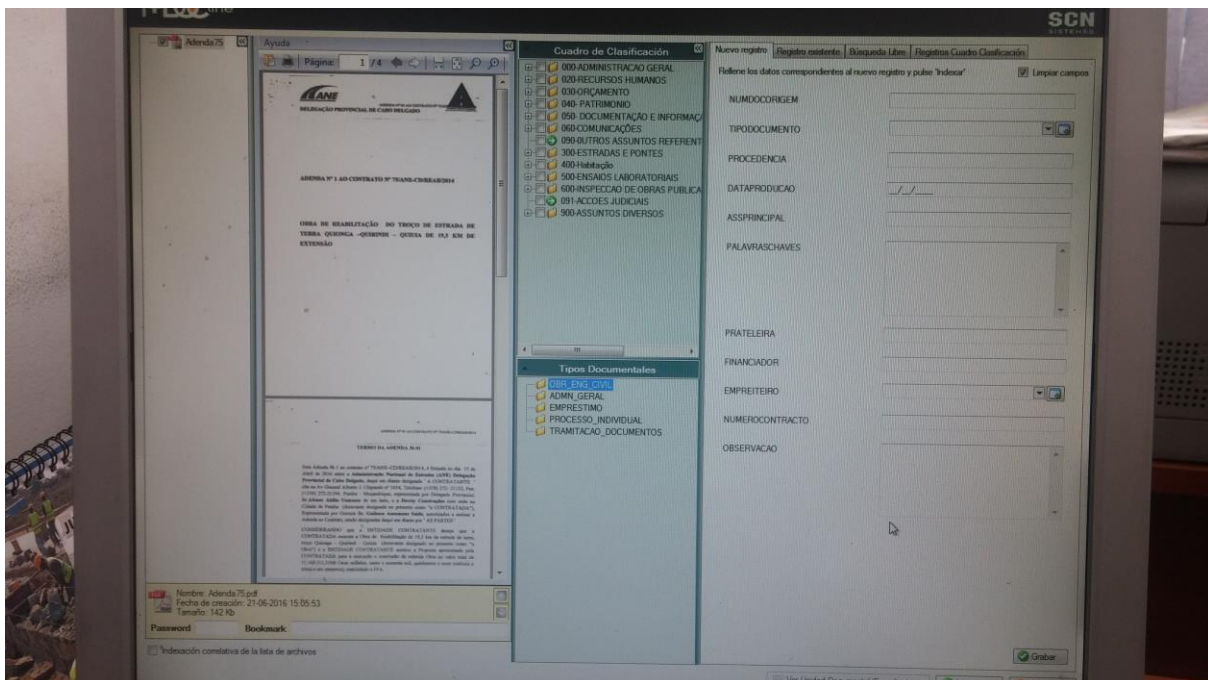


Figure 6: I+DOC indexing screen reflecting the National Archives file plan

¹² República de Moçambique, Ministério da Função Pública, Centro de Documentação e Informação de Moçambique. 2007. *Sistema Nacional de Arquivos do Estado (SNAE)*, Decreto n° 36/2007 de 27 de Agosto.

The classification plan¹³ prescribed by the Ministry of Public Works and Housing (MOPH) is used complementary to the SNAE. It consists of six classes that represent the functions specifically assigned to the Ministry.

Plano de Classificação de Documentos das Actividades-Fim do Ministério das Obras Públicas e Habitação

Apresentação

O presente Plano de Classificação é relativo às Actividades-fim, é adoptado para o uso no Ministério das Obras Públicas e Habitação (MOPH), em complementaridade ao Plano de Classificação das Actividades-meio, aprovado pelo Decreto n.º 36/2007 de 27 de Agosto.

O plano de Classificação engloba as funções do órgão, instituições subordinadas e tuteladas. Segue o método de classificação por assunto, à semelhança do Plano de Classificação das Actividades - meio. É constituído por seis classes que representam as funções atribuídas ao MOPH à luz da Resolução n.º 49/2010, de 31 de Dezembro, que aprova o Estatuto Orgânico do Ministério das Obras Públicas e Habitação.

As seis classes contidas no plano são:

- Classe 100 – Gestão de Recursos Hídricos;
- Classe 200 – Obras e Edifícios do Estado;
- Classe 300 – Estradas e Pontes;
- Classe 400 – Habitação;
- Classe 500 – Ensaios Laboratoriais;
- Classe 600 – Inspeção de Obras Públicas.

Figure 7: Summary of the MOPH classification plan

Documentation from the ANE Provincial Delegation previously was received through the project coordinators or Directorate Directors. It is now, however, first submitted to the Document Management Department where it is scanned and indexed before distribution to relevant staff. Paper copies are archived on the project dossiers.

Paper copies of archival records are kept as back-up to the electronic documents but, in future, only paper copies of important outgoing documents will be kept. A need was expressed to provide ANE staff with access to the I+DOC records via the planned Information Centre webpage.

The Head of the Document Management Department also indicated that change management is required to ensure staff compliance with records management procedures.

4.4 Libraries and information centres

The draft business plan of the RRC¹⁴ indicates that the **Information Centre** will be established within the structures of the RRC within DIMAN, however, it emerged from interviews held with ANE staff during the 3-day Maputo site visit that the Information Centre will be managed by the Head of the

¹³ Plano de Classificação de Documentos das Actividades-Fim do Ministério das Obras Públicas e Habitação, *Boletim da República, Publicação Oficial da República de Moçambique*, 5º Suplemento, I Serie nº 52, 29 Dezembro 2011.

¹⁴ Verhaeghe B, Antunes ML, Paige-Green P. 2014. *Establishment of a Road Research Centre in Mozambique: draft business plan for first five years of operation*, Project AfCAP/MOZ/092/B, Crown Agents (UK).

Document Management Department which falls under DIAFI. As indicated in **Section 4.1**, the Information Centre will be housed in the new building being erected on the ANE premises.

The Information Centre will be expected to serve the information needs of the RRC researchers, ANE and the roads sector in Mozambique as a whole. It is indeed essential that all ANE staff, not only RRC staff, should keep up to date with the latest technologies and developments in their specific disciplines through regular access to relevant journals and publications. The Information Centre will also play a key role in knowledge and expertise transfer to road sector stakeholders and thereby increase the visibility and reputation of the RRC.

Information resources and services will support the competencies of ANE¹⁵ which include:

- the design, construction and maintenance of roads included in the classified network and all the activities associated with selecting service providers, executing and managing contracts for this purpose
- norms and standards for construction, maintenance and rehabilitation of roads by local authorities

Annex C, a list of suggested initial information resources, was compiled based on discussions with a number of ANE technical staff. ANE staff is distributed across a number of sites and to ensure equitable access the information resources strategy should focus on the acquisition of electronic products. Subscription costs associated with these electronic information resources are typically calculated based on the institutional staff equivalent and, in this case, the total ANE staff complement will be considered. Currently ANE has 191 employees in the Maputo headquarters with a further 300 staff members as provincial delegates. **Annex D** provides a breakdown of staff numbers and levels of qualification.

The Information Centre will also be tasked with the warehousing of R&D datasets¹⁶. This is in line with the recent research data management initiatives undertaken by libraries worldwide.

In terms of service provision, resource sharing, document exchange and library skills development, it is advisable that the ANE Information Centre works closely together with the libraries of local academic institutions as well as those of other institutions in the roads sector. This will include the libraries of the Universidade Eduardo Mondlane (UEM), the Instituto Superior de Transportes e Comunicações (ISUTC) and that of the Laboratório de Engenharia de Mozambique (LEM). These activities will further strengthen the planned cooperation between Mozambican academic institutions and the RRC which will focus on capacity building and training, as well as the development of projects of common interest. (The RRC will be a good environment for undergraduate and post-graduate students to carry out research work as part of their academic studies. On the other hand, UEM and ISUTC are well placed to offer the opportunity for RRC young researchers to obtain post graduate degrees).

The **Engineering Faculty of the UEM** is situated adjacent to the ANE premises. It serves approximately 2,500 students from the civil, chemical, mechanical, electrical and electronics engineering disciplines. In addition to undergraduate students it also accommodates post graduate

¹⁵ Verhaeghe B, Antunes ML, Paige-Green P. 2014. *Establishment of a Road Research Centre in Mozambique: draft business plan for first five years of operation*, Project AfCAP/MOZ/092/B, Crown Agents (UK).

¹⁶ Verhaeghe B. 2016. *Technical Assistance to Mozambique Road Research Centre (Interim Phase): Progress Report: January to March 2016*, Project AfCAP/MOZ/2045A, Cardno Emerging Markets (UK).

students up to Master's level. Besides modern computer laboratories, the Faculty also boasts an Engineering Library with a significant book collection and some paper journals. Students can access a limited collection of electronic resources made available through the website of the Central UEM Library.



Figure 8: UEM Engineering Faculty Library

The **Central UEM Library**, which was established in 2007 on the Julius Nyerere Campus, is housed in a modern state of the art building which provides ample space for students to work and study in. It is headed by the Director of Documentation Services and has 60 staff members.



Figure 9: Entrance to the Central UEM Library, Julius Nyerere Campus

Traditional library services such as acquisitions and cataloguing are provided centrally to all UEM libraries and the Central Library has made significant progress in the provision of electronic resources. The University carries 50% of the subscription costs of these electronic resources and the balance is contributed by the Swedish government. The electronic collection includes the various Research4Life open access databases. The University libraries use ABCD, an open source web-based integrated library management system.

The Central Library has established an institutional repository through which University theses are made available in electronic format. Open source institutional repository software (DSpace) is used for the repository. The repository also provides access to a number of electronic journals published

by the University Press. For this the University uses the journal management and publishing software Open Journal Systems¹⁷ (OJS) provided by the Canadian Public Knowledge Project.



Figure 10: Central UEM Library

The UEM library collections are open to anyone in Mozambique provided that they register with the Central Library. (Should ANE register as a company it will be provided with domain specific access.)

Not many universities offer courses in Library and Information Sciences and in Mozambique there are only 3 individuals with PhDs in this discipline. UEM offers a degree course which now, after its third graduation, has delivered a total of 30 graduates. The UEM Library Director, Dr Horácio Zimba, is also a lecturer. He specialises in library IT and systems and confirmed that library positions are mostly advertised in newspapers.

Currently there is no Mozambican library consortium through which cheaper access to information resources could be negotiated but this should change soon with approximately 40 potential consortium partners from universities, polytechnics and research institutes already identified.

ISUTC is a private institution of higher education, founded in 2000. It focuses on the undergraduate and graduate training of engineers and scientists in the Transportation and Communications disciplines. Besides offering degree courses in civil, transportation, mechanical and railway engineering it also offers degree courses in ICT, management, auditing and accounting. ISUTC further cooperates with the Instituto Superior Técnico (University of Lisbon) in offering Master courses in areas such as communication networks and transportation networks. ISUTC currently has 1200 students. It does not train laboratory technicians as this is done by LEM.

The ISUTC Library is only now starting to investigate the acquisition of electronic resources and would benefit from participating in future Mozambican library consortium activities. It could, in the meantime, make available to its students open access resources such as Research4Life. Utilisation of the Directory of Open Access Repositories (OpenDOAR) and the Directory of Open Access Journals (DOAJ) (see [Annex C](#)) should also be promoted.

¹⁷ <http://pkp.sfu.ca/ojs>



Figure 11: ISUTC Library

LEM was created in the late 1940's and its main office and laboratories are located in close proximity to ANE. LEM is an organ of State under MOPH. Presently, it has a staff of about 120 workers, including university graduates, technicians and assistant technicians. LEM's facilities include testing equipment for bitumen, asphalt, cement, concrete, aggregates and soils. It has signed a Memorandum of Understanding with ANE concerning cooperation between the two organisations in the field of material testing and quality control. LEM is well positioned, from a laboratory perspective, to complement and support the activities of the RRC, either through collaborative research, or as a service provider. Laboratory test data is currently stored manually but LEM is planning to move to an electronic system. Its website is hosted externally however servers are in the process of installation.

The LEM Documentation and Technical Information Centre provides LEM staff members with the required standards (mainly ASTM and the Portuguese Instituto Português da Qualidade (IPQ) standards), specifications, test methods and other technical information required to execute their duties. It is also responsible for archiving all LEM publications. The facility is open to university students and staff from technical institutes.



Figure 12: LEM Library

At present the LEM Documentation and Technical Information Centre has a card catalogue but it is in the process of migrating to Koha, an open source library management system. It is headed by an ICT graduate and has three additional staff members of whom two are librarians.

Besides working together with the above academic and roads sector libraries, the ANE Information Centre will also benefit from close interaction with Mozambican library associations as well as from active participation in any future library consortium activities.

4.5 Learning and knowledge sharing

Internal workshops and information sharing sessions are hosted from time to time in the existing ANE Conference Room which can seat up to a hundred people. The auditorium in the new building will also be used to hold seminars.



Figure 13: ANE Conference Room

ANE further has a Training Officer who is responsible for identifying the training needs of the ANE Directorates, formulating training interventions and negotiating funding and sponsorships for these training interventions. Conference attendance by ANE staff is paid for from a centralised annual budget. (The ANE Information Centre will be able to support the Training Officer by setting up a conference announcement alerting service.) The Training Officer indicated that suitable technical courses for engineers are difficult to find.

As indicated in the RRC Capacity Building and Skills Development Plan¹⁸ traditional, formal learning opportunities such as workshops, lectures and conferences, although important, will not be adequate to sustain a workforce in a knowledge-based age. The Plan therefore recommends that the RRC should structure its work environment for rich, ongoing, informal learning and that learning must be deeply embedded in communities of work practices. It further states that well-established, open, and accessible communication infrastructures also facilitate learning while encouraging collegial interaction and improving access to information.

¹⁸ Verhaeghe B, Antunes ML, Paige-Green P. 2014. *Establishment of a Road Research Centre in Mozambique: capacity building and skills development plan*, Project AfCAP/MOZ/092/B, Crown Agents (UK).

At the same time collaboration with external stakeholders should also be encouraged to ensure the influx of new ideas as well as the dissemination of internal knowledge. Such sharing is important for establishing the RRC's reputation for innovation and the development of cutting-edge technologies.

The ANE Communications Department is responsible for the content of the ANE webpage. It is also in the process of developing an IntraWeb page using a free version of WordPress. Branding still needs to be determined by ANE. A need was expressed for the services of a science communicator to assist with technical and scientific communication. The Communications Department will utilise the auditorium and exhibition space in the new building to further promote ANE to its stakeholders.

4.6 Materials testing laboratories

The RRC would rely on available laboratory equipment and services rendered by ANE and LEM to support its initial research activities. The laboratories of LEM will act as a reference laboratory. Field testing equipment will also play a key role in the RRC activities and it is expected that ANE and LEM's field testing equipment located in their provincial laboratories should be made available to support the RRC activities. Over time, the RRC will require specialised laboratory equipment not currently available in the central and provincial laboratories of ANE or the laboratories of LEM. The acquisition of such equipment might necessitate the RRC to establish its own laboratory, or dedicated space and resources in ANE's Central Laboratory could be allocated to accommodate and operate the equipment¹⁹.

ANE's central laboratory is equipped with basic equipment for testing soils, aggregate and asphalt. However, much of it needs updating, repair or replacement. A list of test equipment specifications was submitted by the AfCAP consultant with the purpose of obtaining external funding (e.g. from the World Bank). As yet no plan is in place to appoint skilled technicians and operators.

The laboratories will require interfaces and software to collect, store and process test results as necessary. The software should be such that processed results, as well as the raw data, are directly accessible to all of the researchers through the local area network. Data sets created as part of research activity should be preserved as it will be important for on-going research as well as for verification of research results. The Information Centre should be able to assist with research data management.

Provision should be made for the typical information resource requirements of laboratory staff. This will include test methods; national and international standards; international journals; and guidelines. Discrepancy in the use of different material testing standards should be resolved (i.e. LEM presumably using Portuguese standards and ANE SATC standards).

¹⁹ Verhaeghe B, Antunes ML, Paige-Green P. 2014. *Establishment of a Road Research Centre in Mozambique: draft business plan for first five years of operation*, Project AfCAP/MOZ/092/B, Crown Agents (UK).

5 Proposed knowledge management framework

Each organisation is unique and knowledge management initiatives should be aligned closely with the strategic goals of the organisation. The goal of the RRC is to serve the road engineering needs of the public and private sector of Mozambique through the development, application and dissemination of new knowledge, and the development of human capital. It will strive to provide practical, innovative, cost-effective R&D based solutions that address the current and future road infrastructure needs of the country and the region; support sustainable development and asset preservation; and enhance socio-economic impact and industry competitiveness. The RRC will provide innovative engineering solutions for the design, construction, maintenance and management of road infrastructure assets based on basic and applied research supporting the provision of a sustainable and cost-effective road network.

The draft RRC Business Plan²⁰ highlighted a number of aspects which might influence the knowledge management solutions implemented. These are (in no particular order):

- *The RRC is expected to expand and grow over time. Hence, the institutional structure and location of the RRC will have to be reviewed periodically. In future, its size may necessitate the RRC to become a cross-cutting entity or to be established as an independent organisation outside the structures of ANE. One of the triggers for the latter to occur is when the RRC starts to embark on transportation and other studies that fall outside the mandate of ANE. Typically, this would also imply a name change, from a Road Research Centre (RRC) to a Road and Transport Research Centre (RTRC). Initially Information Centre resources will therefore focus on road engineering. However, resources and services will be expanded as the spectrum of RRC research activities is broadened.*
- *The RRC will operate as an entity that will support all Directorates of ANE on an equitable basis. This will include the Provincial Delegation and standardisation of data and information management activities will thus be required to ensure both service delivery to and compliance by the provincial laboratories.*
- *The RRC should have strong links to other institutes that carry out research within Mozambique. Cooperation agreements with public or private universities in Mozambique will be beneficial for the RRC. The RRC will also establish cooperation links with other major players in the field of road engineering, such as professional associations, consultants, contractors and suppliers through their participation at the RRTC and at the Roads Forum / GESTRAD. Cooperative projects with these entities will require the provision of collaborative electronic research platforms. Ownership of the intellectual property created through joint research activities will also need to be addressed. In addition clear guidelines regarding research records management will have to be established.*
- *One of the value propositions of the RRC is for an information centre that would be a repository for, inter alia, text books, local and international conference proceedings and journals, research reports, technical guidelines, norms and standards. In light of the distributed client base it is recommended that information resources should be in electronic format to allow for web based access.*
- *The Information Centre would serve the technical information needs of the RRC researchers, ANE and the roads sector of Tanzania as a whole. The size and range of the Information Centre client*

²⁰ Verhaeghe B, Antunes ML, Paige-Green P. 2014. *Establishment of a Road Research Centre in Mozambique: draft business plan for first five years of operation*, Project AfCAP/MOZ/092/B, Crown Agents (UK).

groupings will significantly influence the subscription costs of electronic resources and access to electronic information resources will also have to be monitored in terms of publisher/supplier license stipulations.

- *Information transfer activities* should target all stakeholders, both internal and external, to ensure support to fulfil the mandate of the RRC. The generated evidence base of road engineering 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.

In support of the strategic organisational goals, and to enable the Knowledge Life Cycle processes described previously ([Section 2.2](#)), knowledge management activities proposed for the RRC 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 enablement of a knowledge sharing culture
- Enabling the core functions of the RRC by effectively managing its **knowledge base** through good data and information management practices

These three initiatives are discussed in more detail below.

5.1 The enhancement of research capability by strengthening the knowledge creation and evaluation processes

In knowledge intensive organisations, such as research institutions, knowledge generation and evaluation processes should be optimised. Knowledge management efforts should therefore support knowledge generating activities such as individual/group learning, research activity and information acquisition; as well as new knowledge evaluation.

In the RRC knowledge generation activities will focus on the development of innovative local, cost-effective solutions for local problems; the adaptation of appropriate technology and solutions from elsewhere to satisfy local conditions and; the coordination of long-term, demand-driven research activities to maximise benefits to ANE and the country as a whole. Individual/group learning, capacity building and research activities are covered as part of the longer term phase AfCAP technical assistance to ANE and will not be addressed further in this study. The focus will rather be on the acquisition of new information, specifically through library and information services ([Section 6.1](#)), and the support of collaborative research activities through the provision of virtual collaboration platforms ([Section 6.2](#)).

New knowledge generated through research activity and individual/group learning needs to be evaluated before it can be put into practice. In a knowledge intensive organisation such as the proposed RRC, 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. These are already in place. The Road Research Steering Committee (RRSC) was constituted to provide overarching strategic oversight of the RRC. Its membership comprises senior representatives of ANE, LEM, the Roads Fund, MOPH, the National Institute of Surface Transport (INATTER); the Police Force of the Republic of Mozambique, the Association of Municipalities, the Mozambican Council of Engineers; and representatives of developing partners. The Road Research Technical Committee (RRTC) was established to provide technical guidance and direction to the RRC and to advise the RRSC on the nature and scope of research, development and implementation activities to be undertaken in the road infrastructure engineering domain. These two committees will be responsible for the prioritisation and coordination of national road research activities and will inform and oversee research on behalf of stakeholders and the research community. Monitoring and evaluation of research outcome is essential to determine effectiveness of the research activities and to inform future policy improvements.

In terms of published literature such as journals articles, books and conference papers, peer review is understood to be the pre-publication refereeing or evaluation of complete manuscripts by independent experts in the field in order to ensure quality and determine whether manuscripts are publishable or not. 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.

5.2 Optimisation of knowledge dissemination to stakeholders and the enablement of a knowledge sharing culture

Saving even one per cent of the annual expenditure requirements on transport in developing and transition countries would save hundreds of millions of dollars annually. Thus, a small improvement in performance, by applying existing experience and knowledge, would yield large benefits in the sector, and more generally to the economy²¹. However, inadequate access to this knowledge has been a barrier to up-take and application.

Knowledge transfer is one of the key focus areas of the RRC. The main purpose of its knowledge dissemination initiatives should be to facilitate the link between producing research evidence and influencing policy (decision making) and practice (application). Research output should be made accessible through systems for dissemination whereby research uptake and lobbying on policy can be supported. Knowledge dissemination systems should help to ensure the long term sustainability of access to road engineering information and the continuing exchange of knowledge.

Satisfying external stakeholders is a pre-requisite for attracting support to fulfil the mandate of the RRC 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 implication and impact documents

²¹ O'Neill P and Petts R. 2004. Transport knowledge sharing initiatives for ASEAN engineers. *22nd Conference on ASEAN Federation of Engineering Organizations (CAFEO-22), 18-19 December 2004.*

- facilitating policy dialogues with key policy makers and other stakeholders

Research uptake by practitioners could be enhanced by:

- strengthening the interconnectedness of practitioner communities nationally and internationally
- hosting industry 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 norms and standards, best practice manuals and industry guidelines and specifications (and compiling simple manuals and guidelines that could also be used at district and village level)
- undertaking demonstration projects for periodic site visits and workshop discussions
- compiling short digests and policy briefings as few practitioners will read lengthy research publications
- providing input and contribute to the development of academic and training curricula
- making accessible research publications through effective Information Centre services
- publication of newsletters and press releases
- establishing an informative organisational website

The proposed knowledge spaces discussed in **Section 6.1.1** 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 the RRC and to establish its credibility and status among practitioners.

Optimisation of internal knowledge dissemination within the RRC and ANE should also receive attention. The proposed knowledge spaces should be utilised to optimise knowledge transfer and organisational learning within ANE, 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 Directorates, laboratories and research groups. The proposed internal knowledge portal/intraweb (**Section 6.3**) in addition to activities covered under the section on Communities of Practice (**Section 6.4**) will similarly enhance knowledge dissemination efforts within the Research Centre.

5.3 Enabling the core functions of the RRC by effectively managing its knowledge base

It is important to enable the core services associated with research and development, materials testing, quality assurance and capacity building through good data and information management practices. The RRC will have a responsibility to efficiently manage, store and retain research data sets, 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.

For these purposes the RRC will utilise the ANE infrastructure and will comply with its document management procedures. Additional requirements not currently provided for by the ANE systems (i.e. the management of research data) will have to be addressed.

Should the RRC become an independent organisation outside the structures of ANE, it will be required to develop its own infrastructure, systems and procedures. This will, however, provide an opportunity to consider a comprehensive and integrated content management solution aimed at the integration of all its systems, databases and procedures as an independent RRC will not be bound by legacy systems.

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. As a minimum requirement a 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

Once implemented the electronic work flow system planned by ANE ([Section 4.2](#)) will address some of these aspects, e.g. governance roles and responsibilities as well as approval and routing frameworks.

6 Implementation of knowledge management initiatives

Knowledge management activities to be considered in support of the abovementioned initiatives (Sections 5.1-3) are summarised in the table below:

Enhancement of research capability by strengthening knowledge creation and evaluation	Optimisation of knowledge dissemination to stakeholders and the enablement of a knowledge sharing culture	Enabling the core functions through effective management of the organisational knowledge base
<p>Individual or group learning (addressed outside this study as part of the RRC capacity building activities²²)</p> <p>Information acquisition through library and information services</p> <ul style="list-style-type: none"> - User access to reliable information resources - Information specialist services <p>Supporting collaborative research activities through virtual collaboration platforms</p> <p>New knowledge evaluation through peer review and/or management approval structures</p>	<p>Knowledge dissemination to external stakeholders</p> <ul style="list-style-type: none"> - Web-based knowledge portal and institutional repository - Communities of Practice - Journals and publications <p>Knowledge dissemination to internal stakeholders</p> <ul style="list-style-type: none"> - Intranet/internal website - Provision of physical knowledge spaces - Enhancing the organisational culture to optimise knowledge sharing 	<p>Comprehensive data and information management of:</p> <ul style="list-style-type: none"> - Research and consultancy related publications, project specific records and data sets - Governance related records - Externally acquired information and data - Content disseminated externally

Figure 14: Knowledge management initiatives

These knowledge management activities will be discussed in detail in the following sections of the study. It should be noted that the activities proposed will be covered in an integrated manner as certain activities or functions (e.g. the services to be offered by the Information Centre) will contribute to more than one of the framework's three initiatives. Implementation options will be provided where it makes sense to do so.

The degree to which the proposed knowledge management solutions are put into practice will be determined by organisational priorities as well as enabling factors such as funding, ICT infrastructure and support, along with staff capacity and skill levels. Nonetheless, all of the following solutions should be considered.

²² Verhaeghe B, Antunes ML, Paige-Green P. 2014. *Establishment of a Road Research Centre in Mozambique: capacity building and skills development plan*, Project AfCAP/MOZ/092/B, Crown Agents (UK).

6.1 Information Centre

The research capability of the RRC will be enhanced through the library and information services offered by a fully functional Information Centre with skilled staff. Library and information services associated with research centres normally range between the following three options:

- Traditional library services 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 users
- 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 planned activities of the Research Centre 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.

As the Information Centre will be required to provide thought leadership and services in matters directly linked to its mandate, it is important for the ANE management structures to, as a first step, confirm the mandate of the Information Centre. It is foreseen that the Information Centre will support and enable the RRC and ANE 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.

6.1.1 Service streams

In support of the above the activities of the Information Centre 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

Whereas engineers require access to best practices and standards, researchers want to know what has been done before and what other best practices there are. Researchers therefore 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; 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; datasets; codes of practice; and publications from aid organisations). Initially information resources will focus on road engineering, however, resources and services will be expanded as the spectrum of the RRC's research activities is broadened. **Annex C** provides a list of suggested initial information resources. Ideally, access to the Information Centre's

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

Price negotiation should consider the most efficient and cost-effective way of delivering commercially available information resources. Currently there is no Mozambican library consortium through which cheaper access to information resources could be negotiated on behalf of its members but this should change soon with approximately 40 potential consortium partners from universities, polytechnics and research institutes already identified. The Information Centre should therefore interact closely with Mozambican library associations to ensure participation in future consortium activities. The following organisations should also be approached for assistance:

- **International Network for the Availability of Scientific Publications (INASP)**. INASP has been working with Mozambique since 2001. It 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. As Mozambique does not currently have a library consortium this is managed by the UEM. The section of the INASP website dedicated to Mozambique²³ provides online resources negotiated for and accessed via INASP.
- **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 Information Centre is in the position to provide access to the proposed electronic resources, corporate membership of the Engineering and Central libraries of UEM as well as the ISUTC and LEM libraries should be negotiated. Such membership will allow ANE staff access to the paper and electronic resources (e-books and e-journals) of these libraries.

Given the context of the research focus areas publications, both commercially available and free 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 Information Centre will be required to maintain a **grey literature collection** consisting of relevant reports and publications from agencies other than ANE. The grey literature collection will typically include publications from other Government departments as well as publications from national, regional and international research centres. Particular attention should be paid to publications from those institutes in the field of road engineering with which the RRC will enter into cooperation agreements. The grey literature collection should be restricted to publications which cannot be found easily either from the websites of these organisations or through conventional

²³ <http://www.inasp.info/en/network/country/MZ/>

channels such as publishers. Agreements with these agencies should be put into place to ensure that publications relevant to ANE staff are received on a regular basis. Aspects to consider include:

- Policy and procedures for the grey literature collection development
- Report categories and report value in terms of retention and disposal schedules
- An electronic database with metadata and indexing standards
- Storage capacity required to manage paper copies in a suitable environment
- Electronic access for users to the grey literature database through the library portal

Road related research is often fragmented which prevents consistent, continuous, and coordinated research work. During the third meeting of the RRTC²⁴ it was decided that a website should be established which will provide access to previous research undertaken by national and international institutions and agencies on the roads sector in Mozambique. This will allow the RRC and its research partners to maximise the exploitation of past research results. It will also help to avoid repetition or duplication of research undertakings. The Information Centre should therefore establish a **centralised knowledge database of Mozambican roads research** which will be accessible online by all its stakeholders. Besides the actual research findings the database records should also, where possible, indicate the research methodology, controls, institutions involved and competence of the researchers. Such a database will be an indispensable source of information to a broad range of stakeholders including current and future researchers, practitioners, academia, road policy and decision makers, and the general public. Design and implementation of the database will need to take into consideration:

- Assessment of database software options
- The metadata structure and indexing standards
- Policy and procedures for collection development
- A suitable user interface on the ANE website to allow access to and searching of the database

Language is often a barrier to knowledge exchange. To ensure optimal utilisation of information resources a translation facility²⁵, from English to Portuguese mostly, should be available for those researchers not fully fluent in English. (It may also be necessary later for translation from Portuguese to English of RRC documents intended for international use, e.g. conference papers and theses.) Whereas it will not be feasible for ANE to appoint a language translator on a full time basis, the Information Centre should maintain a list of qualified technical translators whose services could be contracted on an ad hoc basis. ANE staff should also be encouraged to, as a first step, utilise the freely available translation software offered by web browsers.

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

²⁴ Verhaeghe B. 2016. *Technical Assistance to Mozambique Road Research Centre (Interim Phase): Progress Report: January to March 2016*, Project AfCAP/MOZ/2045A, Cardno Emerging Markets (UK).

²⁵ Verhaeghe B, Antunes ML, Paige-Green P. 2014. *Establishment of a Road Research Centre in Mozambique: draft business plan for first five years of operation*, Project AfCAP/MOZ/092/B, Crown Agents (UK).

information resources. This aid is often at the information seeking stage, when researchers have difficulty tracking down references, or need expert help formulating search strategies²⁶. 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 behaviours²⁷.

Value-added information services should be provided to ANE staff on both a pro-active and reactive basis. The Information Specialist (see [Section 6.1.2](#)) will be responsible for building and maintaining relationships with the various research groups 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. Involving product suppliers as expert trainers as well as capitalising on the available on-line training material could be considered. The Information Specialist should also participate in the induction training of new research staff²⁸.

As information specialist services will be provided using the Information Centre infrastructure and information resources, no additional planning is required for this service stream other than ensuring that the incumbent has a working knowledge of the relevant subject areas and experience in a similar environment.

Service stream 3: Preserving and making accessible (both internally as well as externally to the organisation) the intellectual property created by the RRC through services focused 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. Therefore the Information Centre should ensure that all RRC generated research publications are collected, captured, managed, preserved and made accessible based on acceptable meta-data standards and according to RRC policies and procedures. As such it will establish and maintain a **Research Outputs Database** which will act as a repository for all research and consultancy project outputs and related material such as project proposals, progress reports, research and consultancy reports, learning briefs, safety documents, laboratory reports, technical manuals as well as information published externally by RRC staff, e.g. conferences papers and posters, journal articles, books, chapters in books and training material.

²⁶ Shorish Y. 2015. The library as research partner. *ACRL TechConnect Blog*, 23 Nov.

²⁷ Research Information Network (RIN) and Research Libraries UK (RLUK). 2011. *The value of libraries for research and researchers: a RIN RLUK report*.

²⁸ Verhaeghe B, Antunes ML, Paige-Green P. 2014. *Establishment of a Road Research Centre in Mozambique: capacity building and skills development plan*, Project AfCAP/MOZ/092/B, Crown Agents (UK).

A suitable electronic database platform should be deployed and the following aspects should be considered:

- Automated routing/approval procedures in support of electronic document submittal
- Metadata and indexing standards
- IT infrastructure to store electronic copies of the research outputs, preferably in the form of an electronic document management system (**EDMS**)
- Storage of archival paper copies in a suitable environment with climate and access control
- Electronic user access to the database through the library portal

As previous discussed in **Section 2.1**, the RRTC expects the Information Centre to play a key role in making the RRC and its outcomes visible externally to the organisation. To facilitate this metadata of selected publications captured in the Research Outputs Database should be exported to a web-based **institutional repository** through which RRC publications can be made accessible to external stakeholders. (An institutional repository is a web-based database of scholarly material which is institutionally defined; cumulative and perpetual; and open and interoperable²⁹.) 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 RRC research reports and research data
- publisher approved versions of external publications (journal articles, book and book chapters, conference papers) authored by RRC 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 primary aim of the repository will be to make the research outputs of the organisation as widely available as possible. The Information Centre will be responsible for the establishment and maintenance of the institutional repository. The following is required to establish an institutional repository:

- Identify suitable institutional repository software based on desired functionality that will be compatible with the existing ICT infrastructure. Consultation with similar established services is advisable. (INASP provides support to libraries wishing to develop their own institutional repositories in line with international standards. The UEM Central Library staff should also be able to provide guidance in this regard as they have already established an institutional repository for the University.)
- 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 and 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.

²⁹ 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>

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

The use of knowledge spaces should form an important part of both ANE and the Research Centre's knowledge management strategies as the physical work environment can encourage knowledge sharing practices, internal dialogue, networking and science communication. Dedicated spaces should therefore be provided where ANE and RRC staff (and external stakeholders, if appropriate) can meet, think together, have conversations and dialogues, collaborate and promote science and research on both a formal and informal basis. The type of venues recommended is based on the typical space requirements of knowledge workers. These are:

- **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 company³⁰. 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 ways³¹.

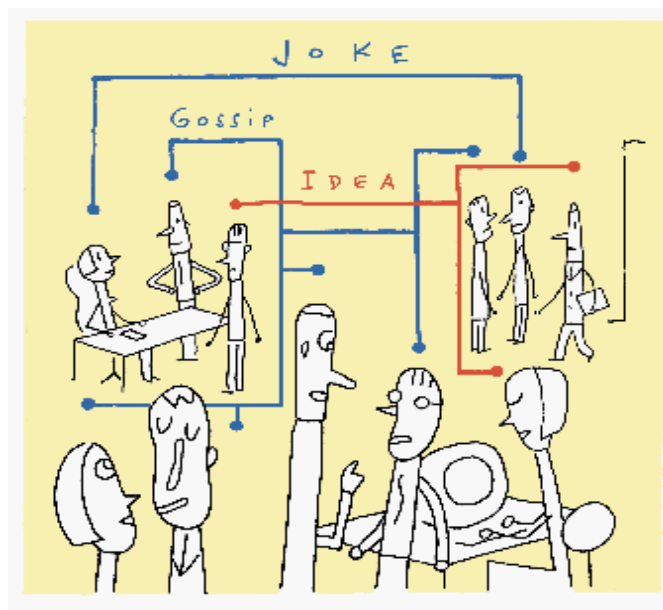


Figure 15: The social side of innovation (graphic from Gladwell¹)

Ideally these knowledge spaces should have formed part of the Information Centre infrastructure as the Information Centre staff will be responsible for the optimisation of knowledge sharing activities within ANE. However, as the venue for and layout of the Information Centre have already been decided, the use of existing spaces should be optimised. Details of the available physical spaces that

³⁰ 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.

³¹ Davenport TH and Prusak L. 1998. *Working knowledge: how organisations manage what they know*. Boston, Massachusetts: Harvard Business School Press.

could be utilised are provided under the **Infrastructure** heading below. Depending on availability, all proposed venues should be considered as each type supports different knowledge transactions.

To ensure optimum utilisation of these spaces the Information Centre staff will be responsible for the conceptualisation, planning, and implementation of an **events plan** and the scheduling of talks, lectures, presentations and exhibitions by ANE staff and external speakers on a regular basis. Topics of events can typically vary between those with a strictly work related focus and those with a more general or actuality theme. The events plan should consider:

- Science and technical dialogues and debates
- Divisional and discipline cross-cutting issues and efficacy
- Organisational and industry conversations
- Research and innovation best practices
- Science and research showcasing
- Social mingling and interaction

The events plan should facilitate innovation and learning, encourage collegial interaction and improve access to information. A regular programme of short presentations should be organised internally so that staff, especially young researchers within the RRC, could develop their presentation skills within the relatively safe environment of the organisation itself. The utilisation of video-conferencing equipment will allow staff from the Provincial Delegation to benefit from these activities. It will also facilitate presentations from outside ANE, e.g. by experts from national and international research organisations.

The events plan should be coordinated with the Communications Department who is planning to utilise the auditorium and exhibition space to further promote ANE to its stakeholders.

The events plan should also encourage collaboration beyond the walls of the ANE as such outside influences are critical not only for the influx of new ideas but as an avenue for "marketing" of local knowledge. Such sharing is important for establishing the RRC's reputation for innovation³².

6.1.2 Human resources

An **Information Centre Manager** should be appointed to establish, manage and operate the Information Centre. Responsibilities will include:

- Conceptualise and establish the service and necessary infrastructure, systems, databases, policies and procedures
- Provide specialist guidance to the Research Centre in terms of the availability of commercial and open access information products and their content and negotiate access to electronic information resources, preferably through consortium participation
- Recruit and manage the staff compliment (see below)
- Develop and lead knowledge management programmes that encourage innovation and the promotion of a culture of knowledge sharing, dialogue and science communication. This will include the conceptualisation and implementation of a knowledge sharing events plan (see [Section 6.1.1](#))
- Manage relationships with several key stakeholders and suppliers

³² Verhaeghe B, Antunes ML, Paige-Green P. 2014. *Establishment of a Road Research Centre in Mozambique: draft business plan for first five years of operation*, Project AfCAP/MOZ/092/B, Crown Agents (UK).

- Maintain the library portal and catalogue to make accessible commercial monographs (books), journals and multi-media library material according to international standards
- Provide routine library technical services such as document delivery, inter library loans, and circulation services
- Index and manage the grey literature collection and populate and maintain the centralised knowledge database of Mozambican roads research publications

This person should have the following skills and competencies:

- Self-starter able to work within broadly defined parameters
- Highly systematic and well organised
- Team player with well-developed networking abilities
- Advanced computer user skills
- Technical competence in electronic information management and gaining access to information
- Well versed in the principles of knowledge management

Due to the complexity of the systems to be implemented it is recommended that the incumbent should hold at least a Master's degree in Library and Information Science. As similar systems are in place in most university libraries and comparable services are provided to academic staff it is advisable to recruit an experienced person coming from an academic environment.

In addition to the Information Centre Manager an **Information Specialist** should be appointed with the following key tasks:

- Empower line staff through training in the use of electronic information resources as well as the critical evaluation and selection of authoritative information resources
- 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
- Advise research staff on the international requirements linked to research data management
- Build and maintain relationships with the research groups to ensure continued awareness of researchers' needs as well as to improve service delivery
- Index the data and documented research output of the RRC through analyses and extraction of relevant metadata so that these could be captured reliably in the Research Outputs Database
- Populate the web-based institutional repository with selected internal (as well as external publications) and ensure that copyright requirements are adhered to

The following skills and competencies will be required for this position:

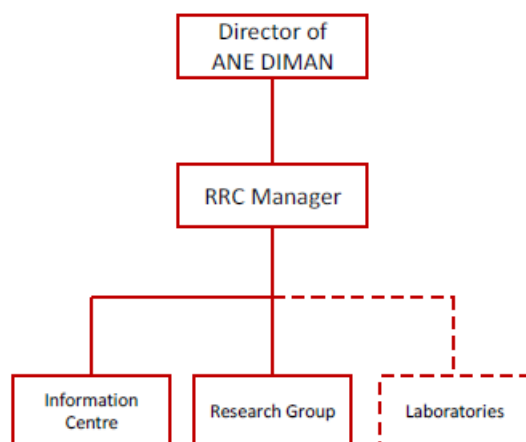
- Knowledge and understanding of the road engineering subject area as demonstrated in the ability to correctly use terminology, to discuss, understand and evaluate the literature, trends and new developments in this area and to index, abstract and write concise summaries of various scientific documents in this discipline
- Advanced Internet and database searching skills as well as expert knowledge of the content of subject specific information resources, including the ability to critically evaluate and filter them
- Good working understanding of ICT and Web 2.0 tools
- Reference interview skills

- Understanding of the Open Access publishing models and research output dissemination
- Presentation skills and an understanding of the learning styles of adult learners

The Information Centre will be highly reliant on the ICT Department for both system implementation and support. As the Information Centre 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 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 Information Centre Manager with the design and implementation of the required library systems. In this regard it might be advisable to approach the UEM Library Director, Dr Horácio Zimba, as he specialises in library IT systems and technology.

Continuous skills development of Information Centre staff should be included in the general capacity building initiatives of ANE and the RRC. 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 INASP should be considered as well as external attachment/secondment programmes to libraries from local universities such as the UEM and international research organisations. Post graduate studies should also strongly be encouraged.

The institutional structure of the RRC will evolve and expand over time. Hence, the **organisational structure and institutional location** of both the RRC and Information Centre will have to be reviewed periodically. The RRC business plan³³ indicates that, while the RRC has a fairly small complement of researchers, it will be located in DIMAN as one of its line departments and the following initial organisational structure was proposed for both the RRC and the Information Centre:



In contrast with the above, it emerged from interviews held with ANE staff during the 3-day Maputo site visit that the Information Centre will be managed by the Head of the Document Management Department which falls under DIAFI. Whereas there are certain synergies in the activities of the two functions, care should be taken that the Information Centre is not treated in the same way as other cross-cutting services. As the Information Centre is central to the knowledge generation process it would strategically be better placed within the RRC structure as was proposed in the business plan. Nevertheless, to accommodate the decision to place the Information Centre within DIAFI, the following organogram, which indicates the human resource requirements of the Information Centre and how it fits into the overall ANE structures, is proposed:

³³ Verhaeghe B, Antunes ML, Paige-Green P. 2014. *Establishment of a Road Research Centre in Mozambique: draft business plan for first five years of operation*, Project AfCAP/MOZ/092/B, Crown Agents (UK).

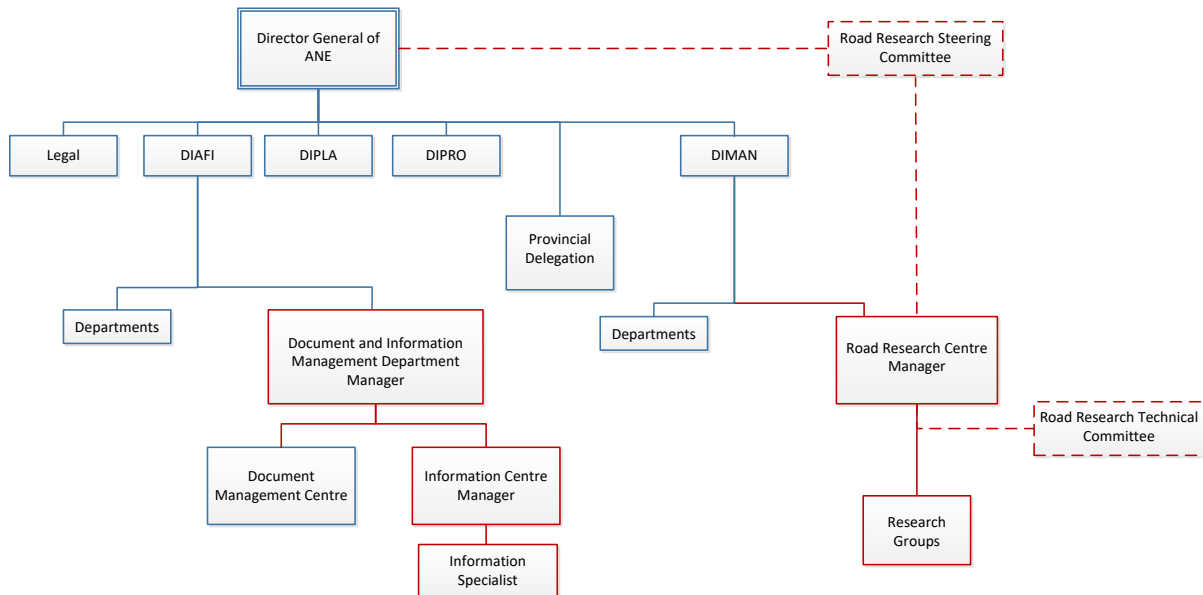


Figure 16: Information Centre organogram

In line with the decision to place the Information Centre within DIAFI, the Document and Information Management Department, incorporating both the Document Management Centre and the Information Centre, will then be managed by the current Head of the Document Management Department. It will be his responsibility to strategically direct the operational aspects of archival activities at organisational level and oversee record management activities within the ANE.

6.1.3 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. Access to the internet with sufficient bandwidth and a reliable supply of electricity is an essential prerequisite for a sustainable service. To support the proposed Information Centre service streams the infrastructure needs to make provision for the following:

Systems

Library Management System: To operate effectively the Information Centre will require an integrated library management system (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 Information Centre staff. These platforms could however be expensive. A

cheaper option will be the implementation of an open source integrated LMS like LibLime Koha³⁴ or ABCD³⁵.

LibLime Koha is used by hundreds of libraries worldwide. It is web based, so there is no software to install on desktop computers and LibLime hosting services means that no servers are required in the library. Upgrades, backups and general system maintenance are managed by LibLime Koha. The development of LibLime Koha is steered by a growing number of libraries throughout the world. These libraries, either on their own, or collaborating in groups, sponsor the development of new features to support their workflows. In keeping with open source tradition, library-sponsored enhancements to LibLime Koha are available for others to use, modify, and re-distribute.

ABCD is web-based integrated library management software comprising the main basic library functions. It was developed by BIREME (the Latin American and Caribbean Centre on Health Sciences) and VLIR (the Flemish Interuniversity Council, Belgium). The main characteristics of ABCD are the coverage of the main library functions, its web centrality and its development and maintenance under the methodology of free and open source software.

It should be noted that open source LMS like LibLime Koha or ABCD still require annual licensing fees. These are however substantially less than purchasing proprietary systems.

Should an integrated LMS not be implemented, individual manual systems will have to be put in place to address the standard technical services required. 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 ANE financial system
- Library network services: negotiate external service provision, e.g. through the libraries of UEM, LEM and ISUTC
- 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
- Information Centre resources and services user interface/library portal through which the user experience of discovering and accessing information can be unified: free versions of blog software, e.g. WordPress or Drupal

Database software: Database functionality will be required to manage the grey literature collection consisting of relevant reports and publications from agencies other than ANE, government departments as well as national, regional and international research centres. It will also be required for the management of the RRC Research Outputs Database and the centralised knowledge database of Mozambican roads research.

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 Information Centre to manage its library collections, the grey literature collection as well as the confidential Research Outputs

³⁴ <http://www.koha.org/about>

³⁵ <http://www.unesco.org/new/en/communication-and-information/access-to-knowledge/free-and-open-source-software-foss/abcd/>

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 software³⁶: As previously noted an institutional repository is a web-based database intended to provide access to scholarly material which is institutionally defined; cumulative and perpetual; and open and interoperable. Software (e.g. DSpace, EPrint, Fedora, Islandora) providing the following functionality should be considered:

- Technical/ICT infrastructure, including hardware and software
- Front-end design for ease of use
- Content organisation, control and discovery tools
- Publication tools and reporting options
- Multimedia support, social features and notifications
- Interoperability
- Authentication
- 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 Department. Implementation of institutional repository software, however, allows the content of the repository to be harvested by other electronic repositories such as the ReCAP Rural Access Library³⁷. (ReCAP's knowledge management strategy³⁸ 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.) Inclusion of RRC research output on other subject related repositories, such as the ReCAP repository and the planned African Road & Transport Research Forum (ARTReF) database³⁹, will increase the visibility of RRC publications.

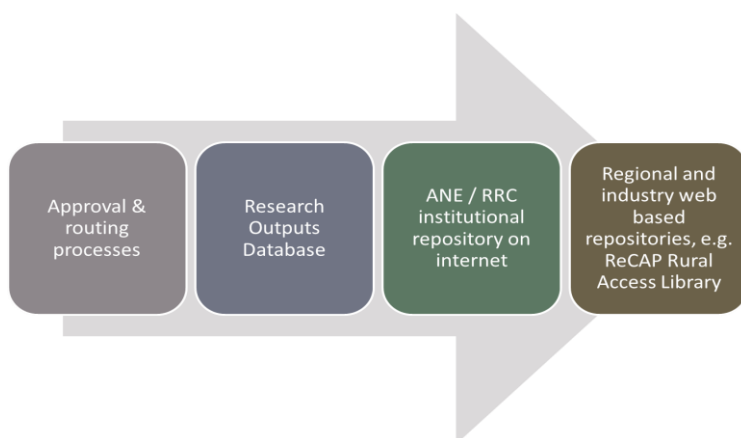


Figure 17: Proposed RRC database & repository work flow

³⁶ Open Society Institute. 2004. *A guide to institutional repository software*. http://www.budapestopenaccessinitiative.org/pdf/OSI_Guide_to_IR_Software_v3.pdf.

³⁷ www.research4cap.org

³⁸ *ReCAP Knowledge Management and Communications Strategy*. Sep 2015. Cardno Emerging Markets (UK).

³⁹ *The establishment of the African Road and Transport Research Forum (ARTReF)* <http://research4cap.org/Recap-news/Lists/Posts/Post.aspx?ID=29>

A less ideal option would be to use searchable internet website/blog software, e.g. WordPress, to create subject categories with alphabetical research publication lists and additional metadata. This option, however, does not allow harvesting by other repositories.

As mentioned in **Section 4.2**, ANE does not currently have an electronic work flow system but plans are in place to customise an off-the-shelf system from Spain. The existing document management system, I+DOC, is used to manage scanned copies of contracts and project reports but an electronic document management system (EDMS) is not yet available. The I+DOC system used by the Document Management Centre will also not be suitable to incorporate the proposed Research Outputs Database as its indexing fields do not correspond with that required for the Research Outputs Database. It will also not provide the sophisticated search capability offered by database software. Therefore, until such time that the ANE implements a content management solution, it is proposed that RRC research publications are managed by the Information Specialist in the following manner:

- Once the research publication is approved by the RRC management structure, a paper copy (signed, if appropriate) as well as an electronic copy is submitted to the Information Specialist.
- The Information Specialist ensures that the paper copy is submitted to the Document Management Centre which will archive it in both paper and scanned format.
- The Information Specialist will save the electronic copy on a separate, access controlled folder created for the Information Centre on the **ANE/RRC server** (depending on the infrastructure architecture determined and implemented by the ICT Department) where full text research publications can be archived. (Electronic copies are often useful for the writing of subsequent or similar documents.)
- Subsequently the publication will be indexed on the Research Outputs Database.
- Selected publications captured in the Research Outputs Database which could be made available outside the organisation will then be exported to the institutional repository from where it could be harvested by regional and industry web based repositories.

Physical spaces

The planned space allocated to the Information Centre in the new building currently under construction should make provision for:

- Office space for the Information Centre Manager
- Storage facilities with appropriate shelving for the library and grey literature collections. As the collections grow standard shelves could be replaced with a compact shelving solution
- A library reading area with work stations and study areas for knowledge workers
- A small social area to encourage staff interaction and informal knowledge exchange. If possible the social area should include a small coffee station

The fixed seat auditorium and foyer in the new building, the existing ANE Conference Room as well as a smaller meeting rooms in the ANE buildings could be utilise for team spaces as well as the implementation of the Information Centre's knowledge sharing events plan. Where possible modular furniture should be used and appropriate audio visual and video conferencing equipment installed to allow these venues to be multifunctional.

Office space for the Information Specialist will be required in the building that will house the RRC.

Computers, office and audio visual equipment

Standard equipment required will include furniture and computers for staff offices and library reading areas as well as a printer/scanner/photocopier.

6.1.4 Finances

Sustainable funding will in all probability be the most important resource to negotiate. Access to reliable information resources is expensive and ongoing (although Mozambique is eligible to several very good discounts through initiatives from organisations such as EIFL and INASP) 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 LMS licence as well as a maintenance agreement.

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 infrastructure costs to further expand the client grouping.

As previously mentioned the Information Centre will be expected to serve the information needs of the RRC researchers, ANE and the roads sector in Mozambique as a whole. This aspect will have cost implications for the access licences to be negotiated with commercial publishers/vendors. Licenses negotiated through INASP and consortia activities might, however, not be influenced by client groupings.

6.2 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 Research Centre 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 Framework⁴⁰ (OSF) are available to assist researchers with the management of 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.)

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

⁴⁰ <https://osf.io/>

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.

Virtual collaboration platforms

Social network, e.g. Twitter, Facebook	Project hashtag for interaction with project target community Community participation, gathering input from target community 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, Vibe, WordPress (Blog), Wiki	Shared organisational knowledge base Include progress & final project reports Project evaluation and lessons learnt

Figure 18: Virtual platforms available to collaborative research teams

6.3 Web-based knowledge portals

ANE requires both an internal website (Intraweb) as well as an external website. ANE has a basic external website but an Intraweb is still under development. As mentioned in [Section 4.5](#), the ANE Communications Department is responsible for the content on the ANE webpage. It is also in the process of developing an Intraweb page using a free version of WordPress. Branding still needs to be determined by ANE.

The **Intraweb** will serve as a portal for ANE staff to find organisational information and to learn about developments and news about the organisation. It will afford staff quick and efficient access to organisational systems and to the databases of the Document Management and Information Centres.

The **external website** requires extensive development and it should also address the requirements of the RRC. It should provide a snapshot of the organisation to the outside world and should contribute to its knowledge dissemination efforts. A sustainable, easily accessible knowledge portal providing a clear description of the Research Centre's purpose and services will assist it in building a strong reputation in the roads sector. It should also make research output accessible to external stakeholders through the **institutional repository** ([Section 6.1.1](#)) and thereby support research uptake. As such it is an important marketing and communication tool for the RRC.

The external website should also provide access to the centralised **knowledge database of Mozambican roads research** (see [Section 6.1.1](#)).

The IntraWeb and the external website will both require holistic website design which considers equally the technical solution and 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 RRC, access to its research and consultancy outputs.

Guidelines and standards for uploading information and links to the websites 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 updates to the website. (ANE and the RRC might also opt to keep high level stakeholders and industry practitioners updated through other means. As Starkey⁴¹ 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 IntraWeb 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 departments in the organisation 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 organisation 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

⁴¹ Starkey P. 2013. *Feasibility study of options for long term knowledge sharing & management*. Project AfCAP/GEN/096, Cardno Emerging Markets (UK).

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 organisation’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.

The Communications Department expressed a need for the services of a science communicator to assist with technical and scientific communication. In this regard it is recommended that the service of a **Communications Practitioner** is obtained (see [Section 6.5](#)). The Communications Practitioner could also assist with portal content and branding aspects.

6.4 Networks and 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 experiences⁴². 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 practice⁴³. COPs differ from project teams which are driven by deliverables and which have a team membership defined by task.

The RRC 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 groups⁴⁴. 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 Information Centre for the RRC’s purposes.

Several new road research centres have been established on the African continent. As indicated in the RRC Capacity Building and Skills Development Plan⁴⁵ it is important for the RRC to establish formal linkages and networks between those and other road research centres as well as universities that have been in existence for a number of years. The establishment of the African Road and Transport Research Forum (ARTReF), similar in concept to the Forum for European Highway Research Laboratories (FEHRL), is but one example of a regional network of research centres that ANE and therefore also the RRC is already involved in.

⁴² Lave J and Wenger E. 1991. *Situated learning: legitimate peripheral participation*.

⁴³ Hennessy C and Anderson S. 2013. *Toolkit: developing a community of practice*.

⁴⁴ *ReCAP Knowledge Management and Communications Strategy*. Sep 2015. Cardno Emerging Markets (UK).

⁴⁵ Verhaeghe B, Antunes ML, Paige-Green P. 2014. *Establishment of a Road Research Centre in Mozambique: capacity building and skills development plan*, Project AfCAP/MOZ/092/B, Crown Agents (UK).

In addition technical committees and working groups will also have to be established to, inter alia, mobilise the intellectual capital of Mozambican road engineers to identify sustainable solutions for addressing current problems; to review, discuss and resolve technical issues, including the acceptance of new or changes to existing norms and standards; to establish a platform for sharing knowledge and building capacity; to identify areas requiring further R&D; and to resolve and endorse implementable outcomes of R&D.

Access to knowledge also concerns the declining pool of experienced experts in the transport sector in general. Much of the sector's 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 the outcomes of reflection workshops should be captured in the formal 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 previously proposed ([Section 6.1.1](#)) would be ideal to host these discussions.

6.5 Journals and publications

To establish the RRC as a reputable research organisation and to promote knowledge dissemination and uptake its 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 in this regard 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 Information Centre staff 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 provide guidelines which will allow potential authors to obtain the basic methodologies necessary to develop good research articles. These 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 AuthorAid⁴⁶ project. AuthorAid offers research writing courses, an active discussion list and a mentoring platform that matches early career researchers to more experienced researchers.

The RRC 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 Starkey⁴⁷ 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 departments and research disciplines. A regular programme of short presentations should be organised internally so that staff within the RRC could develop their presentation skills within the relatively safe environment of the organisation itself.
- The Information Centre 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.

A 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.

It is recommended that the services of a **Communications Practitioner** is obtained to assist with website content and 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. During the initial embryotic phase of the Research Centre, until

⁴⁶ www.authoraid.info/

⁴⁷ Starkey P. 2013. *Feasibility study of options for long term knowledge sharing & management*. Project AfCAP/GEN/096, Cardno Emerging Markets (UK).

demand justifies the appointment of the Practitioner, these services might be contracted in on an ad hoc basis.

6.6 Organisational culture

The organisational culture of ANE and the RRC 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 will be 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 views⁴⁸.

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. Staff involvement in the design and development of knowledge management procedures and platforms will further ensure ownership and participation.
- Encouragement and legitimisation of the use of the proposed knowledge spaces ([Section 6.1.1](#)) and the establishment of and participation in internal and external communities of practice ([Section 6.4](#)) is essential. Staff efforts 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 RRC, 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 RRC 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 Research Outputs Database.

Incentives to share:

⁴⁸ Frost A. 2014. *The significance of organisational learning*, <http://www.knowledge-management-tools.net/organizational-culture.html>.

- 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 reciprocity⁴⁹. 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”⁵⁰.

6.7 Records management

The RRC will have 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. This will require a sustainable records management system.

A record is defined by the International Council on Archives⁵¹ 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 State Archives of Mozambique 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.

Should the RRC become an independent organisation outside the structures of ANE, it will be required to develop its own records management practices. Until such time it should comply with the ANE records management procedures implemented by the Document Management Department. The RRC's research activities may however result in additional records management requirements not currently addressed by the Document Management Department.

6.7.1 Research & consultancy related records management

Research documents and publications: As discussed in **Section 6.1.1** the Research Centre will require a Research Outputs Database with linked routing/approval procedures to record research and consultancy project outputs and related material such as project proposals, progress reports, research reports, learning briefs, safety documents, laboratory reports, technical manuals and guidelines as well as information published externally by RRC staff, e.g. conferences papers and posters, journal articles, books, chapters in books and training material.

⁴⁹ Davenport TH and Prusak L. 1998. *Working knowledge: how organisations manage what they know*. Boston, Massachusetts: Harvard Business School Press.

⁵⁰ Frost A. 2014. *The significance of organisational learning*. <http://www.knowledge-management-tools.net/organizational-culture.html>.

⁵¹ <http://www.ica.org/>

While file servers are useful for day to day research or laboratory activity, it is not suitable for research document/content management. In that respect file servers have 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 access control and assign appropriate reading, modification and approval rights; version control; linked workflow and approval processes; and powerful searching and retrieval tools. It is advisable that the EDMS chosen/installed should allow for specified levels of control in accordance with ISO 9001 requirements.

Other project specific records: Besides the project reports and publications discussed above other documentation associated with research projects will also form part of the RRC's records. These include risk assessments; contracts and proof of delivery of contracts; 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 as a rule stored in **project files** (either in paper format, e.g. arch lever files, or electronic on file servers). Project files could be managed by the Document Management Department. Infrastructure project files should be kept for longer periods in line with the design life of the structures.

Research data sets: Data sets created as part of the research activity form part of the research outputs of the Research Centre 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 context giving documentation, research reports and results. It should be noted that many journal publishers and international funders now also require that associated data sets are made accessible as part of the publication process. It would be essential to develop research data management policy and procedural documentation (that would include naming conventions and long term preservation formats) as well as to provide sufficient digital storage for these records.

A number of online research data management courses are available. The free online course, MANTRA⁵², developed by the University of Edinburgh, can be recommended. MANTRA provides guidelines on the management of the digital data collected through research. It has been crafted for the use of post-graduate students, early career researchers, and also information professionals.

Materials testing laboratory records: The RRC would rely on available laboratory equipment and services rendered by ANE and LEM to support its research activities. Field testing equipment will also play a key role in the RRC activities and it is expected that ANE and LEM's field testing equipment located in their provincial laboratories will be made available to support the RRC activities.

Records management systems for these laboratories should make provision for sample tracking and the handling of test results. Standards relevant to laboratory processes, e.g. ISO/IEC 17025:2005

⁵² <http://datalib.edina.ac.uk/mantra/>

General requirements for the competence of testing and calibration laboratories, might provide guidance on the design of appropriate automated work flows.

In addition, the materials testing, road monitoring and field tests activities of these laboratories will provide a wealth of geo-referenced data on road structural and surface conditions which should be shared with the RRC research groups as well as with other Government agencies. Data management procedures and infrastructure for the curation and sharing of data sets should therefore be provided.

6.7.2 Governance related records management

An organisation's records management file plan and procedures should 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.

Since the RRC will form an integral part of ANE and the permanent staff of the RRC will be employed by ANE, the RRC will share the functions of Human Resources, Finance, Legal Services and Facility Management with ANE. Hence, there would be no need to duplicate any of those services in the RRC and no additional governance related records management requirements are anticipated.

6.7.3 Externally acquired information

Externally acquired information sources such as books, journals, standards and technical specifications, conference proceedings and publications from professional societies, other research organisations and government agencies, etc. are not regarded as organisational records. These publications will typically be managed by the Information Centre through its Library Management System (LMS) and grey literature collection database. (See [Section 6.1.1.](#))

7 Implementation schedule and resource requirements

The degree to which the proposed knowledge management initiatives are put into practice will be determined by organisational priorities as well as enabling factors such as funding, ICT infrastructure and support, along with staff capacity and skill levels. The proposed high level schedule for the implementation of recommended knowledge management initiatives is available in graphic format in [Annex E](#). This implementation schedule was created with the RRC institutionally located within ANE. Should the RRC become an independent organisation outside of the structures of ANE, it will be required to develop its own infrastructure. In such a case the knowledge management implementation schedule proposed in this study will have to be reviewed extensively.

7.1 Start-up actions

A final decision regarding the RRC's physical location on the ANE Maputo site has not been made. At present, it is envisaged that the RRC will share offices with DIMAN staff. The RRC may also take over the current office space of DIMAN should the decision be made that the Directorate will move to the new building being erected on the ANE premises.

An RRC Working Group comprising members from ANE and LEM has been formed which, together with the Road Research Technical Committee (RRTC) and the Road Research Steering Committee (RRSC), furthers the establishment of the RRC. It is the objective that the members of the Working Group would be incorporated in the structures of the RRC once current constraints have been resolved. In the meantime, the RRC will rely on partnerships between ANE, LEM and local academic institutions to execute projects. To support these initial research activities and to ensure preservation of the research project outputs it is necessary to fast-track the establishment of the Information Centre and its service streams.

Start-up actions for the **establishment of the Information Centre** and its services will entail the following:

- The Information Centre will provide services as determined by its **mandate**. It is therefore important for the ANE management structures to, as a first step in the establishment of the Information Centre, confirm its mandate. (As indicated in [Section 6.1](#), it is foreseen that the Information Centre will support and enable ANE and the RRC 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 Information Centre implementation actions is the **appointment of the Information Centre Manager** ([Section 6.1.2](#)) to, in conjunction with the current Head of the Document Management Department, conceptualise and establish the service, its infrastructure, systems, policies and procedures. Key steps are the preparation of a job description; position evaluation and salary determination; advertisement of the position and recruitment of a suitably experienced incumbent. 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.
- The new building currently under construction makes provision for the **planned Information Centre**. It emerged from interviews held with ANE staff during the 3-day Maputo site visit in July 2016 that the Information Centre's furniture schedule, equipment and shelving have been

decided. It is advisable that the final layout of the Information Centre is confirmed with the Information Centre Manager before installation of shelving, equipment and furniture.

- Until this space is ready for occupation, an **office in the RRC** area close to the researchers should be allocated to the Information Centre Manager from where services, systems and procedures could be planned. The close proximity to the research staff is important as the Information Centre Manager will initially also assume the duties of the Information Specialist. (See **Section 6.1.2.**) The office, which will also serve as temporary library, will require office furniture and a computer for the Information Centre Manager; chairs and a small desk for visitors; a printer/scanner/photocopier; and at least two walls of library shelving. Furniture and equipment specifications will have to be prepared, quotations obtained and funding allocated. Once the Information Centre in the new building is up and running this office should be allocated to the Information Specialist.
- The DIMAN building currently allocated to the RRC has limited network connections but rewiring is planned. It is of critical importance that this is completed as a matter of urgency as connectivity is part of the bare minimum infrastructure essential for contemporary library services delivery. The **ICT infrastructure** required by the future Information Centre also has to be planned and implemented with the assistance of the Head of the ICT Department.
- As the Information Centre will initially have limited information resources the implementation of an integrated Library Management System (LMS) (see **Section 6.1.3**) 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.
- Until the Information Centre is in the position to provide access to the required electronic **information resources** discussed in **Section 6.1.1**, corporate membership of the libraries of the UEM, UEM Engineering Faculty, LEM and ISUTC should be negotiated. Such membership will allow ANE staff access to the paper and electronic resources (e-books and e-journals) of these libraries during staffed service hours. In addition Open Access resources indicated in **Annex C** could be made accessible to ANE 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. The portal should be made accessible through the ANE Intranet currently being developed by the Communications Department.)
- **Database functionality** will be required to manage the grey literature collection, the RRC's Research Outputs Database, the centralised knowledge database of Mozambican roads research as well as the institutional repository (**Section 6.1.3**). 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 ANE internet website.
- ANE 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

either the ANE or RRC **server** (depending on the infrastructure architecture determined and implemented by the ICT Department) 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 ANE staff.

- Provision should be made for the preservation and secure storage of **research data** sets with archival value (**Section 6.7.1**). These data sets could be stored, along with the context giving documentation, in a similar access controlled folder on the file server discussed above. 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.

RRC records relevant to its research and consulting services as well as to its support services will need to be managed (**Section 6.7**). The ANE records management procedures implemented by the Document Management Department will address most of the RRC's records management requirements. Its research activities will however result in additional records management requirements not currently addressed by the Document Management Department. In terms of **records management**, the following interim measures should be considered:

- Support services (HR, Finances, Procurement, etc.) will be provided by ANE and the associated records will be handled by the Document Management Department.
- The Information Centre will manage research publications and datasets as discussed above. Research project files (**Section 6.7.1**) could be managed by the Document Management Department.
- Records management systems for the materials testing laboratories (as well as for regional laboratories) should make provision for sample tracking and the handling and storage of test results. Data management procedures and infrastructure for the curation and sharing of data sets should therefore be provided.

The infrastructure required to establish the interim Information Centre and records management functions is provided in graphical format in Annex F.

7.2 Medium to longer term actions

The proposed high level schedule for the implementation of recommended knowledge management initiatives for a fully operational RRC is provided in **Annex E**. The expected growth in RRC research activities and staff compliment as well as the completion of the new building will require the actions listed below:

- The use of the various **physical spaces** (**Section 6.1.3**) available in both the new and existing ANE buildings should be optimised in line with the requirements of ANE 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. The Information Centre Manager, in conjunction with the Communications Department, will be responsible for the conceptualisation, planning, and implementation of an **events plan** and the scheduling of talks, lectures, presentations and exhibitions by ANE staff and external speakers on a regular basis.
- Initially the Information Centre's **information resources** will focus on road engineering, however, resources and services will be expanded as the spectrum of RRC 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 (**Section 6.1.1**). An information resources budget will have to be prepared and funding allocated accordingly.

- As the collections and databases of the Information Centre 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 RRC databases (e.g. the Research Outputs Database and the Grey Literature collection) and provide portal functionality to make the Information Centre 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 Guides⁵³.
- As the RRC research publications grow **institutional repository** software should be implemented (**Section 6.1.3**). As repository software (e.g. DSpace, EPrint, Fedora, Islandora) is mainly Open Source, implementation will require substantial support from the ICT Department.
- The Information Centre will be highly reliant on the ICT Department for both system implementation and support. As the Information Centre 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 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 Information Centre Manager and the ICT Department with the design and implementation of the required library systems. In this regard it is recommended that the UEM Library Director, Dr Horácio Zimba, is approached as he specialises in library IT systems and technology.
- As the demand for information increases, both from the perspective of ANE and the RRC researchers, an **Information Specialist** should be appointed (**Section 6.1.2**). This will require the formulation of a job description; position evaluation and salary determination; advertisement of the position and recruitment of a suitable appointee. The Information Specialist should not be placed in the Information Centre in the new building but should rather occupy the office previously allocated to the Information Centre Manager in the RRC area so as to be close to the RRC staff.
- ANE has a basic external website but the internal website/Intraweb is still under development (**Section 6.2**). Principles of holistic website design need to be considered for both the external website and the intranet 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 (**Section 6.5**).
- Records management efforts will 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;

⁵³ Breeding M. 2016. Perceptions 2015: an international survey of library automation. *Library Technology Guides*, <http://librarytechnology.org/perceptions/2015/>.

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 RRC starts functioning as a fully-fledged research centre.

The RRC is expected to expand and grow over time. Hence, the institutional structure and location of the RRC will have to be reviewed periodically. Institutional setup will significantly influence the knowledge management implementation plan, i.e. should the RRC become an independent organisation outside the structures of ANE it will not be able to rely on the support services and infrastructure provided by ANE. One of the triggers for this to occur is when the RRC starts to embark on transportation and other studies that fall outside the mandate of ANE. In such a case the knowledge management implementation plan will have to be revised accordingly.

Annex A: Stakeholders consulted

Administração Nacional de Estradas (ANE)

ANE, DIAFI

- Belmira Teresa Sarmento, Director DIAFI
- Joaquim Maraques, ICT
- Rodrigues Alberto Jamine, Document Management
- Virgilio Lichucha, Training Officer
- Xavier Zandamela, Communications
- Maria Macuacua, Communications
- Jorge Cumbe, HR Manager

ANE, DIMAN

- Eng Sylvestre Elias, Director DIMAN
- Eng Joana Guiuele

ANE, DIPLA

- Eng Hilario Tayob

ANE, DIPRO

- Eng Raquel Damiao Langa

Instituto Superior de Transportes e Comunicações (ISUTC)

- Dr Fernando Ventura Leite, Rector

Laboratório de Engenharia de Mozambique (LEM)

- Carlos Rodrigues Cumbana
- Santos Aurelio Cuinica
- Milord Mazive, Head, LEM Library

Universidade Eduardo Mondlane (UEM)

UEM, Faculty of Engineering

- Dr Alexandre Charifo, Dean
- Eng Celso Manuel de Rehentula Nicols, Dept Civil Engineering
- Dr Daniel Baloi, Dept Civil Engineering
- Francisco António Albino, Librarian

UEM, Julius Nyerere Campus

- Dr Horácio Francisco Zimba, Director of Documentation Services

Annex B: ANE ICT infrastructure

1. Por cada edifício:

Categoria	Descrição
1.1. Designação	Sede da ANE
1.2. Localização	Av. de Moçambique Nº 1225, Caixa Postal 14 39, Maputo, Moçambique
1.3. Tipo de Rede / Mb	10/100/1000
1.4. Domínio	ane.gov.mz
1.5. Servidores de Rede	2 Domain Controlers
1.6. Servidores de Base Dados	2 Servidores SQL Server; 1 MySQL Server
1.7. Servidores de Email	1 servidor de Mail (CentOS); Está a ser migrado para Microsoft Exchange Server
1.8. Servidores de Intranet	HIMS e Sistema de Gestão Documental
1.9. Servidores de Internet	1 para servir a página da ANE
1.10. Outros Servidores	Windows ServerUpdateService
1.11. Scanners de Grande Formato	1 A0
1.12. Plotters	3 Plotters A0
1.13. Sistemas de Antivírus	Centralizado: eSet Nod32 Antivirus 4
1.14. Sistemas de Detecção de Intrusão	CyberRoam
1.15. Sistema de Gestão Documental / Arquivo	Sistema De Gestao De Documentos Electronicos I+DOC
1.16. Aplicações de Gestão	Primavera Software (Gestão Financeira)
1.17. Sistemas de Firewall	CyberRoam
1.18. Solução de Backup's	Dell PowerVault; LTO Tapes
1.19. Sistemas de Storage	Storage; Capacidade de 7TB; 560GB livres
1.20. Nº Postos de Trabalho	165
1.21. Características Postos de Trabalho	Os PC's são actualizados em termos de Características do Hardware; Estão neste omento em processo de aquisição de 80 novos PC
1.22. Sistemas Operativos dos Postos de Trabalho	Windows 7 e Windows 8
1.23. Nº de Utilizadores	165
1.24. Software de CAD / SIG	2 Licenças de ArcGIS for Desktop Standard 10; 1 AutoCAD 2014
1.25. Características Postos Trabalho CAD / SIG	1 PC (Windows 7, RAM 2GB, 32Bit, Processador 3.1Ghz); 1 Laptop (Windows 7, Core i5, RAM 4GB, 64 bit, 2.4Ghz)
1.26. Aplicações que explorem IG	HIMS
1.27. Solução de Virtualização	Está neste momento a decorrer o processo de virtualização para VMWareESxi 5.5, com o apoio de uma entidade externa.

2. Por cada ligação de um edifício:

Questões		Respostas					
2.1.	Designação	Edifício Sede ANE – Edifício Delegação Provincial de Maputo					
2.2.	Localização	Av. de Moçambique Nº 1225, Caixa Postal 14 39, Maputo, Moçambique					
2.3.	Tipo de rede	Exclusivamente dados		Exclusivamente voz		Integração de voz e dados	X
2.4.	Objectivos						
2.5.	Âmbito	Interligação de edifícios de um organismo	X	Interligação de diversos organismos			
		Ligação a entidades externas		Outros (especifique)			
2.6.	Entidade responsável pela gestão estratégica	ANE					
2.7.	Entidade responsável pela gestão operacional	ANE					
2.8.	Nomes das entidades interligadas nesta infra-estrutura de rede	ANE – Delegação Provincial de Maputo					
2.9.	Nomes de entidades externas directamente ligadas a esta infra-estrutura de rede	na					
Infra-estruturas de transmissão e comutação	2.10. Tipo de troço de transmissão	Circuitos dedicados ponto-a-ponto alugados		Troço de fibra-óptica (indicar em kms)	X		
		Ligação ponto-a-ponto sem fios (wireless)		Acesso Frame-Relay			
		Ligação ATM		Ligação X.25			
		Outros (especifique)					
	2.11. Velocidade / Taxa Contenção	1GBit					
2.12.	Protecções da Ligação (Firewall; VPN; etc)						
2.13.	Descrição de eventuais mecanismos de integração de voz e dados	VoIP (Voice over IP)		VoFR (Voice Frame-Relay)		TDM (Time Division Multiplexing)	
		Outros (especifique)					

3. Dimensão global das infraestruturas de comunicações existentes de acordo com as seguintes categorias:

Equipamentos e instalações		
3.1.	N.º de equipamentos de comutação e routing SWITCH/ ROUTERS	1
3.2.	N.º de centrais telefónicas (PPCAs)	1
Infra-estruturas de transmissão		
3.3.	N.º de acessos comutados à Internet (dial-up analógico ou RDIS) Nº de MODEMS	0
3.4.	N.º de acessos permanentes à Internet (circuitos dedicados, ADSL, entre outros)	2

4. Número de acessos à Internet e de circuitos de comunicação em rede alargada existentes, enquadrados com os seguintes escalões de largura de banda:

Largura de banda	N.º de acessos à Internet
4.1. ≤ 64 Kbps	
4.2. > 64 e ≤ 128 Kbps	
4.3. > 128 e ≤ 256 Kbps	
4.4. > 256 e ≤ 512 Kbps	
4.5. > 512 e ≤ 1024 Kbps	
4.6. > 1 e ≤ 2 Mbps	
4.7. > 2 e ≤ 11 Mbps	Govnet (3/3 Mbps); Redundância com TV Cabo (4/6 Mbps)
4.8. > 11 e ≤ 100 Mbps	
4.9. > 100 Mbps	

Annex C: Information resources

Electronic journal platforms and bibliographical databases from international publishers
<ul style="list-style-type: none"> • ScienceDirect • IEEE • EBSCOHost • Scopus • Web of Science
Standalone subscription journals
<ul style="list-style-type: none"> • Asphalt Paving Technology http://www.asphalttechnology.org/annual-journal.html • Road Materials and Pavement Design http://www.tandfonline.com/toc/trmp20/current • Technical journals and publications from Mozambican institutions, e.g. the academic institutions, Public Procurement Regulatory Authority, Contractors Registration Board, etc.
Standards and technical specifications
<ul style="list-style-type: none"> • Southern Africa Transport and Communications Commission (SATCC) <ul style="list-style-type: none"> – Standard Specifications for Road and Bridge Works – Code of Practice for the Rehabilitation of Road Pavements – Code of Practice for the Geometric Design of Trunk Roads – Code of Practice for the Design of Road Pavements • Manual de Planificação de Nível Provincial http://www.ane.gov.mz • Manual de Gestão de Contratos http://www.ane.gov.mz/ • International Organization for Standardization (ISO) Standards http://www.iso.org/iso/home.html • British Standards (BS) http://shop.bsigroup.com/ • American Association of State Highway and Transportation Officials (AASHTO) www.transportation.org • American Society for Testing and Materials (ASTM) http://www.astm.org/ABOUT/overview.html • Southern Africa Transport and Communications Commission: Guideline for Low Volume Sealed Roads • Instituto Nacional de Normalização e Qualidade, Moçambique (INNOQ), www.innoq.gov.mz • Normas de Execução • Manual de Melhoramentos Localizados • Desenhos Tipo para Obras de Estradas no Nível Provincial • Especificações Técnicas para Estradas com Baixo Volume de Tráfego • ANE Design Standards (draft) • Urban Transport Guidelines (UTG) (Available on the SANRAL web site) • Technical Recommendations for Highways (TRH) (Available on the SANRAL web site) • Technical Methods for Highways (TMH) (Available on the SANRAL web site) http://www.nra.co.za/
Conference proceedings
<ul style="list-style-type: none"> • Transportation Research Board Annual Meeting http://www.trb.org/Main/Home.aspx • Conference on Asphalt Pavements for Southern Africa (CAPSA) http://www.capsa11.co.za/ • International Conference on Asphalt Pavements http://asphalt.org/ • Euroasphalt and Eurobitume congress http://www.eecongress2016.org/ • AfCAP and ReCAP conference papers • Association of Southern African National Road Agencies (ASANRA) www.asanra.int.mw/

<ul style="list-style-type: none"> • International Transport and Road Research Conference www.transportconferencekenya.org • Annual Argus Africa Bitumen conferences www.argusmedia.com • South African Transport Conference (SATC)
<p>Publications from professional societies</p>
<ul style="list-style-type: none"> • Ordem dos Engenheiros de Moçambique www.ordeng.org.mz • Sociedade Moçambicana de Geotecnia (SMG) www.issmge.org • Associação Moçambicana de Empresas de Consultoria • Federação Moçambicana de Empreiteiros • American Society of Civil Engineers (ASCE) http://www.asce.org/ • South African Institution of Civil Engineering (SAICE) http://www.saice.org.za/ • Institution of Civil Engineers https://www.ice.org.uk/
<p>Other transportation databases</p>
<ul style="list-style-type: none"> • Transportation Research Board (TRB) collection: Transportation Research Record including Research Results Digests, Transit Cooperative Research Program and National Cooperative Highway Research Program http://www.trb.org/Main/Home.aspx • Transport Research and Innovation Portal (TRIP) http://www.transport-research.info/ • Transport Research International Documentation (TRID) https://trid.trb.org/ • Virginia Department of Transportation (VDOT) Research Library http://www.viriniadot.org/ • Federation of European Highway Research Laboratories (FEHRL) www.fehrl.org
<p>Open / Free access:</p>
<ul style="list-style-type: none"> • ReCAP Rural Access Library www.research4cap.org • African Road and Transport Research Forum (ARTReF) • Research4Life, specifically the Access to Research for Development and Innovation (ARDI) program coordinated by WIPO http://www.wipo.int/ardi/en/ • Directory of Open Access Repositories (OpenDOAR) http://www.opendoar.org/ • Directory of Open Access Journals (DOAJ) https://doaj.org/ • Publications from similar research organisations: <ul style="list-style-type: none"> ○ Transport Research Laboratory (TRL), selected publications only www.trl.co.uk/reports-publications/ ○ Australian Road Research Board (ARRB) https://www.arrb.com.au/ ○ CSIR, South Africa, report collection ○ Building and Road Research Centre (BRR), CSIR, Ghana ○ Ethiopia Road Authority Road Research Centre (ERA RRC) www.rta.gov.et ○ Materials, Testing and Research Department (MTRD), Kenya ○ Kenya Rural Roads Authority (KeRRA) http://www.kerra.go.ke/ • South African Department of Transport www.transport.gov.za/ • Library of Laboratório Nacional de Engenharia Civil (LNEC) http://biblioteca.lnec.pt/ • Publications from Mozambican academic institutions (e.g. Universidade Eduardo Mondlane; the Instituto Superior de Transportes e Comunicações; and the Universidade A Politecnica) and regional universities, e.g. the Universities of Pretoria and Stellenbosch • World Road Association http://www.piarc.org/en/publications/ • International Road Federation (IRF) www.irfnews.org • Federal Highway Administration of the USA (FHWA) www.fhwa.dot.gov • The global Transport Knowledge Practice (gTKP) www.gtkp.com • UK Roads www.highways.gov.uk
<p>Mozambique Government publications</p>
<ul style="list-style-type: none"> • ANE documents (e.g. tender documents, rehabilitation/maintenance projects, specifications, 'as built' files, laboratory operation manuals, reports, etc.) • The Evaluation of Long Term Behaviour of Pavement Layered Materials by Means

Accelerated Pavement and Supplementation/Verification Testing in Mozambique
<ul style="list-style-type: none">• Average Annual Daily Traffic Report
Programs and software
<ul style="list-style-type: none">• HDM-4 (specifically the cost-benefit analysis).• HDM-4 tools http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTTRANSPORT/EXTROADSHIGHWAYS/0,,contentMDK:22011461~pagePK:148956~piPK:216618~theSitePK:338661,00.html• Geographic Information System (GIS)• Road Management System (HIMS)• WinDCP 5.0 (Dynamic Cone Penetrometer) More info http://asphalt.csir.co.za/DCP/

Annex D: ANE staff compliment

Nº FUNCIONÁRIOS POR NÍVEL ACADÉMICO E GÉNERO - 2016																			I Semestre de 2016			
SECTOR	Licenciatura			Bacharelato			Médio Técnico			Médio Geral			Básico			Elementar			Total			
	Fem	Mas	Soma	Fem	Mas	Soma	Fem	Mas	Soma	Fem	Mas	Soma	Fem	Mas	Soma	Fem	Mas	Soma	Fem	Mas	Soma	
CA	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	1	1	
DG	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	2	
A. C. Imagem	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	2	
UGEA	3	6	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	3	7	10
Djuridico	1	1	2	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	2	1	3	
GAT	2	2	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	4	
Gabinete Nova Ponte	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	
Emergencia	1	8	9	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	2	8	10	
DIAFI	15	12	27	1	1	2	-	5	5	-	5	5	3	8	11	1	30	31	20	61	81	
DIPLA	2	13	15	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	2	14	16	
DIPRO	4	21	25	-	1	1	-	4	4	-	-	-	-	2	2	-	-	-	4	28	32	
DIMAN	4	10	14	1	-	1	-	3	3	-	-	-	1	-	1	-	-	-	6	13	19	
EM OUTRAS INST	1	5	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	5	6	
NAS OBRAS	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	3	3	
Desligados/Aposentação	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	2	
Soma	35	84	119	3	2	5	0	13	13	1	5	6	4	10	14	1	33	34	44	147	191	
%	80%	57%	62%	7%	1%	3%	0%	9%	7%	2%	3%	3%	9%	7%	7%	2%	22%	18%	23%	77%	100%	
Delegações	Maputo	4	6	10	-	1	1	1	1	2	2	4	6	-	2	2	-	1	1	7	15	22
	Gaza	2	7	9	-	-	-	-	2	2	-	4	4	-	2	2	-	3	3	2	18	20
	Inhambane	4	6	10	-	-	-	-	1	1	1	5	6	-	7	7	2	6	8	7	25	32
	Sofala	4	8	12	-	-	-	1	-	1	1	4	5	-	6	6	-	15	15	6	33	39
	Manica	3	6	9	-	-	-	2	4	6	-	3	3	1	2	3	-	6	6	6	21	27
	Tete	2	8	10	-	-	-	2	3	5	6	9	15	-	6	6	-	4	4	10	30	40
	Zambézia	1	10	11	-	-	-	-	4	4	1	5	6	-	3	3	-	5	5	2	27	29
	Nampula	4	10	14	-	-	-	-	1	1	-	3	3	-	4	4	-	10	10	4	28	32
	Niassa	2	6	8	-	-	-	2	5	7	-	4	4	-	2	2	-	3	3	4	20	24
	Cabo Delgado	-	12	12	-	-	-	-	1	1	-	7	7	1	2	3	-	6	6	1	28	29
	NAS OBRAS	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	2	2
	Desligados/Aposentação	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	1	3	4	2	3	5
	Soma	26	81	107	0	1	1	8	22	30	11	48	59	3	36	39	3	62	65	51	250	301
%	51%	32%	36%	0%	0%	0%	16%	9%	10%	22%	19%	20%	6%	14%	13%	6%	25%	22%	17%	83%	100%	
Total Geral	61	165	226	3	3	6	8	35	43	12	53	65	7	46	53	4	95	99	95	397	492	
%	131%	90%	98%	7%	2%	3%	16%	18%	17%	24%	23%	23%	15%	21%	20%	8%	47%	39%	19%	81%	100%	

06/08/2016 11:01

Última actualização: 27 de 06 de 2016

	Delegação	Sede	Total
Masculino	252	146	398
Feminino	52	42	94
Total	304	188	492

Formação Académica

	Delegação			Sede			Total		
	Homens	Mulheres	Total	Homens	Mulheres	Total	Homens	Mulheres	Total
Licenciado	82	24	106	82	33	115	164	57	221
Eng. Civil	55	4	59	49	8	57	104	12	116
Direito	5	2	7	1	5	6	6	7	13
Contabilidade e Gestão	8	5	13	8	6	14	16	11	27
Outras	14	13	27	24	14	38	38	27	65
Bacharel	1	0	1	2	3	5	3	3	6
Técnico Médio	22	8	30	13	0	13	35	8	43
Geral Médio	48	14	62	5	1	6	53	15	68
Básico	37	3	40	4	3	7	41	6	47
Elementar	62	3	65	40	2	42	102	5	107
Total	252	52	304	146	42	188	398	94	492

Distribuição de Eng^o Cíveis por afectação e género

	Masc	Fem	Total	%
ANE-Sede	48	8	57	49%
Delegações Provinciais				
Maputo	6		6	5%
Gaza	4		4	3%
Inhambane	3	1	4	3%
Sofala	8		8	7%
Manica	3		3	3%
Tete	7	1	8	7%
Zambézia	7		7	6%
Nampula	7	1	8	7%
Niassa	4	1	5	4%
C.Delgado	6		6	5%
Sub-total	55	4	59	51%
Total	104	12	116	100%

Annex F: Interim Information Centre and records management infrastructure

