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PROJECT: ROAD MATERIALS AND AGGREGATE INVENTORY DATABASE – PHASE 1

Regional Stakeholder Workshop Report

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Orion Consulting Associates (OCA) in association with Link Asea

RAF2101A

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OCA

Link Asea

The views in this document are a reflection of what was discussed at the workshop and they do not necessarily reflect the views of the Research for Community Access Partnership (ReCAP), or Cardno Emerging Markets (UK) Ltd for whom the document was prepared

Cover Photo: Representative from Sierra Leone reporting back to the plenary session

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AfCAP Regional Stakeholder Workshop Report

AfCAP Database Details: RAF2101A Road Materials and Aggregate Inventory Database			
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Abstract

The Road Materials and Aggregate Inventory Database Phase 1 has three phases: Phase 1 – Scoping study to identify a suitable architecture for a materials database, Phase 2 – Development of the database and partial population for beta-testing, and Phase 3 – Rollout to interested partner countries, including training.

Phase 1 is implemented by Orion Consulting Associates in association with Link Asea. Through literature review, a stakeholder survey and fieldwork consultations, the Consultant assessed the institutional and regulatory framework in the AfCAP partner countries, their current systems and workflows, needs and ambitions for materials testing and information management.

The results were presented in the Draft Database Report and the Draft Recommendations Report for Presentation at the Regional Stakeholder Workshop, which took place on 5 September 2017 at the Afrin Prestige Hotel in Maputo, Mozambique. This final workshop report presents the outcome of the Regional Stakeholder Workshop.

Key words

Low Volume Roads, High Volume Roads, Materials, Aggregates, Materials Information Management, Materials Indicators, Materials Database Systems, Regional Stakeholder Workshop, Sub-Saharan Africa.

Acknowledgements

We would like to acknowledge the contribution of the Mozambique National Road Administration (ANE) in hosting the Regional Stakeholder Workshop and assist with workshop preparations.

Acronyms, Units and Currencies

AfCAP	Africa Community Access Partnership
ANE	Mozambique National Road Administration
BPIM	Borrow Pit Information Module
CBR	California Bearing Ratio
CML	Central Materials Laboratory
DCP	Dynamic Cone Penetrometer
DFID	Department for International Development
DMS	Data Management Specialist
DRC	Democratic Republic of Congo
DROMAS	District Roads Maintenance System
ERM	Entity Relationship Model
FTE	Full Time Equivalent
GIS	Geographical Information System
GPS	Global Positioning System
HVR	High Volume Roads
HQ	Head Quarter
ICMIS	Indonesian Construction Materials Information System
ICT	Information Communication Technology
IT	Information Technology
HIMS	Highway Information Management System
LAN	Local Area Network
LVR	Low Volume Roads
MDIS	Materials Database and Inventory System
MI	Materials Inventories
MIM	Materials Information Management
MIMS	Materials Information Management System
PMU	Project Management Unit
PRMD	Pilot Road Materials Database
SADC	Southern African Development Commission
TL	Team Leader
TOR	Terms of Reference

Table of Contents

List of Tables

1 Introduction

1.1 Rationale

The development of a generic road materials database linked to a mapping tool, providing detailed inventory of the location, properties, quantity and potential use of road materials, has been identified as a priority by many AfCAP partner countries. To prevent duplication of effort, it is intended that this project will scope the general requirements and architecture of a generic materials database to be developed by partner countries to suit their own circumstances.

1.2 Scope

The objective of the project is to develop a generic road materials database that can be developed, populated and used by partner countries. The project has three phases: Phase 1 – Scoping study to identify a suitable architecture; Phase 2 – Development and piloting; and Phase 3 – Rollout.

Phase 1 of the project (April to September 2017) was awarded to Orion Consulting Associates in association with Link Asea. The consultant's team consists of Jan Bijl (Team Leader) and Ravindra Corea (Data Management Specialist). Phase 1 was carried out to identify the stakeholder needs and propose the general architecture and system requirements of the road materials database that can be implemented at national level for improved management of road materials, in particular LVR.

A draft Database Report was submitted to the AfCAP Project Management Unit (PMU) on 25 July 2017. The main findings and recommendations were presented and discussed at the Regional Stakeholder Workshop to be held in Maputo on 5 September 2017, see **Annex A** (workshop agenda).

1.3 Pre-workshop arrangements

The Mozambique National Road Administration (ANE) accepted the role of host and issued letters of invitation letters for participants to obtain their visas. Booking of venue, accommodation and tickets (through Dana Corporate Travel Agent) was all done from the Maputo office of Orion Consulting Associates.

1.4 Participation

It was agreed with the PMU that the 11 visiting partner countries would be allowed to nominate one representative well embedded in road materials testing and information management. International air travel, accommodation, per diem and visa cost were covered by the project. Mozambique, as the host country, was allowed to nominate 14 representatives.

Regretfully, Liberia, Ghana and Ethiopia did not manage to send their delegates to the workshop. The nominee from Liberia had other duties incompatible with the dates of the workshop. The nominees from Ghana and Ethiopia had logistical problems to board their flights.

The total number of participants was 30 representing the AfCAP PMU (3), the Consultant (2) and the 9 partner countries: Mozambique (17), Sierra Leone (1), South Sudan (1), Kenya (1), Uganda (1), DRC (1), Tanzania (1), Zambia (1) and Malawi (1). The list of participants is attached in **Annex B.**

2 Workshop outcome

2.1 Opening and introduction

After welcome remarks by the TL, the AfCAP PMU Infrastructure Research Manager, Mr. Les Sampson provided a welcome to the participants and a brief introduction to the Africa Community Access Partnership (AfCAP) and the road materials database project. The General Director of ANE, Eng. Marco Vaz dos Anjos, officially opened

the workshop. He reiterated the importance of having reliable access to materials information in his opening address.

The TL presented the introduction to the project and discussed the workshop objectives and program, see presentations in **Annex F-1.**

2.2 Current systems for materials testing, findings and recommendations

This session included 4 short presentations by the TL to present the key findings and recommendations from the stakeholder survey, a desk review of existing materials database systems, the fieldwork consultations (in 3 selected countries) and a case study from Mozambique related to the potential benefits of including Consultant's materials reporting, see **Annex F-2**.

The objective of these presentations was to validate the key findings and recommendations, in particular for those countries not visited by the Consultant.

The clarifications and discussions after the presentation are summarised in **Table 1.**

Table 1: Participants' feedback on the Presentation "Key Findings and Recommendations"

Subject	Issue
1. Update on the status of the road materials database systems for countries that did not return the stakeholder survey.	Malawi: they developed a database for the CML but over the years there have been many changes in personnel. The database has fallen out of use and all of the original staff has retired. DRC: has a long history of detailed materials investigations. Materials properties have been stored and used as an input to road design work. The location of the materials sources is known. Materials information is kept in excel sheets and stored with the chief engineer. This can be shared with consultants upon request. Zambia: started development of a road materials database in 2016. The software was reportedly completed in July 2017 by an Indian consultancy firm with a local representation in Zambia. Zambian Engineering Consultants are currently in the field carrying out materials sampling and testing as an input to the database. The database is mainly developed for use by the Road Development Agency staff. Liberia was not present at the workshop and could therefore not provide an update on their materials information management.
2. Open access to data.	Uganda raised the issue of distinguishing between accessibility and availability of the data to the public based on their recent experiences with the establishment of a road research database. It was suggested that it would be acceptable for data to be provided at a fee as a means of sustaining the database operations.
3. Realizing cost benefit of road materials database.	Malawi observed that the materials information is not usually provided with the bidding documents for works mainly because of the associated risks of providing information that may lead to future contractual claims. However, the participant stated that to realise the full benefits of materials information this would need to be provided in the bidding documents to help reduce materials prospecting cost and ultimately haulage cost in the road sector. *The Consultant clarified that a disclaimer (e.g. for information purpose only) can be provided*

Subject	Issue
	similar to what is done with road materials reporting as part of road design studies.
4. HVR specifications	The AfCAP PMU noted that some AfCAP partners use the SADC technical specifications, which were written for HVR, for LVR design. However, many AfCAP partners have now developed their LVR design manuals. These manuals allow for the use of non-traditional materials, which may not meet the traditional specifications for HVR but have demonstrated to perform well in LVR pavement layers. Currently, Road Authorities only store materials information that meets the traditional specifications for HVR. It is therefore important that the database captures all materials that meet the specifications for use in LVR pavement layers.

2.3 Database system development

This session included a presentation by the Data Management Specialist (DMS) to present the proposed materials database architecture and system requirements, see **Annex F-3**. The objective of these presentations was to obtain feedback from the participants with respect to the appropriateness of the proposed arrangements.

The clarifications and discussions after the presentation are summarised in **Table 2.**

Table 2: Participants' feedback on the presentation "Database System Development".

Subject	Issue
1. System architecture	Uganda affirmed that the presented system architecture is logical and the provision to accommodate various levels of technology was also welcomed. DRC raised the issue that the term *public internet* could be confusing as it implied that the information was made available to the general public. *The Consultant clarified that the terminology can simply refer to the internet.* Malawi raised a question as to whether the road materials database would have to be hosted at the CML according to the proposed system architecture. For the case of Malawi, this would imply that the road materials database would fall under the Ministry and not under the Road Authority. *The Consultant clarified that it is up to the partner country to propose the most appropriate institutional framework.*
3. Integration of materials testing workflows	PMU raised the issue that there should be a further step to ensure that test results that were not approved in the quality review would subsequently be properly amended in the road materials database. *This was acknowledged by the Consultant and will be amended in the workflow diagram.* Uganda commented that they supported the proposed workflows. However, suggested there should be a check and balance for the materials reports submitted by consultants / contractors before data is added to the materials database. *This was acknowledged by the Consultant and will be amended in the workflow diagram.*
4. Entity Relationship Model (ERM)	PMU raised the issue that there could be materials sources that are not linked to a particular road section and they need to be accommodated in the ERM. They further observed that the inclusion of road pavement structure information might lead to some confusion with the other AfCAP supported regional project for the evaluation of road pavement performance.

Subject	Issue
	The Consultant explained that the purpose of the road pavement information in the ERM is to demonstrate the possible linkage with road asset management systems. However, it was acknowledged that this could be misinterpreted as if materials information would be linked to a specific road section. This will be amended accordingly in the ERM diagram.

2.4 Group works

After the presentations by the Consultant, the participants were divided in three groups (with each having 7 - 8 participants) to discuss some key issues in more detail, **see Annex C**. Each group was allowed 45 minutes after which the rapporteurs were invited to present the key findings of the group in the plenary session, as summarised below.

1. Discuss the proposed integration of Module 1 with materials testing workflows / laboratory management systems. Identify possible differences that may exist between the partner countries:

Group 1 (Sierra Leone, Mozambique, South Sudan, DRC and Uganda): Overall the processes in the central materials laboratories are more or less the same as in the diagram presented, in all countries represented in the group. Occasionally, there is one additional review by a supervisor or senior technician before review and approval by the materials manager or director. With respect to contractor's reports, Sierra Leone and Mozambique practice the same method where there is on-site supervision by a representative of the respective roads authority. Therefore materials reports from the contractors seemed to be generally reliable sources of information. In Uganda and South Sudan, there is limited supervision by the Roads Authority and they acknowledge this to be a weakness in the quality control of materials information data. In DRC all samples are directed to and tested at the CML. Test results are therefore reliable.

Group 2 (Zambia, Mozambique and Malawi): There are differences between the countries in the group in terms of institutional arrangements. In Mozambique, the main materials laboratories fall under different semi-autonomous institutions (albeit all falling under the Ministry of Public Works and Housing). This results in a certain lack of harmonization of procedures and systems when it comes to road materials information management. Another challenge presented by the group is the need for harmonizing standards and procedures for materials testing within the country. Currently, materials laboratories use different protocols for testing which lead to a variation of test results. There is a need to standardise the materials testing protocols. In Zambia, all road materials laboratories fall under the Roads Development Agency so this ensures a harmonised approach.

Group 3 (Mozambique, Tanzania and Kenya): this group also noted that overall the processes in the central laboratories are the same as in the diagram presented by the Consultant. However, in Kenya there is one additional review by a supervisor or senior technician before review and approval by the materials manager or director.

2. Discuss the key information (parameters) that should be covered by Module 2 (the materials information and mapping module):

Table 3 presents the feedback from the groups on the issues of materials' parameters.

Table 3: The feedback of the groups on "Materials Parameters"

Subject	Issue
Materials location	Group 1 suggested adding soil maps to the geological zone at different scales as well as to include hydrology as a separate field. Group 3 suggested including under item "ownership and operating status", the historical use of the materials source.
Materials description	Group 1 and 2 recommended an addition to the potential use in road works by indicating suitability of the materials for high and low volume roads. Group 2 further suggested that the

Subject	Issue
	field "potential use" should move to category materials properties. Group 3 suggested that the current available quantity to be updated in line with the use of the materials source.
Materials properties	Group 1 suggested the addition of two materials properties, namely organic matter content and specific gravity. Group 2 suggested adding flakiness index and bitumen affinity for road surfacing. Group 3 suggested that chemical properties (salinity and acidity) be added.

2.5 Outline proposal for Phase 2 and 3 of the project

This session included 4 short presentations by the Consultant to present the minimum database requirements, the country selection criteria (**see Annex D**), the action plan and the budget for Phase 2 and Phase 3 of the project (see **Annex E)**.

The objective of these presentations was to make the countries aware that they would have to provide substantial inputs, in particular staffing, to the development of the road materials database. The presentation about the country selection criteria was to obtain feedback on the transparency and fairness of the proposed framework.

The country selection criteria, work plan and budget were discussed in a plenary sessions, as summarised below.

Country selection criteria:

Uganda stated that the criteria presented for country selection (Phase 2) were objective and fair.

In response to a question as to whether Phase 2 would be limited to 1 country only, the PMU stated that this was still open for discussion in view of possibly adding a second country to test the development of the materials database in different operating environments and would be budget dependent.

The issue of open access was elaborated on further. The PMU stated that while the individual countries may own the materials data and therefore restrict access to selected users, the database design and the software would have to be open source and available not only to AfCAP partners but also to other interested users.

It was discussed whether the selection for Phase 2 would be from one of the 3 countries visited in Phase 1. The overall conclusion was that this would be unfair as these countries were selected by the Consultant in consultation with the PMU based on the need for information rather than an assessment of their readiness.

Work plan

The work plan indicates a start of Phase 2 early in April 2018 whereas the presentation mentioned a start in the first quarter of 2018. The Consultant clarified that this would be corrected in the work plan.

The Consultant noted that the work plan was based on the assumption that all partner countries would adopt the 6 modules and that this may not be realistic or necessary.

Budget

The PMU requested that the Consultant provide potentially 3 alternative budget scenarios covering the minimum feasible options in terms of number of modules to be covered as well as the extent of sub national roll

out. It was agreed that the support for sub national roll out could be limited to a certain number of locations (e.g. maximum 5) and that modules 4, 5 and 6 are left as optional subject to the specific country needs.

Mozambique noted that the integration with existing road asset management systems might be important in order to obtain higher-level management support in their country.

It was further stressed by the PMU that AfCAP funds would not support the purchase of IT equipment.

2.6 The way forward

Next steps

The PMU noted that the next step would be to discuss the project internally within the country institutions to decide whether this is indeed their priority and to communicate the decision at the next planned steering committee meeting in Uganda.

In order to reach a decision it was agreed that a cost benefit analysis would be desirable. The Consultant noted that without substantial additional data collection this would not be possible however the presented case study from Mozambique could be included in the final report to provide an illustration of potential benefits. The Consultant would further work out different cost scenarios in terms of number of modules to be covered.

The Consultant further agreed to submit the draft final report by end of September 2017.

Overall conclusion

The findings from the stakeholder survey, the country visits and the review of database systems elsewhere were largely confirmed, and in certain areas refined and strengthened, by the participants.

The recommended database solution and implementation arrangements were supported in principle. A number of suggestions for refinement were recommended in respect of workflow integration, data inclusion, potential benefits and alternative scenarios for project implementation including budgets.

3 Workshop evaluation

3.1 Evaluation by the Consultant

The Consultant was generally satisfied with the workshop. The attendance and participation levels were good.

3.2 Evaluation by the Participants

An evaluation form (**Annex E**) was handed to one representative from each one of the AfCAP partner countries.

The table below shows a summary of the evaluation results with some additional qualitative statements made by the participants.

Questions	++	+	o	-	--	Average Score (%)
1. Did the workshop meet your expectations?	9	3				94%

Briefly explain, if necessary:

Yes, the workshop and discussions follows the hand out sent prior to the workshop.
Yes, it enabled a clear view of the needs and facilitated brainstorming on the way forward.
Yes, it allowed the Consultant to obtain feedback on findings and recommendations of the scoping study.
Yes, interaction with the Consultant and others helped to better understand the needs of each country.
The workshop was good but Module 2 needed more details on how the link with GIS will be made.
Too many topics covered and presentations too long.

2. What did you find the most interesting and relevant topic of the workshop?

Current systems and workflows for materials testing and information management (4).
Database system development (4).
All topics were interesting (3).
Planning for Phase 2 and 3 are most interesting; it would allow my country to take part in the project (1).
Country selection procedure (1).
Consultants and contractors materials reporting (1).

3. Were the presentations, handouts and clarifications clear?	7	5				90%
4. Was the facilitation of the workshop such that it gave you an opportunity to share your views?	8	4				92%
5. Were the topics chosen for the group works and the plenary discussion relevant for the objective of the workshop?	8	4				92%

6. Do you think differently about the need for developing a road materials database in your country after having participated in this workshop? Please explain.

I would like to see the road materials database implemented in my country.
It shared light into the collective need to use our limited natural resources wisely and sustainably.
I hope my country is part of the project.
The workshop justified the need for each country to develop a road materials database.
Actually, the workshop helped to obtain better insight in the need for having a road materials database.
Doing many road materials surveys is a waste of resources if you don't store the data for future use.
The proposed modules and steps forward are a good start to the project.

7. Were logistical arrangements / pre-workshop comm. satisfactory?	8	4				92%
8. Were accommodation and conference facilities satisfactory?	9	4				94%

9. Finally, do you have any other suggestions to improve future workshops?

Time was too short (6).
Use translation services for the participants from Mozambique (1).

Overall score appreciation of the workshop:	**49**	**23**				**92%**

Overall, the workshop was well received by the participants obtaining an overall approval rating of 92%. The workshop managed to achieve its objectives. The Consultant managed to test and validate the findings and recommendations of the scoping study and the participants are convinced about the need to develop and implement a road materials database min their country.

Annex A: Workshop Program

Time	Description	Presenter	Facilitator
Session 1: Opening and setting the scene			
09:00 - 09:10	Welcome remarks		Jan
	Self introduction participants		
09:10 - 09:20	Introduction AfCAP	AfCAP	
	Opening Address ANE	ANE	
09:20 - 09:30	Workshop program, objectives and project intro	Consultant (Jan)	
Session 2: Materials testing and information management findings and recommendations			
09:30 - 10:30	Findings and Recommendations of the Scoping Study • Stakeholder survey (inception stage) • Experiences from elsewhere, lessons learned • Country visits: findings and recommendations • Case study: Consultant's materials reporting	Consultant (Jan)	Ravi
	Clarification and Discussion	-	Ravi
10:30-11:00	*Coffee/Tea Break*		
Session 3: Database system development			
11:00 - 12:00	Proposed Database System Development: • Common pitfalls and best practice • Design strategy and system architecture • Integration with work flows • Data model and functional description • Technology choice and implementation	Consultant (Ravi)	Jan
	Clarification and Discussion	-	
Session 4: Validation of our findings and recommendations			
12:00 - 13:00	Group works to review findings and recommendations		
13:00 - 14:00	*Lunch Break*		
14:00 - 15:00	Report back from the groups	Participants	Jan/Ravi
	Plenary discussion	-	
Session 5: The way forward: outline proposal for Phase 2 and 3 of the project			
15:00 - 15:30	Outline Project Proposal (for Phase 2 and 3): • Minimum requirements (Ravi) • Country selection procedure (Jan) • Project management arrangement (Ravi) • Action plan / budget (Jan)	Consultant (Jan/Ravi)	Jan/Ravi
15:30 - 16:00	*Coffee/Tea Break*		
Session 6: Wrapping up and closure			
16:00 - 16:30	Focussed discussion: • Country selection procedure • System development approach • Local IT service provider • Review risk analysis	-	Jan/Ravi
16:30 - 17:00	Summary of key points and workshop evaluation	Consultant	AfCAP
	Final remarks and the way forward	AfCAP	
	Closure of the workshop	ANE	
17:00	Administrative matters	Consultant	

Annex B: List of Participants

Ref.	Name	Institution	Position	Country	Mobile phone	Email
1	Jan Bijl	Orion Consulting Associates BV	Team Leader	Netherlands	258 87 3922661	bijl@orion-associates.com
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4	Fernando Dabo	National Road Administration (ANE)	Engineer	Mozambique	+258-843222390	fernadida@gmail.com
5	Lauretta A. C. Dumbuya	Sierra Leone Roads Authority	Senior Engineer	Sierra Leone	+232-79624037	lacscivil@yahoo.com
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7	Irene Simoes	National Road Administration (ANE)	Director of Maintenance	Mozambique	+258-826117340	irecel2005@yahoo.com.br
8	Osorio Antionio Muianga	National Road Administration (ANE)	Head of Department, Delegation Maputo	Mozambique	+258-7754157	wakomuianga@gmail.com
9	Hilario Tayob	National Road Administration (ANE)	Geologist	Mozambique	+258-823233230	tayobhi@gmail.com
10	Rubina Normahomed	National Road Administration (ANE)	Head of Department	Mozambique	+258-823074570	rubnormah@yahoo.com
11	Presley Chilonda	Roads Development Agency	Principal Engineer	Zambia	+260-978949956	PChilonda@roads.gov.zm
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22	Antonio Arone	Engeneering Laboratory Mozambique (LEM)	Engineer	Mozambique	+258-848328620	Not provided
23	Armindo da A. Leonardo	National Road Administration (ANE)	Head of Provincial Materials Laboratory (Maputo)	Mozambique	+258-828745030	am_anza@yahoo.com.br
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Annex C: Questions for the Group Works

- Three groups of about 6-7 participants each
- Each group should nominate a moderator and a rapporteur.
- You have 40 minutes to discuss 2 topics (about 20 min each topic)

1. Discuss the proposed integration of Module 1 with materials testing workflows / laboratory management systems. Identify possible differences that may exist between partner countries

2. Discuss the key information (parameters) that should be covered by Module 2 (the materials information and mapping module), see below for an initial list of parameters.

- Write your key findings (bullet points) on the flipchart for presentation in the plenary session (about 5 -10 minutes for each group).

Key Parameters:

Material Location

- Materials Source (ID)
- Location (administrative area, road, chainage, offset, village, geo-reference)
- Layout (sketch, map, satellite image, area)
- Ownership, operating status
- Climate zone (Weinert or similar)
- Geological zone
- Land use
- Topography (terrain, land form, etc.)
- Environmental sensitivity
- Exploration risks (e.g. accessibility, landmines, water table, flooding)

Materials Description

- Type of material (sand, gravel, aggregate)
- Physical description (colour, structure, consistency, photos, etc.)
- Material definition (by geological type, parent material, etc.)
- Overburden (thickness, type)
- Estimated quantity
- Classification (e.g. Unified Soil Classification, AASHTO, etc.)
- Potential use in road works (Surface, base, sub base, selected fill, etc.)

Materials Property

- Particle size distribution
- Plasticity of the fine fraction of the material
- Density and moisture content
- Load bearing capacity
- Volume stability
- Particle strength and durability
- Particle shape

Annex D: Proposed Country Selection Criteria for Phase 2

1. Initial Sreening (using pass/fail criteria)		Max. Points	Description	DRC	Ethiopia	Ghana	Kenya	Liberia	Malawi	Mozambique	Sierra Leone	South Sudan	Tanzania	Uganda	Zambia
1. Initial Sreening (using pass/fail criteria)	1. A written request to AfCAP signed by the head of the proposed lead road sector institution	Yes/No	A 'Yes' is required in order to be considered for Phase 2 and 3												
	2. Declaration of undertaking showing a commitment to meet the project's counterpart contribution and support to open access to road materials information (yes/no)	Yes/No	A 'Yes' is required in order to be considered for Phase 2 and 3												
	3. Brief proposal outlining how the road materials database project would be implemented using the template provided	Yes/No	A 'Yes' is required in order to be considered for Phase 2 and 3												
2. Scoring matrix of the proposal against key selection criteria (minimum 50 points for project readiness for Phase 2 and 3, highest ranked country with > 50 points is selected for Phase 2)	4. Level of commitment demonstrated during Phase 1 of the project (the country returned the stakeholder survey)	5	Countries who completed and returned the stakeholder survey (5 points). Those who did not (0 points).												
	5. The experience of the lead institution with successful development/operation of similar information systems (based on max. 3 project reference sheets)	15	Each successful project implemented (5 points). Successful is defined as operational and in use by the institution.												
	6. The maturity of the existing regulatory framework for road materials testing (independent oversight, quality assurance procedures and the use of standard protocols)	10	Laboratories are inspected and equipment is calibrated at minimum required intervals by an independent authority (5 points)												
			Materials testing manual and protocols are in place and used (5 points).												
	7. The appropriateness of the proposed institutional cooperation framework (constitution of the project team and proposed mechanism for project coordination with road sector instititions, academic & research institutions and the private sector)	15	Institutional cooperation framework (5 points)												
			Expertise and experience of the road materials database project team (10 points)												
	8. The availability ICT facilities and current use of Information Systems within regular operations and/or a proposal on how any gaps will be addressed.	30	IT policy, strategy and data protection mechanism in place (5 points)												
			Hardware facilities in the lead institution (5 points)												
			Hardware facilities in sub-national offices (5 points)												
			Network facilities: LAN in Lead Institution (4 points);												
			Network facilities: LAN in sub-national offices (4 points);												
			Network facilities: Corporate network links to sub-national offices or adequate Internet at those locations (2 points).												
			Significant use of information systems in operations (5 points)												
	9. The availability of in-house staff with experience of managing the development, maintenance and operation of information system of comparable scope and complexity	25	Staff with experience of managing external contractors or internal teams for development of Information Systems projects (8 points).												
			Staff with experience of developing functional requirements and specifications for Information Systems projects (8 points).												
			System administrator, Database administrator (5 points)												
			Progammer, developer and/or dedicated user technical support staff (4 points);												
Total assessment score		**100**		0	0	0	0	0	0	0	0	0	0	0	0

Annex E: Evaluation Form

Road Materials and Aggregate Inventory Database Workshop Evaluation Form

Please take a few minutes to respond to the following questions (where requested circle the rating).

1. Did the workshop meet your expectations?

++	+	0	-	--

Briefly explain, if necessary:

2. What did you find the most interesting and relevant topic of the workshop?

3. Were the presentations, handouts and clarifications clear?

++	+	0	-	--

4. Was the facilitation of the workshop such that it gave you an opportunity to share your views?

++	+	0	-	--

5. Were the topics chosen for the group works and the plenary discussion relevant for the objective of the workshop?

++	+	0	-	--

6. Do you think differently about the need for developing a road materials database in your country after having participated in this workshop? Please explain.

7. Were the logistical arrangements and pre-workshop communications satisfactory?

++	+	0	-	--

8. Were the accommodation and conference facilities satisfactory?

++	+	0	-	--

9. Finally, do you have any other suggestions to improve future workshops?

Annex F: Presentations

Annex F-1 Introduction to the Project and the Workshop

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PROJECT: ROAD MATERIALS AND AGGREGATE INVENTORY DATABASE – PHASE 1

Session 1: Introduction

OCA

Cardno

RAF2101A Road Materials Database Regional Stakeholder Workshop, 5 September, Maputo, Mozambique

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Objectives of the workshop

- The scoping study (Phase 1 of the Road Materials Database Project) is to identify needs, system architecture and requirements for development of a generic road materials database
- Presentation of the consultant's team
- The objective of the workshop: get your feedback on our findings, recommendations and outline database system
- Discuss the proposed way forward for Phase 2 (Development and Piloting) and Phase 3 (Roll Out)
  - Action Plan
  - Budget
- Workshop program

RAF2101A Road Materials Database Regional Stakeholder Workshop, 5 September, Maputo, Mozambique

Annex F-1 Introduction to the Project and the Workshop

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- Any questions so far?

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Project context

- Lack of reliable information about road materials generally recognized
- Result in frequent waste of scarce resources
- Many AFCAP partners identified the need for better materials information management
- Therefore included as a regional project
- Should cover all natural materials
- Potential for cross fertilization (HVRs → LVRs)

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Project phases

- The project is divided into three phases:
  - Phase 1 – Scoping study and identification of a suitable architecture and system requirements
  - Phase 2 – Development of the database and partial population for piloting / testing
  - Phase 3 – Roll–out to interested partner countries, including training
- Project output: develop a generic database
- Populated and implemented at national level

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Objectives Phase 1 (Scoping Study)

- Review current systems for materials testing and information management
- Identify stakeholder needs and ambitions
- Propose suitable materials database system (architecture and system requirements)
- Provide action plan and budget for:
  - Phase 2: the development and piloting of the database
  - Phase 3: actions for supporting training and roll-out

Annex F-1 Introduction to the Project and the Workshop

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Implementation Phase 1

- April – September 2017
- Four tasks:
  - Task 1: Inception phase (April/May)
  - Task 2: Country visits, draft report (June/July)
  - Task 3: Stakeholder workshop (August)
  - Task 4: Final reporting (September)

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Annex F-1 Introduction to the Project and the Workshop

Annex F-2 Findings and Recommendations

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PROJECT: ROAD MATERIALS AND AGGREGATE INVENTORY DATABASE – PHASE 1

Session 2: Findings and Recommendations

Key results of the Stakeholder Survey

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Introduction

- Stakeholder survey reviewed current systems for materials testing and information management:
  - Part A: Inst. framework for testing / data management
  - Part B: Current information management systems
  - Part C: Stakeholder needs and expectations
- Sent on Monday 24 April to all partner countries
- Reminder was sent on Monday 1 May
- 2 weeks to complete and return the questionnaire

Annex F-2 Findings and Recommendations

Partner Countries	Returned	Not Returned
DRC		✓
Ethiopia	✓	
Ghana	✓	
Kenya	✓	
Liberia		✓
Malawi		✓
Mozambique	✓	
Sierra Leone	✓	
South Sudan	✓	
Tanzania	✓	
Uganda	✓	
Zambia		✓

Institutional framework

- The main inst. resp. for materials information management lies with the national road authority.
- On an increasing scale, private laboratories are emerging.
- The need for regulation and oversight has been recognised.
- In most countries, specialised institutions for rural and urban roads. Typically less resources for materials testing and rely on national road authorities' facilities.
- Budget resources generally low.
- Staff resources: major differences between countries.

Annex F-2 Findings and Recommendations

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Current materials database systems

- Of those responded, only Ethiopia has a materials.
- The other 7 not. Some store information in excel files.
- DRC and Malawi may have (had) database in place. Status?
- Materials information used by in-house staff (project engineers):
  - HVR: consultants / contractors bear a contractual resp.
  - LVRs: government engineers road design work in-house
- The survey feedback show that improved materials information management is seen as a priority:
  - To better manage scarce resources
  - To protect (register) existing materials
  - To better manage overhaul

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Stakeholders' needs and expectations

- Priority Materials Info Management Modules
  - Geotechnical investigations
  - Materials and workmanship testing of road works
  - Materials properties / mapping existing sources
  - Road pavement evaluation and performance data
  - Prospecting tools for locating unexplored sources
  - Road alignment (subgrade) testing
- You responded overwhelmingly that mapping existing quarries and borrow pits are the top priority

Annex F-2 Findings and Recommendations

- Questions?

PROJECT: ROAD MATERIALS AND AGGREGATE INVENTORY DATABASE – PHASE 1

Session 2: Findings and Recommendations

Materials databases: experiences from elsewhere

Annex F-2 Findings and Recommendations

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Road database systems

- Cambodia, the Pilot Road Materials Database (PRMD)
- South Africa, Western Cape Province, the Borrow Pit Information Module (BPIM)
- Namibia, the Materials Information Management (MIM)
- Botswana, the Materials Database and Inventory System (MDIS)
- Zimbabwe, the Materials Inventory (MI)

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System	Year	Access and Choice of Technology			Development Process				Linked to Asset Mngt. System	Current Status
		Level of Access	Platform used	Technology used	Part of laboratory workflows	Historic Data collected	Developed externally or internally	Link to GIS		
Indonesia (ICMS)	1997	Restricted	Desktop	dBase and Fox Pro	No	Yes	Externally	No	No	Unknown
Cambodia (PRMD)	2008	Restricted	Desktop	Microsoft Access	No	No	Externally	Yes	Yes	Not operational
SA Western Cape (BPIM)	2007	Public	Desktop Web Based	Unknown	Yes	No	Internally	No	Yes	Out of use but now revived.
Namibia (MIM)	2010	Restricted	Desktop Web Based	Re-developed in PostgreSQL	Partially	No	Externally	Yes	Yes	Operational. Not fully updated.
Botswana (MDIS)	2008	Restricted	Desktop	Oracle XE 10g	No	No	Externally	No	No	Partly operational
Zimbabwe, (MI)	1998	Restricted	Desktop	Fox Pro	No	Yes	Externally	Yes	No	Not operational

Table 1: Summary Roads Materials Database Systems

Annex F-2 Findings and Recommendations

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Findings

- The majority are desktop based, for internal use and with restricted access
- Externally developed (mostly by an international engineering consultants)
- Not, or only partly, embedded with workflows of the road materials laboratory
- About half are linked to GIS and road asset management systems

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Operational performance?

Country	Current Status
Cambodia (PRMD)	Not operational. Largely externally driven (SEACAP). Lacked ownership.
SA W. Cape (BPIM)	Was out of use but revived. Integrated with asset management and materials testing workflows.
Namibia (MIM)	Operational but not fully updated. Integrated with road asset management.
Botswana (MDIS)	Partly operational. Not integrated workflows. IT issues. Lack of expertise to change source code.
Zimbabwe, (MI)	Reportedly no longer operational. Main emphasis on historic data collection.

Annex F-2 Findings and Recommendations

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Important lessons learned

- **Level of Access**
  - Promote open access and bi-directional flow
  - Web-based user interface allowing access from remote locations
- **Technology platform**
  - Systems mostly developed for desktop environment.
  - Users are increasingly operating on site, far from office and network.
  - Access from remote locations. Allow data up/download on and offline. Ease of administration, maintenance and updates to software from one single location.
  - Selected technology platform can have significant long-term impacts.
  - The technology platforms selected with view to long-term sustainability of the system, considering local environment.

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Important lessons learned

- **Integration within work processes**
  - Developing a information system is not the biggest challenge.
  - Incorporate the materials database as part of institution(s).
  - Integration with work flows is a key requirement.
  - No additional requirement for data collection/entry.
  - The points of integration need to be identified and embedded in the system design from the outset.

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Important lessons learned

- **Data capture**
  - Avoid an initial focus on historic data collection.
    - Very time-consuming and costly.
    - Frustrate the development process
    - Impose high demands on the limited staff and budget resources.
  - Adopt a forward-looking data collection approach
    - Starting from the date of implementation.
    - Ensure road stakeholders contribute to the information supply chain
    - Past data can be entered later on, working backwards

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Important lessons learned

- **Ownership / local capacity development**
  - Be cautious with sole reliance on international technical resources to develop software
  - Knowledge transfer: substantive roles for the client and local ICT service providers
  - Local ownership: participate in problem solving and the design process.
  - Effective capacity development:
    - Close engagement of the beneficiary institution(s)
    - Deployment of multidisciplinary project teams
    - Engagement of local ICT service providers

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Important lessons learned

- **Link to other Information Systems**
  - Can be challenging if such systems are not developed simultaneously, and if a simple and consistent basis of linkage cannot be identified.
  - At an early stage of database development: link database structures.
  - How can this be achieved:
    - Wider issues are considered during the design of the materials database.
    - Establish consistent logic (even if some functions are not initially supported by the software).
    - Road asset management: unique referencing system for materials sources, which is used consistently across both systems (this is an example of the consistent logic referred to above).

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Important lessons learned

- **The System Development Process**
  - Avoid focus on the production of a piece of software as a technological challenge
  - Pay adequate attention to the challenges of implementation: integration with work flows, change management, user training and support.
  - Growing recognition that the development approach has a key role to play in the success of the initiative.
  - Achieve specific outputs that are useful in the regular work of the organisation.

Annex F-2 Findings and Recommendations

- Questions?

PROJECT: ROAD MATERIALS AND AGGREGATE INVENTORY DATABASE – PHASE 1

Session 2: Findings and Recommendations

Country visits and field work consultations

Annex F-2 Findings and Recommendations

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Country visits

- TOR required the Consultant to visit 3 representative AfCAP countries
- In depth qualitative review of:
  - Institutional and regulatory framework
  - Systems and workflows for materials testing and information management
  - Identify stakeholder needs and ambitions
- Countries: Ethiopia, Ghana and Mozambique.
- Replaced Ethiopia with Tanzania

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Institutional framework

- The institutional framework varies in terms of:
  - Number of road sector institutions
  - The level of de-concentration (regional labs)
  - The level of private sector involvement
  - Materials testing market (private laboratories)
- Implications for the materials database:
  - Cooperation framework public institutions
  - Effort required to roll out the materials database
  - How to engage the private sector

Annex F-2 Findings and Recommendations

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Regulatory framework

- The regulatory framework is common with respect to oversight and quality control
- The regulatory framework varies in terms of ownership of materials:
  - Materials considered public property and explored permanently by road authority (open pit)
  - Materials extracted for the duration of the project (pits remain privately owned, reinstated after use)
- Implications for the database:
  - Management of materials quantities

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Current systems and workflows

- The materials testing procedures have a lot in common. Based on the same international references.
- Materials properties tested are very similar.
  - As mentioned, only Ethiopia has a materials database in place.
  - Most countries use excel templates for data storage
- Minor differences can be accommodated by making a distinction between:
  - the materials property tested (e.g. strength),
  - the test used (e.g. CBR),
  - the test method (e.g. BS),
  - the test description (e.g. CBR 4–days soaked, OMC or 0.75 OMC),
  - the test value obtained (e.g. % CBR value)
  - acceptable ranges for HVR and LVR
- Some partner countries have developed LVR design manuals
- Resource availability remains one of the key challenges

Annex F-2 Findings and Recommendations

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Stakeholder needs and ambitions

- Main priority is to have a road materials database system in place that shows:
  - Locations of road materials sources (in particular gravel and aggregates, some to include sand and water)
  - Summary of the material properties
  - Estimate of the available quantities (if feasible)
  - Historic and potential use of the materials.
- In terms of materials properties, sufficient similarity to justify reference to a generic road materials database
- Some flexibility required for country specific needs.
- No evidence of any significant use of industrial by-products (e.g. residual coal slag)

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Stakeholder needs and ambitions

- Materials properties:
  - Particle size distribution
  - Plasticity of the fine fraction of the material
  - Density and moisture content
  - Load bearing capacity
  - Volume stability
  - Particle strength and durability
  - Particle shape
  - (adherence to bitumen)

Annex F-2 Findings and Recommendations

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Stakeholder needs and ambitions

- No need to differentiate between LVR and HVR.
- No evidence of use of materials indicators (remote sensing, botanical and landform) for prospecting.
- Establish a link with a GIS as a tool for materials prospecting.
- Development of the road materials database tied in with improved laboratory management.
- Important to protect the professional liability of the client through a disclaimer.

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Stakeholder needs and ambitions

- Provisions can be made to extract summary data from the laboratory materials testing sheets (once approved).
- Same applies to the materials reports submitted by consultants and contractors. Requires the use of a standard template.
- If both covered, the database would embrace the full range of materials tests carried out.
- Pragmatic, staged development process prioritising interfaces for the most important users.
- Important to allow access to the road materials database from remote locations to support field work

Annex F-2 Findings and Recommendations

- Questions?

PROJECT: ROAD MATERIALS AND AGGREGATE INVENTORY DATABASE – PHASE 1

Session 2: Findings and Recommendations

Case study materials reporting Consultant

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Introduction

- Case study upgrading trunk road Mozambique
- > 3 MESA
- Detailed design: 19 borrow areas identified
- Design review:
  - Asses availability of natural gravel for use in the base layer (CBR > 80%) to replace the need for expensive crushed stone
  - 10 additional borrow areas were identified during the design review with potentially good materials

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Materials sampling and testing

- At each potential borrow area:
  - 16 trial pits were dug max. depth of 2.0 m
  - Grid spacing 50m, area 150m x 150m
- Laboratory tests on the collected samples:
  - Particle size distribution
  - Atterberg limits
  - Compaction (modified)
  - CBR 4 days soaked at 90, 93, 95 and 98% MDD

Annex F-2 Findings and Recommendations

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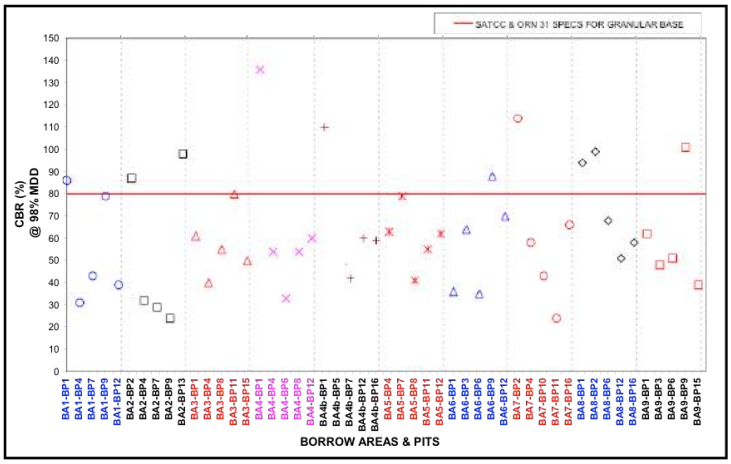
CBR results against target of 80%



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Results

- Of 50 trial pit samples, only 10 had CBR's > 80%
- 40 rejected (CBR < 80%), but 34 had CBR's > 30%
- Can be used in pavement layers for LVR projects
- What happens with information? Used for LVR?
- Probably not or, at best, not fully, because:
  - The way road authorities manage their network
  - Materials rejected for HVR usually ignored
  - No road materials database, at best stored in project files at HQ

Annex F-2 Findings and Recommendations

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Summary of materials availability

Geo-reference	Chainage	Offset (from CL) (Km)	Right or Left	Ave Thick Over Burden (m)	30% < CBR < 80%		
					Average Gravel Seam Thickness (m)	Area of Gravel Seam (m^2)	Volume of Gravel Seam (m^3)
36 K 797897 8214254	8.8	0.85	Right	0.64	0.77	37,500	29,000
36 K 799795 8213428	10.8	0.15	Right	0.79	0.52	30,000	15,000
36 K 799989 8211402	12.8	0.10	Right	0.35	0.63	37,500	23,000
36 K 798408 8208743	16.3	0.65	Right	0.38	0.45	40,000	18,000
36 K 812403 8197503	37.3	0.20	Left	0.58	0.79	37,500	29,000
37 K 184715 8180992	60.5	0.65	Left	0.20	1.32	40,000	52,000
37 K 186411 8174516	68.5	0.15	Left	0.75	0.84	35,000	29,000
37 K 190674 8170350	74.5	1.15	Right	0.40	0.86	37,500	32,000
37 K 202020 8164878	91.0	0.35	Right	0.52	0.75	37,500	28,000
37 K 212736 8160471	105.0	0.17	Right	0.35	1.42	40,000	56,000
						Total	**311,000 m3**

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Conclusions

- Typical case: 60-70% of materials are rejected for HVR projects
- Materials testing cost USD 50,000 +
- Information submitted as Consultant's materials report
- Valuable information but probably lost in the archives
- 311,000 m^3 of gravel, market value: USD 2 Million
- Used as wearing courses, base or sub base layer for LVRs
- In a typical partner country: 5 or more of such projects at a given time

Annex F-2 Findings and Recommendations

- Questions?

Thank you for your attention

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Annex F-3 Database System Development

Database System Development

- Common pitfalls / Best Practices
- Design strategy and system architecture
- Integration with work flows
- Data model and functional description
- Technology choice and implementation

Common Pitfalls / Best Practice

- Facilitate access to those who need to use the system
  - Data input as well as usage
  - Access policies
  - Technology to support users in the field and remote offices.
- Appropriate technology platforms
  - Technology environment (Internet, Skills)
  - Future costs: Expansion and Maintenance
- Integration with work processes
  - Data capture as part of the process rather than extra work
  - Make work easier
  - Opportunities for improvement (efficiency, effectiveness)
- Historic data capture
  - Difficult. Holds up implementation unnecessarily.
  - Design to use current data; work backwards for historic data if available.

Annex F-3 Database System Development

Common Pitfalls / Best Practice

- Design for the long term – Generic Data Model
  - Sustainability – maintenance and expansion
  - Link to other information systems
    - The myth of compatibility (technology)
    - Linkage based on system design logic and data model (e.g. Common reference system for road links and material source)
- Ownership and local capacity
  - Close involvement of client institution in design and management
  - Local (or easily accessible) technology service providers
- System development process
  - Increasingly recognised as a Critical Success Factor
  - Conventional methods tried to address all requirements through one project.
  - "Agile" methodologies are based on a succession of small projects, each producing a specific useful output.

Database System Development

- Common pitfalls / Best Practices
- Design strategy and system architecture
- Integration with work flows
- Data model and functional description
- Technology choice and implementation

Annex F-3 Database System Development

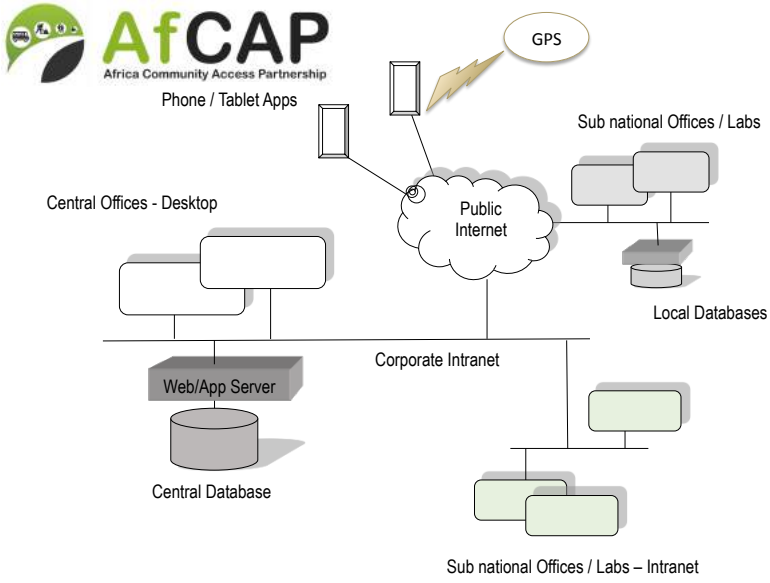
Design Strategy

- Develop System Architecture based on available technology services, but allow for future developments
- Identify work flows and functional logic based on current practices of the roads sector as well as potential improvements
- Establish a data model that is
  - As "generic" as possible
  - Encompasses the information needs of the sector to the best degree possible, even if some areas may not be developed immediately
  - Allows for modular development and expansion

System Architecture

- Assume no major improvements in infrastructure during the implementation period (2-3 yrs)
  - Internet services at sub-national level
  - Corporate Internet
- Design for
  - Anticipated usage patterns
  - Future improvements in technology, if/when they occur

Annex F-3 Database System Development



Proposed System Architecture

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Database System Development

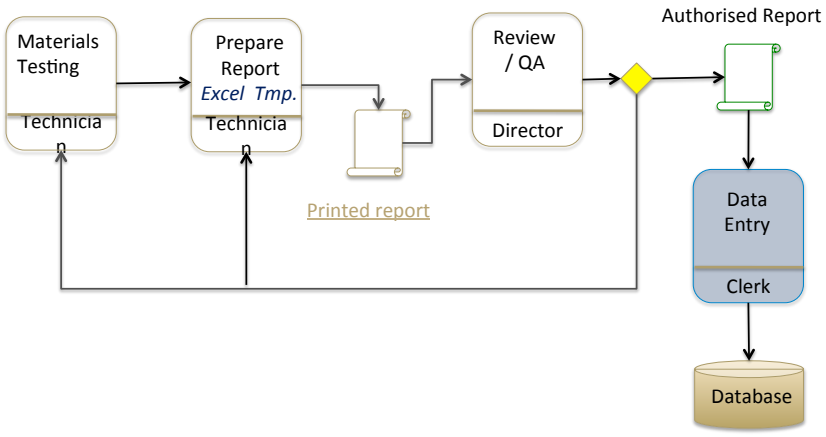
- Common pitfalls
- Design strategy and system architecture
- Integration with work flows
- Data model and functional description
- Technology choice and implementation

Annex F-3 Database System Development

Integration with workflow

- Points of integration:
  - Materials testing at government laboratories
  - Accessing materials information and mapping - design and planning
  - Materials testing (reports) from contractors and consultants
  - Prospecting in the field
    - Accessing material source data
    - Recording observations

Materials Testing Process (simplified)



Annex F-3 Database System Development

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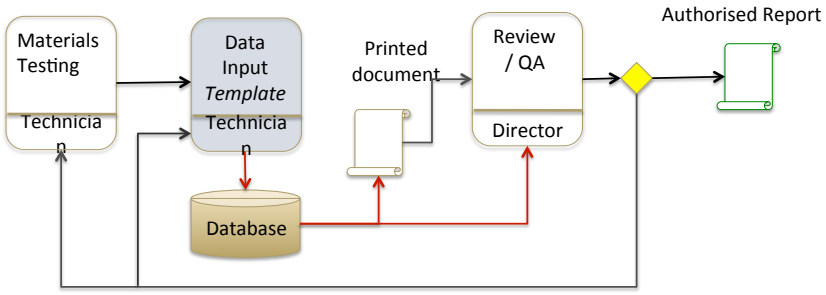
Materials Testing Process - Integration



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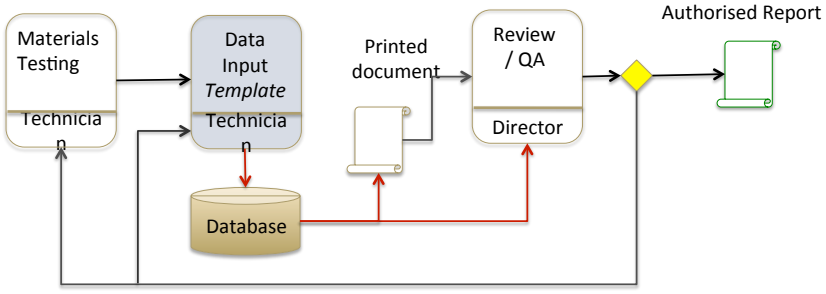
Materials Testing - Integrated



- *Each process needs to be carefully reviewed at design stage.*
- *Input of users (Engineers, Technicians, Managers) is vital*
- *Seek opportunities for improvement over current process*

Annex F-3 Database System Development

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Database System Development

- Common pitfalls
- Design strategy and system architecture
- Integration with work flows
- Data model and functional description
- Technology choice and implementation

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Functional Description – Proposed modules

Module	Users / Location	Functionality
1. Materials Testing	Materials testing laboratories.	User Interface to support sample collection and materials testing process, including data entry screens for Lab Technicians and support for the workflow related to review and approval of results.
2. Materials Information and Mapping	All user groups subject to assigned authority levels.	Presentation of summary and detailed material test data queried by location, road link, material type, test date, sample owner and/or a similar prioritised set of criteria.
3. Capture of Contractor & Consultant Materials Reports	Roads sector regional offices and HQ engineers.	User screens to input materials data from templates included in contractor and consultant's materials report; support for query and retrieval of such information.

Annex F-3 Database System Development

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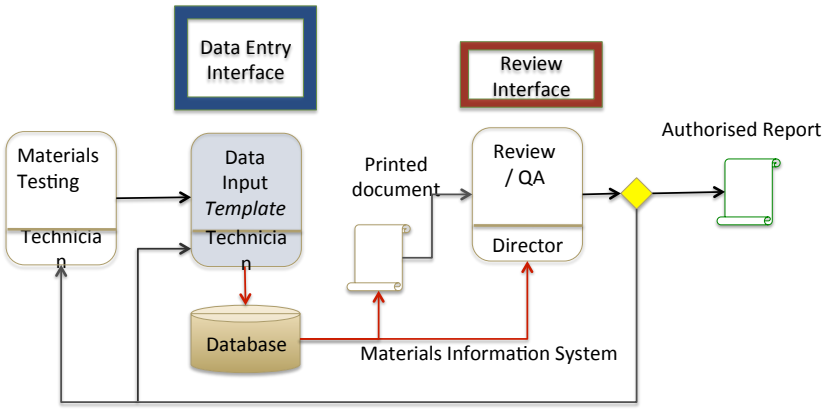
1. Materials Testing Module



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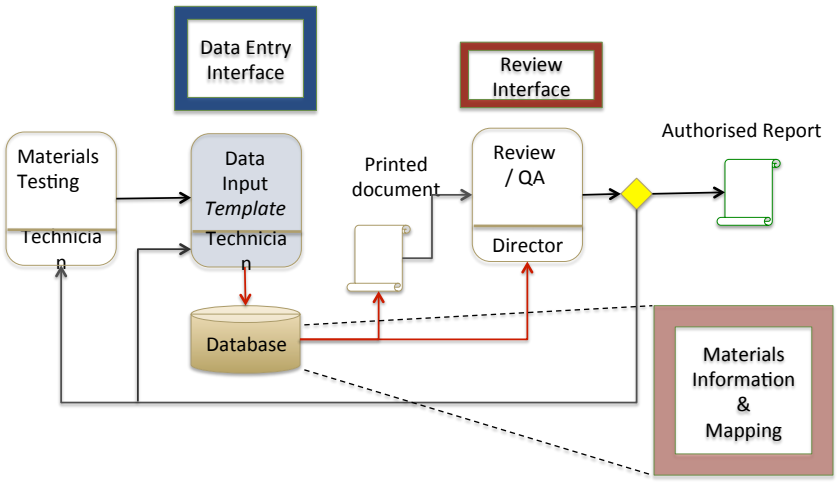
Materials Information Module



Annex F-3 Database System Development

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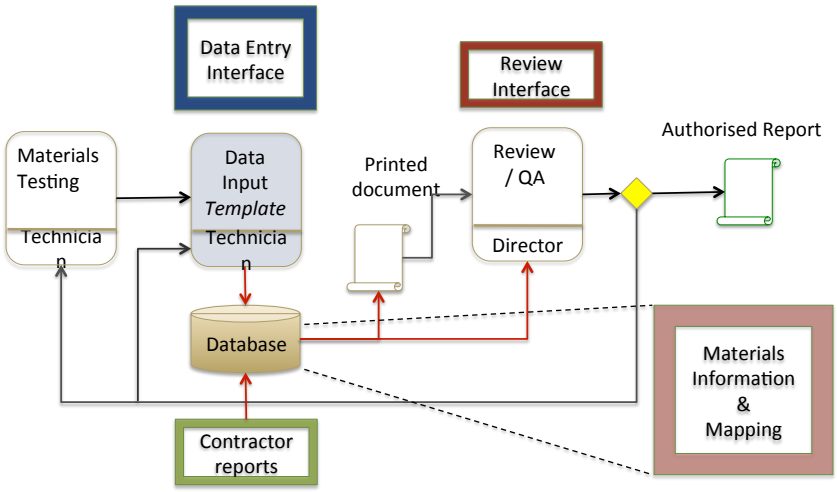
Materials Information Module



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Module	Users / Location	Functionality
4. Smart Phone App	Road sector agencies, contractors and consultants in the field.	Downloadable App, providing access to limited set of information and input facilities, intended for use in the field, by roads sector agencies as well as contractors and consultants.
5. Linkage with Road Asset Management	Roads sector regional offices and HQ, engineers.	Provision to link "as built" information on pavement layers in Asset Management systems with materials sources and classification (based on aunique Materials Source Code and Materials Classification Code).
6. GIS Assisted Materials Prospecting	All user groups subject to assigned authority levels.	Provide topographical, soils, geological and climate map layers on a GIS with overlays of road network, aerial photos and satellite imagery, to assist with prospecting of new materials sources.

Annex F-3 Database System Development

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Database System Development

- Common pitfalls
- Design strategy and system architecture
- Integration with work flows
- Data model and functional description
- Technology choice and implementation

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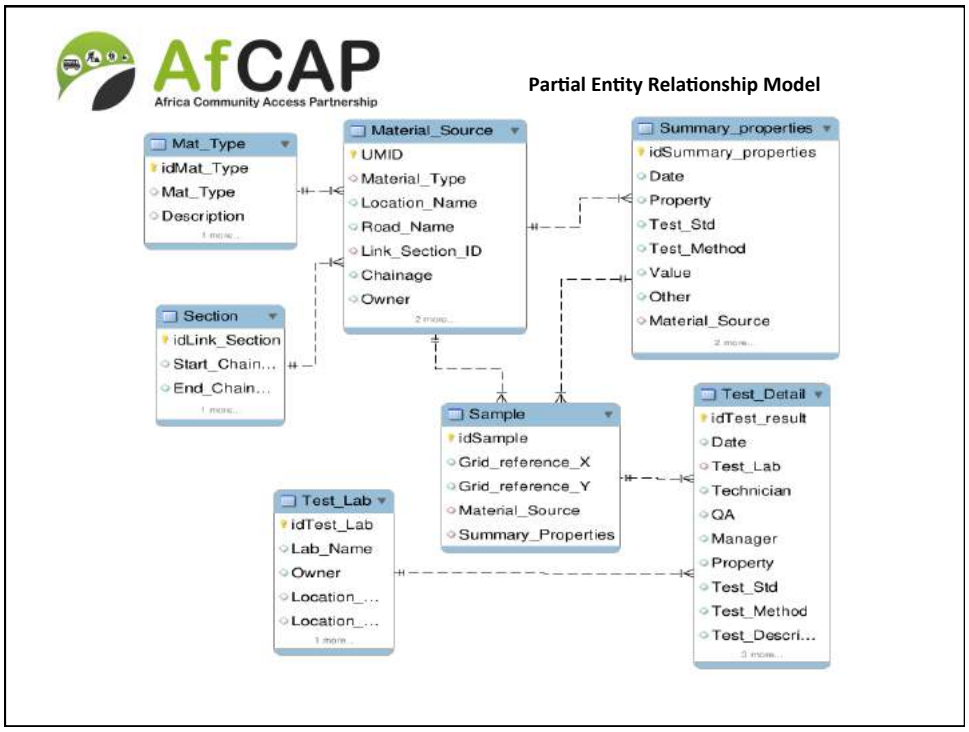
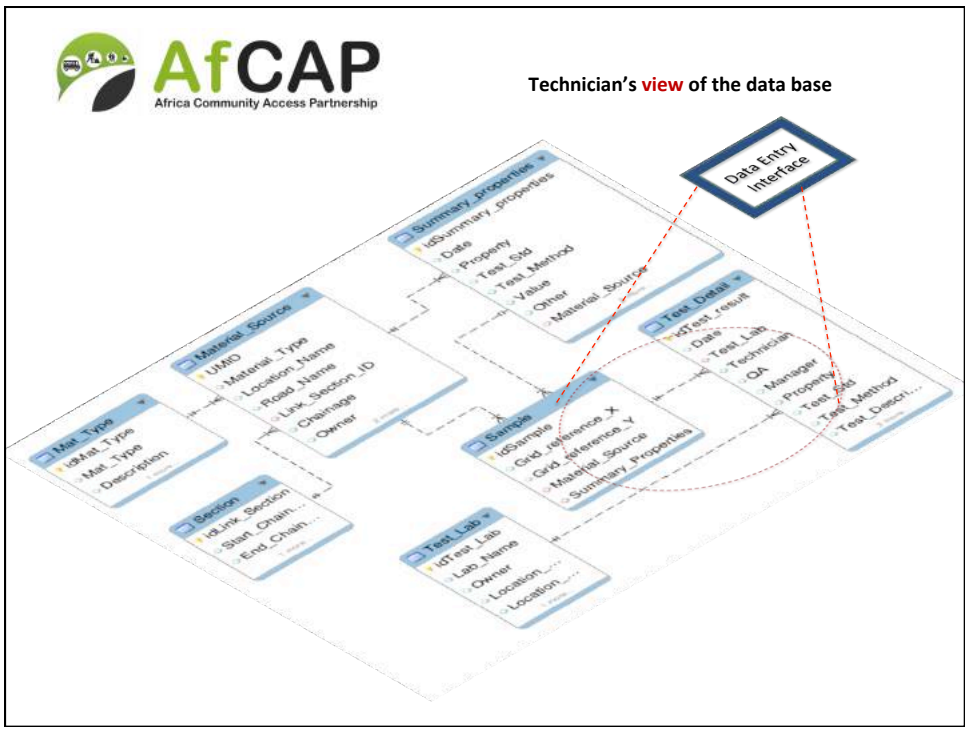
Data Model

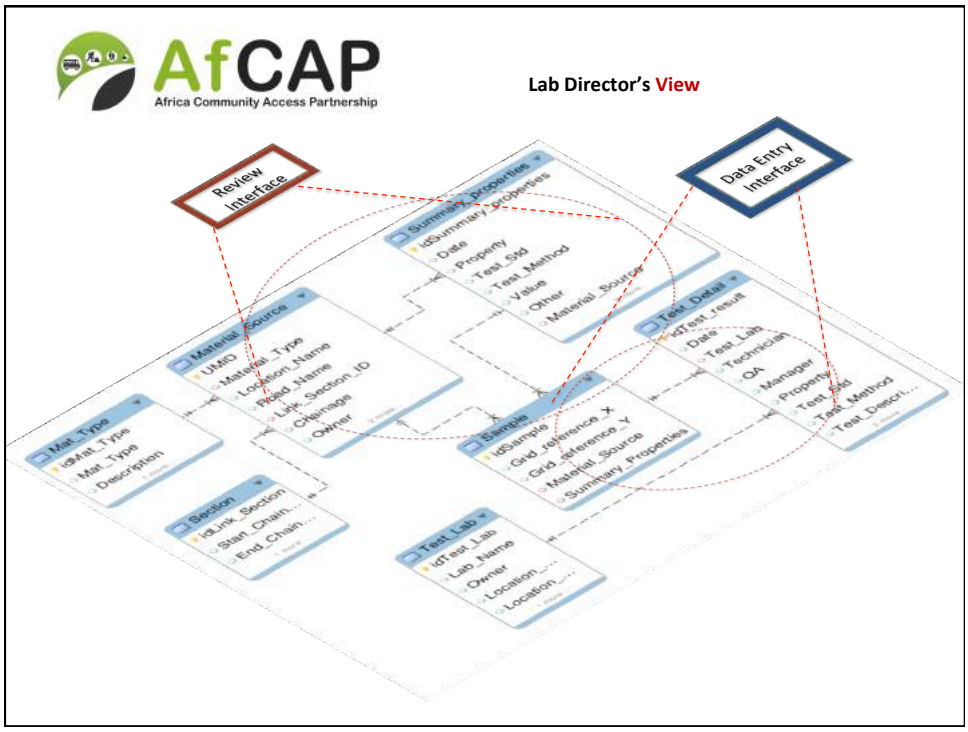
- Establishes the foundations of the database
  - "Generic" properties
  - Encompasses the domain of application to the best degree possible
  - Prevents duplication of data
  - Maintains relationships so that data integrity is retained

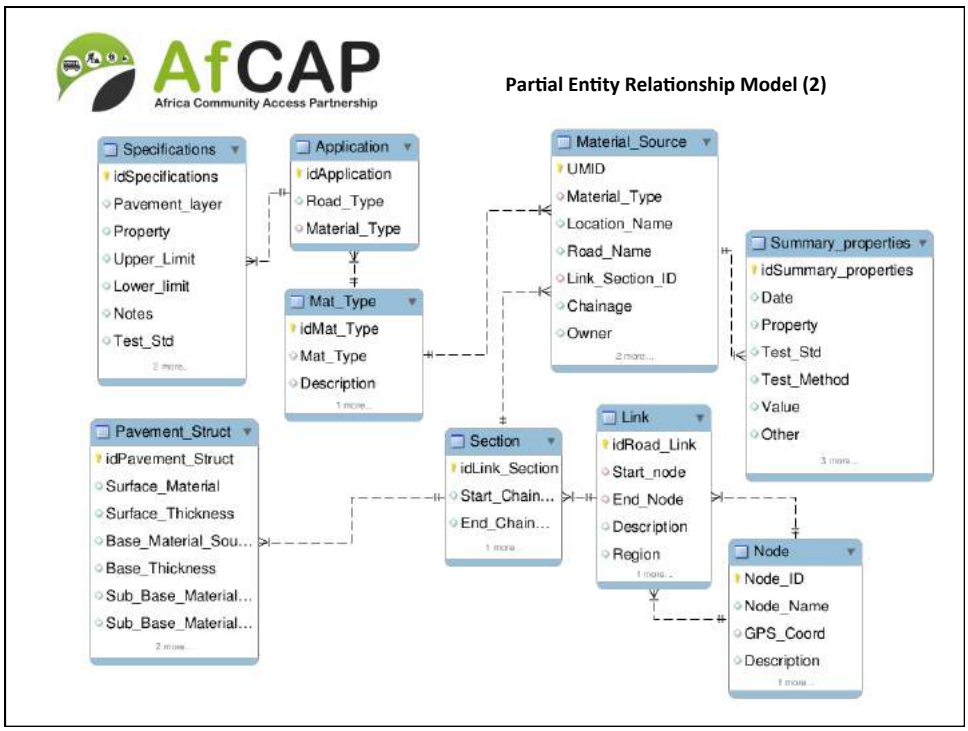
Annex F-3 Database System Development





Annex F-3 Database System Development





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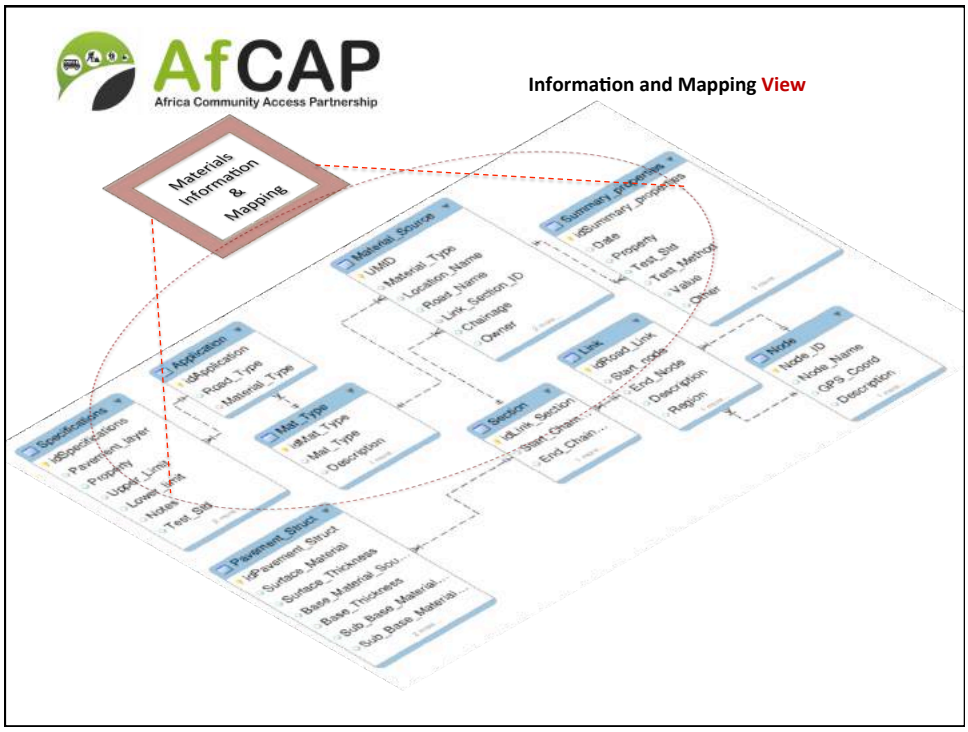

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Data Model

- Key Points:
  - Different views can be generated (applications) at any time
  - Data model should not be based on views currently required
  - Aim for complete representation of information as far as possible in design phase
    - All of it need not be built at the one time

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Database System Development

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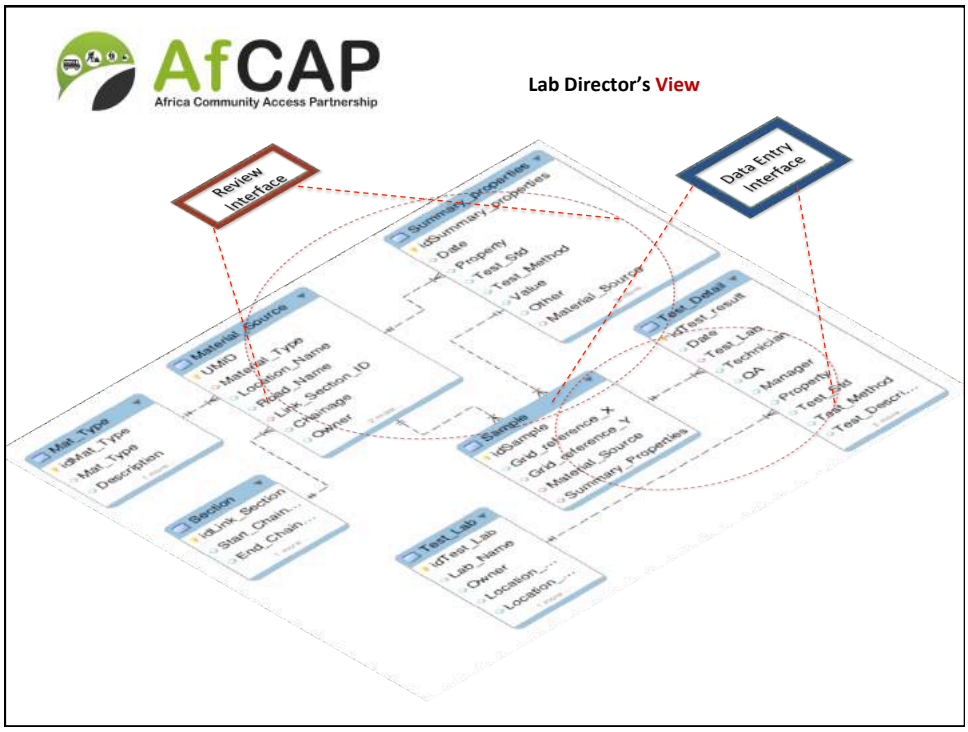
Technology Choices

- Technology considerations
  - Capacity requirements and performance (anticipate future needs)
  - Operating environment
  - Government ICT Policies
  - Available skills
  - Total cost of ownership
    - E.g. Open Source Software is free. But there need to be support skills
    - "Free" versions of Commercial Software are also available. But with very limited capacity.
- Some pitfalls to avoid
  - Aiming for "Modern" technologies. E.g. cloud based systems without consideration of internet facilities in remote locations.
  - Expensive products that may not be fully utilised for many years.
  - Choice of technologies based on familiarity of suppliers.
  - The myth of "compatibility" with existing systems.

Annex F-3 Database System Development



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Implementation

- Avoid a single, large implementation project
- Propose adoption of an "Agile" methodology
  - Proceed through several small projects
  - Each designed to deliver a useable result
  - Approx 3 months (maximum) development time
    - May be further broken into shorter activities
  - Provides early results and opportunities to review and change
  - Some modules may be run concurrently

Annex F-3 Database System Development