WORKSHOP PROCEEDINGS

PROPOSAL DEVELOPMENT WORKSHOP				
Title	Labour-based construction, testing and monitoring of proof-of-concept ultrathin continuously reinforced concrete pavement technology demonstrators			
Duration	Start date	2011/09/29	End date	2011/09/30

For this workshop, members of the Regional research alliance (RRA) and delegates from the construction industry were invited to present ideas and contribute towards the implementation of Ultrathin Concrete road pavements.

Groups or organisations represented:

- BOTEC
- CSIR
- SIRDC
- AURECON
- RRA Secretariat

Workshop Chair:

- Joe Mapiravana

Programme committee:

- Joe Mapiravana
- Sipho Mtsweni
- Mandla Dlamini
- Kenneth Mkhabela

Regional Research Alliance (RRA) Workshop Provisional List of Participants

1. Cynthia Malan – RRA Secretariat
2. Dr. Thulani Dlamini – CSIR Group Executive: R & D (Apologies)
3. Kagiso Keatimilwe – CSIR Manager: Strategic Research Alliances
4. Dr. Chris Rust - CSIR –BE Strategic Research Manager (Apologies)
5. Theuns Knoetze – CSIR – BE BST Competency Area Manager
6. Sipho Mtsweni – CSIR Manager: Africa Research Alliances
7. Dr. Joe Mapiravana – CSIR BE BST Research Group Leader
8. Rafeek Louw – CSIR Consultancy and Analytical Services
9. Adrian Bergh - CSIR Consultancy and Analytical Services
10. Dr Erik Denneman – CSIR BE Infrastructure Engineering (Apologies)
11. Louw Duplessis - CSIR BE Infrastructure Engineering
12. Stoffel Kriel - Aurecon
13. Adrian Esterhuizen – Aurecon (Apologies)
14. Tilanana de Meillon - Aurecon
15. Dr Leonard Madzingaidzo – SIRDC Executive Director - Technical
16. Douglas Tafara Manyadza – SIRDC Research
17. Jackson Aliwa - Botec
18. Sihle Dlungwana - CSIR BE Research Group Leader
19. Mandla Dlamini - CSIR BE BST Research
20. Kenneth Mkhabela - CSIR BE BST Research

Executive Summary

Dr. Joe Mapiravana made a presentation to the RRA board of directors that outlined the advantages of Ultrathin Continuously Reinforced Concrete Pavements (UTCRCP). From this presentation the board initiated a meeting between the members of the RRA namely SIRDC, CSIR and BOTEC. Aurecon was also invited to give input as private industry partners.

The goal of the work sup was to nucleate the consortium of partners for the ultimate rolling-out of labour based ultrathin continuously reinforced concrete pavements in the SADC region and beyond using a Public –Private-Partnership approach.

The objectives of the workshop were to:

- Review opportunities for low and high volume roads in the SADC region
- Introduce and review, progress technology readiness and advantages of ultrathin continuously reinforced concrete pavements technology
- To draft a bankable project proposal on "Labour-based construction, testing and monitoring of proof-of-concept ultrathin continuously reinforced concrete pavement technology demonstrators" including:
  - Assignment of roles and responsibilities
  - Defining the project objectives, activities, milestones, timeframes, budgets and expected project deliverables, including expected human capital development and joint publications
- Discuss potential funding strategies
- Defining and agreeing on the way forward.

The first day of the workshop comprised of presentations given by representatives from Aurecon, CSIR Consulting and Analytical Services (CAS) and CSIR Infrastructure Engineering (IE).

Tilana De Meillon (Aurecon) gave a presentation on Aurecon's consulting experiences through out the African continent. The presentation highlighted the high potential for development in road infrastructure in Africa. Further more it highlighted the economic benefits of a good road network, Aurecon estimate that if $32 billion spent on road infrastructure, this will result in a $250 billion increase in trade on the African continent.

Rafeek Louw and Adrian Bergh gave a presentation on Ultrathin Continuously Reinforced Concrete Pavements in a summary of the work they have done in the past 10 years. Their presentation highlighted the performance of the ultrathin pavement, where testing was performed on mine roads or by the Heavy Vehicle Simulator (HVS). The presentation showed how UTCRCP was used successfully

Louw Du Plessis gave a presentation on the CSIR's heavy vehicle simulator (HVS), which was used in the testing of the ultrathin reinforced concrete pavements. The presentation focused on the development of the HVS from the original prototype to the current version. Further more the presentation showed the wide use of the HVS to test road pavements internationally, with Heavy Vehicle Simulators being exported to the US, China and Europe.

The second session was dedicated to visiting sites where Ultrathin Reinforced Concrete Pavements have been used and tested. The site visits were hosted at the university of Pretoria and Transnet. From the site visits the delegates could inspect the Ultrathin Concrete Pavements and pose questions to Rafeek Louw and Adrian Bergh.

On the second day of the conference, Sihle Dlungwana gave a presentation on small contractor development (SME's) in South Africa. He gave specific reference to the training up and skilling of small and emerging contractors in the eastern and the Western Cape. The presentation highlighted the models used in helping small contractor development.

The presentations served as a primer for the discussion to be held on last session of the workshop. From the workshop it was established that the members of the RRA regard Ultrathin Continuously Reinforced Concrete Pavements as a technology worth pursuing in the member countries.

The expectations given and agreed upon by the delegates were:

- The project should ultimately provide employment
- The project should include Human Capital Development and skills development
- URTCP road projects would be used to bench mark and sell the technology
- The RRA project will also engage appropriate partners from industry
- A team of champions would be formed to roll out the technology
- Guideline documents and standards would be produced for construction in RRA member countries
- The ultimate implementation of UTRCP in rural, township and main roads

The involvement of the delegates was agreed to be

- Do further work on understanding the technology and to add to the body of knowledge in the construction process
- To liaise with stakeholders for familiarisation with UTRCP
- Attracting funding (Lobby funders/donors) and to come up with a project proposal that funding organisations expect
- To contribute knowledge of local conditions, opportunities and needs in RRA countries and SADC
- To provide technical backstopping, training and project management skills
- To assist in the field assessment of the roads using the Heavy Vehicle Simulator

The project related concerns raised by the delegates identified to be

- Difficulty in identifying the best partners
- Sourcing funding
- Regulation of road construction (the need for standards)
- The acceptability of the technology by industry (poor buy in)
- Further Research and Development of the technology is likely to be expensive.
- Commitment from governments

- Availability of construction materials (Cement and concrete)
- UTRCP used for conditions and climate that it has not yet been tested for

The phases that the project would go through were decided as

- Monitoring and Evaluation (Critical review of the current status of UTRCP)
- Proof concept
- Assessment of consumer acceptance
- Up-scaling
- Marketing and technology transfer

Delegates decided that the deliverables and the timelines of the workshop objectives would be

- A UTRCP proposal by RRA partners by end October 2011
- Identification and discussion with funders November 2011 to January 2012
- A literature review of the technology (Prior and evaluation)
- Technical economic appraisal (feasibility study)
- Identification of locations of trial sections and demonstration of UTRCP
- Extent of testing to be decided upon (material tests etc)
- A committee of 2-3 champions nominated to proceed with work once finances are approved.

The delegates decided that the deliverables and milestones of the project would be

- Guidelines and standards on the application of the technology (Based on test sites)
- Situational analysis report
- Human capital development outputs
- Consultation with stake holders, government departments and SADC
- Funding through Private Public Partnerships
- Complete appraisal of prior outcomes through demonstrable review of literature
- Trained technicians and engineers in UTRCP construction technology
- Development of road construction business with adequate project management skills
- At least one demonstration project in each RRA member country

The delegates suggested the following sources and organisations as potential funders for the project

- SADC infrastructure desk
- NEPAD infrastructure
- DBSA
- Development partners (ADDB, World Bank, ILO/UNDP)
- Individual government budgets (local and central)
- Government departments (e.g. Department of transport)
- Private companies/businesses
- Donors (e.g. Bill gates foundation)
- Industry (Mining and Construction)
- National Roads Authorities

- Cement producing companies
- Steel mesh producing companies
- Aggregate quarry companies

The delegates decided that the next actions of the project would be

- Submission of a proposal document for RRA board approval
- Lobbying government
- Approaching test section sponsors and project funders
- Involvement of communities
- Action committee should be enacted but before this should be done it must be decided who should be the most appropriate members of this committee.

With these high level resolutions agreed upon and consensus reached, the workshop was closed by Dr. Joe Mapiravana and Sipho Mtsweni.

Table of contents

Presentation by Tillana De Meillon (Aurecon): Experience and Opportunities in Africa

AFRICA AND AURECON NEEDS "AFRICANS"

- Leading. Vibrant. Global.
- Energy
- Competence
- Creativity
- ....
- above all "Africans"

WHY?

Africa is not a predictable continent - We know it well

Africa is not a simple continent - We need to understand and support it well

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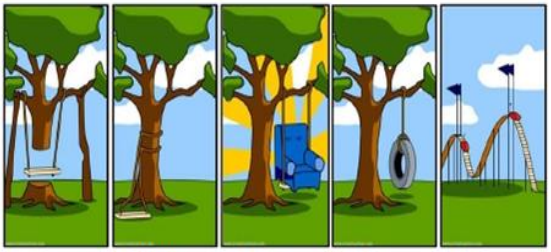
PEOPLE FROM THE CONSTRUCTION INDUSTRY



CONSTRUCTION INDUSTRY EXPLANATION

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DONORS: AFRICA'S RELIANCE ON AID

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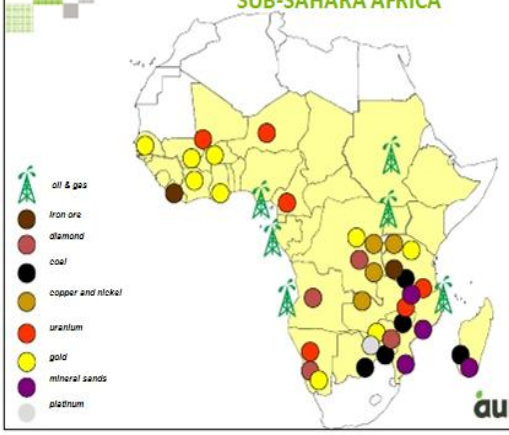
MINING - MINERAL RESOURCES IN SUB-SAHARA AFRICA



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"GROUPS" IN AFRICA

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THE PLAYERS

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ROADS

Africa $93-billion infrastructure investment each year

60000km to 100000km of roads to integrate the region.

$32-billion on roads will increase trade on the African continent by $250-billion dollars over the next 15 years.

Africa Down Under DLA Piper 2011

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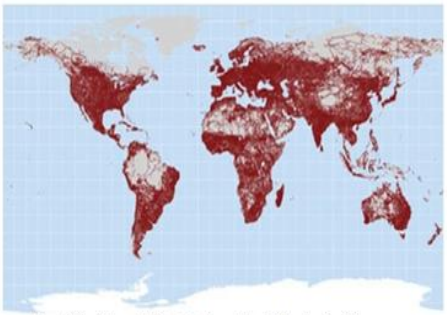
ROADS



New Scientist - satellite data from the US Geological Survey
This map shows how the world is riddled with roads

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Main challenges
Risk of doing business is high

Slide 15

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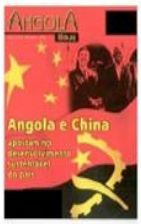
Main challenges
A "melting pot" of participants

- Dependency on and Contraction of the Market
- Political Climate
- Logistics
- Skills Availability
- Work ethics
- Mobility of Staff
- Chinese influence

Multi-Cultural Issues & Differences

- Language
- Education
- War
- Nationality



Slide 16

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Main challenges
A "melting pot" of participants

- Third world reality with first world clients
- Security
- Funding
- Maintenance?
- Business Culture – Red Tape, bureaucracy,
- Non - Payment etc.

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BUT AFRICA WORKS!

cementing_in_africa_02.wmv

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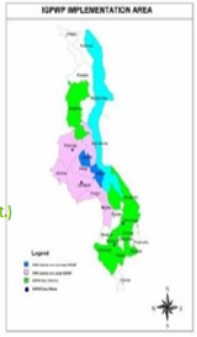
OPPORTUNITY EXAMPLES - SHOWCASE PROJECTS



MALAWI Income Generating and Food Security Public Works Programmes



Country: Malawi
Project cost: €23 million
Services & solutions:

- Programme management
- Technical assistance

Components:
1 : ROADS
Rehabilitation and Small bridges (cont.)
Routine Road Maintenance
2 : FORESTRY
3 : IRRIGATION

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OBJECTIVE AND PURPOSE

To contribute to the reduction of poverty in line with existing Government Strategies, and to enhance the socio-economic situation of these communities and assist them to promote sustainable livelihoods, addressing the needs of the beneficiaries, and ensuring buy-in from all

End-Result:	· Improve accessibility · Establish infrastructure
Sustainability Factors:	· Addressing cross-cutting issues (HIV/AIDS, gender, youth, environment) · Training and capacity building on all levels and for all beneficiaries including instutional capacity

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KEY SUCCESS FACTORS

- Responded to market needs
- Community driven & Fully supported by all stakeholders
- Multi-tier & Bottom-up approach
- Immediate & long term impact & benefits
- Wide impact (more than 550,000 beneficiaries)
- Capacity building, skills transfer & training
- Follow-up and "long" term assistance
- Restoring self pride and dignity (ownership)
- Sustainability
- Effective and efficient implementation
- Supporting policy & use of existing line structures



OPPORTUNITY EXAMPLES - SHOWCASE PROJECTS




NOVA VIDA HOUSING DEVELOPMENT (PHASE 1 & 2)

Country: Angola
Completion date: 2009
Project cost: ± $362 million USD
Services & solutions:

- Detailed engineering design
- Construction supervision
- Contract management

Interesting facts & figures:

- Site covers 400 ha
- 4 397 residential units

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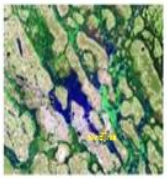
OPPORTUNITY EXAMPLES - SHOWCASE PROJECTS

ONDJIVA 2500 SOCIAL HOUSING DEVELOPMENT

Country: Ondjiva, Angola
Completion date: 2011
Services & solutions:

Urban Design:
- Social Housing Units
- Associated Infrastructure

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OPPORTUNITY EXAMPLES - SHOWCASE PROJECTS



LUBANGO-ONDIVA ROAD AND CUNENE BRIDGE

Country: Angola
Completion date: 2008
Project cost: ± $75 million USD
Services & solutions:

- Feasibility studies
- Engineering surveys
- Pavement and materials investigations
- Detailed engineering design
- Bridge condition assessments
- Construction supervision
- Contract management

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OPPORTUNITY EXAMPLES - SHOWCASE PROJECTS

REHABILITATION OF 62KM KIFANGONDO – CATETE ROAD

Country: Angola
Completion date: 2008
Services & solutions:

- Detailed Design
- Materials Investigation
- Bridge Assessments and Design
- Tender documentation and Adjudication
- Construction Supervision

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OPPORTUNITY EXAMPLES - SHOWCASE PROJECTS

ACCESS TO NEW NIEN HOUSING FACTORIES FROM MASERU BYPASS

Country: Lesotho
Completion date: 2003
Services & solutions:

- Project Management
- Preliminary Design
- Geotechnical Investigation
- Detail Design
- Quantities
- Drawings
- Tender Documentation
- Contract Management

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OPPORTUNITY EXAMPLES - SHOWCASE PROJECTS

SUMBAWANGA-MPANDA (237KM) UPGRADING PROJECT

Country: Tanzania
Completion date: 2006
Services & solutions:

- Studies
- Design
- EIA
- SIA

- Scope of study was to establish the technical, economical, social and environmental feasibility of upgrading the road

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OPPORTUNITY EXAMPLES - SHOWCASE PROJECTS

LOBATSE AND KANYE BYPASS ROADS

Country: Botswana
Completion date: 2004
Project cost: ± $2 million USD
Services & solutions:

- Detailed engineering and geometric design
- Material investigations
- Pre-contract services
- Construction supervision

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OPPORTUNITY EXAMPLES - SHOWCASE PROJECTS

Upgrading of Route EN1 (Inchope Caia Road)

Country: Mozambique
Completion date: 2002
Project cost: $1 billion USD
Services & solutions:

- Environmental and material investigations
- Bridge, pavement, geotechnical and topographical surveys
- Economic analysis
- Detailed roads and bridge engineering design
- Construction supervision
- Rehabilitation and repair of bridges and stormwater drainage systems

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OPPORTUNITY EXAMPLES - SHOWCASE PROJECTS

Transport and communications strategic planning in the Common Market for Eastern and Southern Africa (COMESA)

Client: East African Community Secretariat
Location: AFRICA Regional
Duration/Completion: 1 years
Project: The overall purpose of the study is to ultimately address economic growth and poverty reduction in Eastern and Southern Africa.
Services:

- Data collection
- Investigation of current transport and communication strategies, practices and regulations
- Facilitation of workshops
- Poverty reduction
- Enhance capacity of Regional Integration Organisations

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OPPORTUNITY EXAMPLES - SHOWCASE PROJECTS

EAC Transport Strategy and Regional Road Sector Development Programme

Client: East African Community Secretariat

Location: Kenya, Tanzania, Uganda, Rwanda, Burundi

Duration/Completion: 1.2 years/2010

Project: Multi-year work programme for strategic management of priorities and resources for transport sector development in the medium term (10 years).

Services:

- Road condition surveys
- GIS mapping
- Strategy formulation

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Partnership

- Proven Technology – reduce risk
  - Design Guideline
- Statement of Benefits confirmed
  - Whole life cycle cost
  - Proven life expectancy
  - Maintenance benefit
  - Community upliftment
  - Sustainability
- Complementary skills
- Specialist inputs towards:
  - Bridge and Pavement Management Systems
  - Potholes
  - Maintenance Systems
  - Logistics
  - Specialist Training
  - Overloading
  - Etc.

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Thank you

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Presentation by Rafeek Louw and Adrian Bergh (CSIR CAS): Ultrathin Reinforced Concrete Pavements

EMPLOYMENT INTENSIVE ROADS

Labour Intensive Construction Philosophy

- There are thousands of kilometres of unsurfaced roads especially in communities,
- These communities often have a high unemployment rate,
- The quality of life (health and financial) would improve once the roads are surfaced,
- Employment generated, more money retained and turned around in the community and the community can afford to pay for basic services.

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EMPLOYMENT INTENSIVE ROADS

Design Philosophy

- Final alignment must be completed,
- Proper stormwater design and drainage to be allowed for,
- Pavement designed according to design principles but must be fit for purpose and not over designed e.g. we do not need national road standards for minor street,
- Meet the need of the client and end user.

Construction Philosophy

- Meaningful employment and transfer of skills
- Quality (equal or better than conventional)
- Cost must be reasonable (compared to conventional)
- Employment of labour using light plant executing appropriate work

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EMPLOYMENT INTENSIVE ROADS

Technologies successfully used in Labour Intensive Construction:

1. Layerworks
   - Emulsion Treated Base (ETB)
2. Bituminous Seals and Surfacing
   - Single Seal
   - Cape Seal (Single seal plus slurry)
   - Slurry Seal
   - Penetration Seal
   - Coldmix Asphalt
3. Concrete
   - **Ultra Thin Reinforced Concrete Pavement (UTRCP)**

INTRODUCTION

Background

- Delegates attending the 2nd International conference on low volume roads in IOWA during 1979 were taken on a site visit to a road experiment including amongst other a 100mm un-reinforced and 100mm reinforced (6"x6"x $^{1}/_{8}$" mesh) road.
  - Mesh reinforced pavement performance impressive
- Observations during a follow-up visit in 1999 on farm to market roads constructed on clay subgrades(1100 vpd 4 – 4.5% heavies) revealed:
  - Main failures unreinforced roads (125mm and 150mm):
    - Joint failures
    - Isolated failures at areas with poor support "Mud spots"
    - "Quarter point" failures due to shaping of round gravel road to two flat sections

INTRODUCTION

- Reasoning
  - If detailed attention be given to support layers then "mudspot" and "Quarter point" failures could be addressed.
  - If concrete laid continuously with limited steel mesh and without joints the following might be achieved:
    - No joint failures
    - Little or no pumping
    - Possible better spreading of load
    - Thinner and more flexible slabs
  - CSIR of the opinion that the technology was ideal for the construction of low volume roads especially in residential areas by labour using light plant and equipment.
  - Towards the end of 2001 the CSIR was given an opportunity to participate in the Roodekrans thin concrete pavement together with CNCI and UP

Roodekrans access road

- Eight years and > 1 000 000 E80 loading later the three sections are still performing

- The 50mm thick section surprising all.

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MTHATHA DEMONSTRATION PROJECT

RESEARCH AND TESTING: HEAVY VEHICLE SIMULATOR / UNIVERSITY OF PRETORIA

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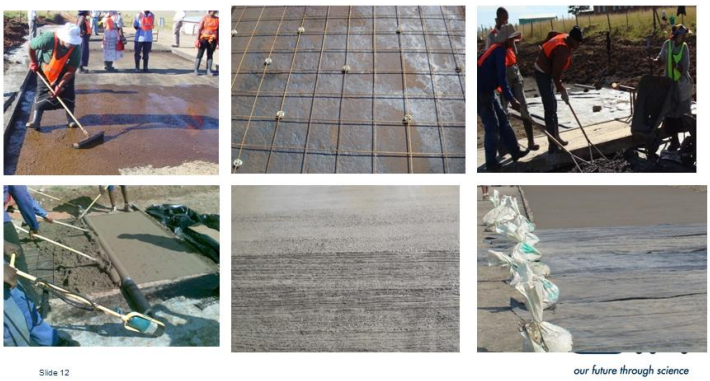
GAUTENG DEMONSTRATION PROJECTS

	Material	Length	PI	CBR	CBR Stab
Shoshanguve	dark, reddish-orange ferricrete	1.2 km		80	
Atteridgeville	dark reddish sandy shale	2.5 km	± 15	20	50
Mamelodi	clayey material	2.5 km	15 +	15 – 20	50

GAUTENG DEMONSTRATION PROJECT PHOTOS

Employment intensive surfaced roads



UTRCP Construction Team (Site)

- Contractor
- Supervisor
- Skilled persons:
  - Preparation (shutters, reinforcing): 5 workers
  - Concrete mixing and testing: 16 workers
  - Placing and finishing: 8 workers
- 1 124 person.days jobs created per km of road

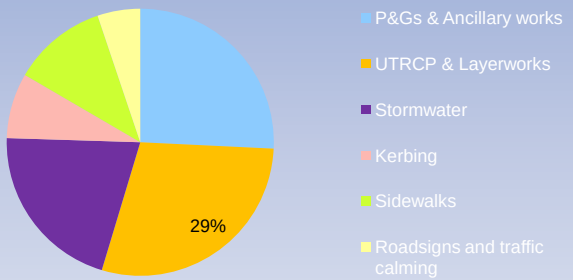
UTRCP Construction Team (Readymix)

- Contractor
- Supervisor
- Skilled persons: (15 person team)
  - Preparation (shutters, reinforcing)
  - Concrete placing and testing
  - Finishing & Curing
- 270 person days jobs created per km of road
  - But more km of road completed increasing the gross number of jobs created.

Construction and Life Cycle Costs

Surfacing	Construction Cost	Life Cycle Cost (25 yr maintenance)
Cape Seal	R 128/m^2	R 171/m^2
UTRCP	R 139/m^2	R 140/m^2
Asphalt	R 156/m^2	R 181/m^2
Block paving	R 256/m^2	R 257/m^2

Percentage cost of UTRCP in relation to total project cost (Mamelodi - 2010)



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AWARDS

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Further Research

Design Philosophy

- Thin concrete support structure – establishment of limits,
- Maximisation and use of local materials – establishment of limits,
- Design parameters e.g. deflections for community streets – establishment of limits,
- Up scaling to higher order streets,
- Value for money.

Construction Philosophy

- Concrete mixing, placing, finishing and curing using local labour
- Training requirements for local community
- Concrete optimisation
- Alternative Steel / Mesh material

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QUESTIONS

CSIR

VERSION 1

NOVEMBER 2008
(Revision 2: March 2009)

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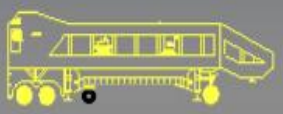
Presentation by Louw Du Plessis(CSIR IE) Heavy Vehicle Simulator Overview

Heavy Vehicle Simulator Overview

Louw du Plessis
28 September 2011

Contents

- Brief history on the development of the South African HVS programme
- Instrumentation
- Possible R & D Applications
- Examples of successful research done with the HVS



History of the HVS programme

- During 1960's SA developed an analytical pavement design procedure, but field verification of the models was required
- To determine the effect of abnormal vehicles on roads full-scale test sections loops were constructed on the premises of the CSIR. Normal heavy vehicles were used to apply the traffic
- Due to the slow rate of load applications an accelerated testing facility was designed to replace the heavy vehicles
- HVS Mk I: Bailey bridge, wheel pushed back & forth by an agricultural tractor

History Continue

- Major limitation of Mk I: system was not mobile – test sections had to be constructed under the Bailey bridge structure.
- Lead to the development of the first fully self-powered mobile accelerated testing device, the HVS Mk II
- Max load 75kN, linear tracking, single full-scale wheel

HVS MK II

- Main purpose:
  - Determination of load equivalency factors
  - Rutting in un-treated granular layers
  - Load associated cracking in cement treated bases
- Data collected: Deflections, Radius of curvature, permanent deformation, visual distress (cracks, shear failures)

HVS MK III

- Main motivation: Severe failures of a new coal delivery road. 18 tests with the Mk II were conducted to identify the cause of the problem
- Results so promising that By 1972, CSIR motivated for the manufacturing of 3 improved HVS models.

HVS MK III testing objectives

- Refinement of load equivalency factors
- Verification of new designs as proposed by the new design method
- Extend data to the 4 climatic regions in SA
- Verify theoretical predictions of distress in cemented base layers
- Refine the prediction models of fatigue cracking in Bituminous pavements
- Evaluate stress-dependant response for overlay design purposes

HVS-A (Mk V)

HVS (Mk VI)

HVS programmes worldwide

- California 1994

US Army Corps of Engineers

ERDC – CRREL (Feb 1997):
Cold Regions Research and Engineering Laboratory Hanover, NH

HVS programmes worldwide

- Sweden May 1997

US Army Corps of Engineers
Waterways Experimental Station
World's biggest HVS HVS V (Dec 1998)

- 36.3 m long, 102 tonnes
- Test section length 12m, max load = 440kN
- Single & Dual Aircraft wheels

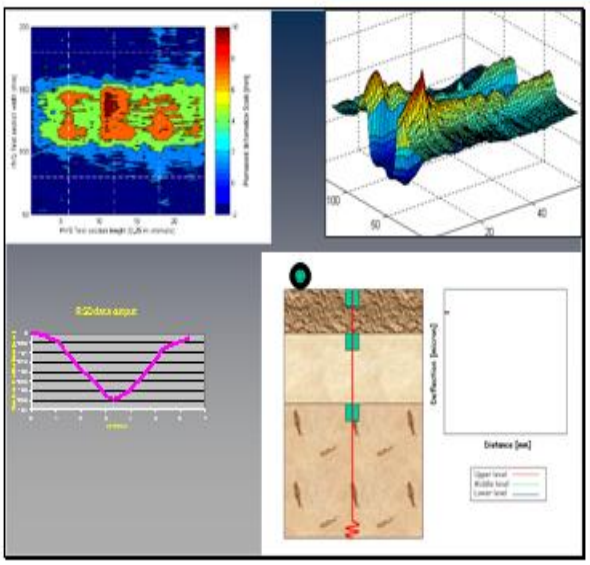
ERDC
Engineer Research and Development Center

Florida DOT USA (June 2000)

China (March 2009) Chang'an University, Xian

India (March 2010)

Associated Pavement Monitoring Instrumentation



Possible R& D Applications in terms of:

- Pavement Structure
- Economical motivations
- Material Performance Evaluation

Pavement Structures

- Determination of remaining life on existing pavements
- Determination of possible weaknesses in the pavement layers and the mode of failure
- Evaluation of the Environment influences of pavement performance
- Comparative testing

Determination of remaining life on existing pavements

- Case study: N2 highway near Pietermaritzburg

Background

- Slow lane on N3 near Pietermaritzburg constructed with asphalt was severely rutted
- CRCP inlay constructed in 1998 and designed for 5 years to carry 6 million E80s.
- Original asphalt in slow lane removed and replaced with CRCP
- Some deterioration visible after 7 million E80s
- Question was, in the light of the failures, what the remaining life would be of these inlay sections
- HVS evaluation on a section where failure appeared imminent

Transverse and Longitudinal Cracks

Cracks and Punch Outs – After 6 years and 7 M E80s

Transverse cracks	2 % of area
Longitudinal cracks	16 % of length
Punch outs imminent	0.4 % of area
Punch outs and repairs	0.4 % of area

Due to the existing condition it was important to determine the remaining life of this structure

Visual condition at end of test: Minor pumping of fines

Major finding

- Prior to testing pavement subjected to approx 7 mil E80s. Using the 4.2 power law pavement was subjected to another 5.9 mil E80s = total of 12.4 mil
- Pavement was not considered failed after testing has stopped
- Valuable field performance data used to calibrate and improve cncPave

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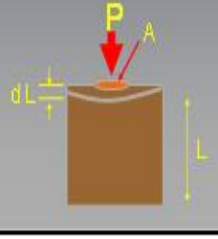
Economical studies

- ✓ Optimization of pavement design
  - ✓ Prevents overdesign
    - Appropriate design for certain traffic demand and environmental conditions
  - ✓ Prevents under design
    - ✓ Avoidance of costly early failures
- ✓ Reduction in vehicle operating costs
  - ✓ Pavement / Tyre interaction
  - ✓ Rolling resistance

Material characterization

- ✓ Determination of real in-field behavior of materials under the influence of loading and the environment
- ✓ Determination of engineering parameters for pavement design and modeling
  - ✓ Stress, strain and deformation determination of all pavement layers
  - ✓ Water sensitivity of materials
  - ✓ Stress stiffening / weakening of pavement layers under the influence of increased loading



Material characterization

- Testing of innovative materials (product evaluation):
  - Bit-rubber & other modifiers
  - Warm AC
  - High Modulus AC
  - clinker ash as aggregate replacement
  - recycled construction rubble as aggregate replacement
  - Environmental friendly designs (fully drainable pavements)
- Environmental friendly pavements
  - Reduction of the heat island effect
  - Noise reduction
  - fully drainable pavements (water run-off & erosion reduction)
  - Re-use of building materials
    - (asphalt, aggregates, concrete, glass, plastic, etc)

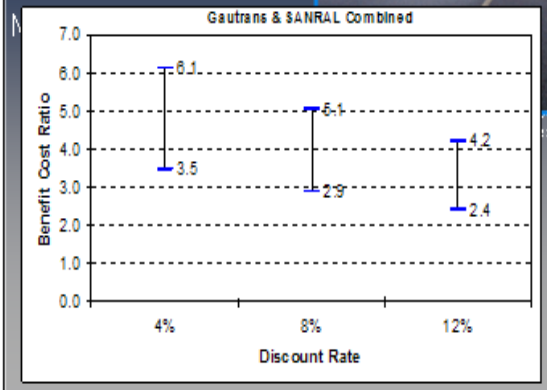
Impact and Benefits of the SA HVS Programme

- Gauteng, national & SADC pavement design standards and guidelines
- Material specifications and guidelines
- Development of human resources
- Capacity building in industry
- Innovative products and designs

Breadth of benefits

Materials/methods development of a new large-stone mix design method; use of modified binders in mixes; in situ recycling of materials (using cement, lime, foamed bitumen and bitumen emulsion); block paving (masonry and concrete); coarse power station generator ash; roller compacted concrete; slag; bitumen-rubber; waterbound macadam; recycled asphalt base; upgrading of gravel roads; marginal natural aggregates with various additives; high quality granular bases; evaluation of drainage layers as structural layers; lime-stabilized sand subbases under bitumen; design and rehabilitation procedures for concrete roads; lightly-cemented base pavements; identification and evaluation of cost-effective rehabilitation techniques; evaluation of labour-intensive construction methods; testing various asphalt base pavements and improving the design, analysis and understanding of the behaviour of such pavement types; porous asphalt

Breadth of



South African HVS Programme

Gauteng Department of Public Transport, Roads and Works

HVS R&D applications

- Concrete pavements
- Pavement - vehicle interaction
- HMA study

Concrete study I: Objectives

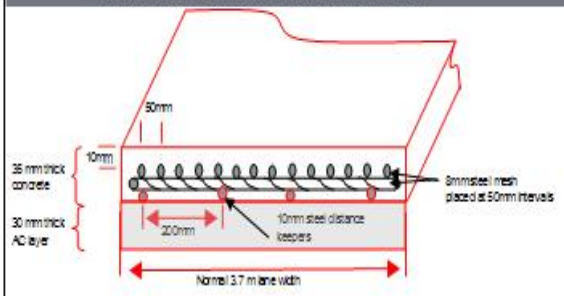
- Investigate the influence of the environment and load on joint deterioration (improve cncPave)
  - Plain aggregate interlock joints
  - Doweled joints
  - On 2 aggregate types

Concrete Study II:

The Evaluation of a Ultra Thin Continuously Reinforced Concrete Pavement

Ultra Thin Continuously Reinforced Concrete Pavement (UTCRCP)

- 20 to 40 mm Layer Thickness
- 50 x 50 mm (Ø5mm to Ø8mm) Welded Mesh
  - Normal deformed bar (+ - 450 MPa tensile strength)
  - **4.5% versus 0.6% Steel for Traditional CRCP**
- Ultra High Strength Cement (UHSC) .



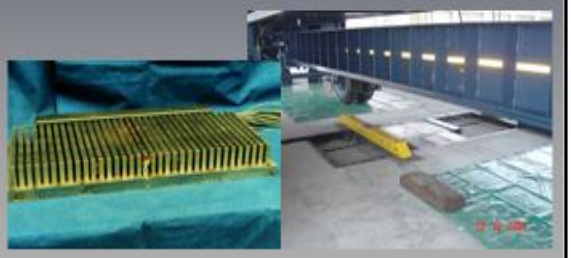
The Concrete mix

- Normal aggregate (6.75mm stone)
- W:C Ratio = 0.30
- Steel- and polypropylene fibres
- Normal Portland Cement (CEM I 42.5).

Pavement-vehicle interaction

Stress in motion (SIM) measurements

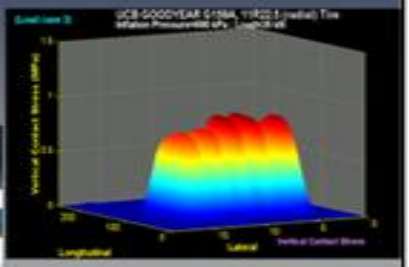
- Improved understanding of vehicle contact stresses and strains – improvements to the SAMD
- Application in HVS testing and pavement design



Pavement-vehicle interaction

Important Conclusion

- Vertical contact stress vs tyre inflation pressure:
  AMVCS is 1.2 to 2.58 times greater than tyre inflation pressure



Gautrans HVS reports
www. gautrans-hvs.co.za

TITLE	REPORT NO.	AUTHOR	APPROVED	SUBMITTED
Establishment of two LTPP experiments in association with HVS tests on Road D2388 in Gauteng	CR-2005/03	D Jones	May 2005	May 2005
Establishment of an LTPP experiment in association with HVS tests on Road P243/1 in Gauteng	CR-2005/04	D Jones	May 2005	May 2005
Initial monitoring of the LTPP experiment in association with HVS tests on Road P243/1 in Gauteng	CR-2005/06	D Jones	May 2005	May 2005
Initial monitoring of the LTPP experiments in association with HVS tests on Road D2388 in Gauteng	CR-2005/05	D Jones	May 2005	May 2005
First Level Analysis report: HVS Testing of the concrete test sections on the N3 near Hilton: Tests 421A5 to 423A5	CR-2004/43	AC Brink L du Plessis	May 2005	July 2005
First Level Analysis report: HVS Testing of the concrete inlay test sections on the N3 near Hilton: Test 424A5.	CR-2004/59	L du Plessis	May 2005	July 2005
Concrete pavement research. Construction report: CR-2004/33. HVS testing of the concrete test sections on the N3 near Hilton. Version: Final	CR-2004/33	AC Brink	May 2005	July 2005
Second level analysis of Hilton concrete sections	NA	P Strauss	May 2005	July 2005
Assessment of Gautrans HVS programme benefits	NA	F Jooste & L Sampson	July 2005	July 2005
The economic benefits of HVS development work on G1 base pavements	NA	F Jooste & L Sampson	July 2005	July 2005
SIM-HVS report	CR-2005/07	M de Beer	June 2005	July 2005
LVR test in WC	CR-2004/36	H Theyse	July 2005	July 2005

Conclusions

- The HVS is the ideal tool for gaining better understanding of pavement behavior within a shorter time frame
- It is a simple effective tool to predict the performance of any combination of layers (pavement) under real life trafficking and environmental conditions with confidence
- Through HVS testing the time from the development of an innovative idea to full scale implementation is shortened.
  - Innovative ideas can be implemented with confidence without costly errors
- Pavement design models can be calibrated with confidence
  - Eliminating the use of fudge factors

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Presentation by Sihle Dlungwana (CSIR BS&T): SME-Contractor Skills Development for Infrastructure and Sustainable Job Creation

Presentation Content

- Problem statement
- Discuss contractor development models
  - Training and mentorship
  - Monitoring and evaluation
- Thoughts on way forward
- Discussion

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PROBLEM STATEMENT

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Problem statement

Low skills base

- Small contractors are a critical part of the supply chain in road construction projects, particularly on low-volume roads;
- Yet many of these contractors have very low skills level;
- Critical skill base includes:
  - business managerial skills,
  - technical skills
  - project management skills

Lack of skills = poor quality of work and bankrupcy

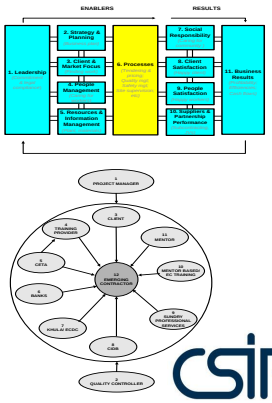
Problem statement

- This low skills base contributes to poor quality of workmanship, accidents and unsustainable business
- RRA needs to factor in the skills development strategy in its plan to create and maintain road infrastructure in the region.

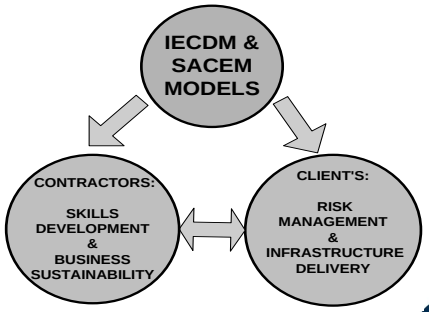
CSIR contractor skills dev't models

- To address the skills problem, the CSIR has developed and implemented two contractor development models;
- The models are:
  - South African Construction Excellence Model (SACEM)
  - Integrated Emerging Contractor Development Model (IECDM)

SACEM & IECDM Models

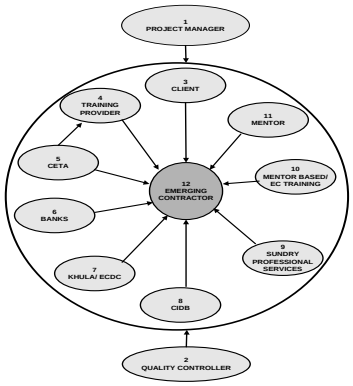


Key objectives of the models

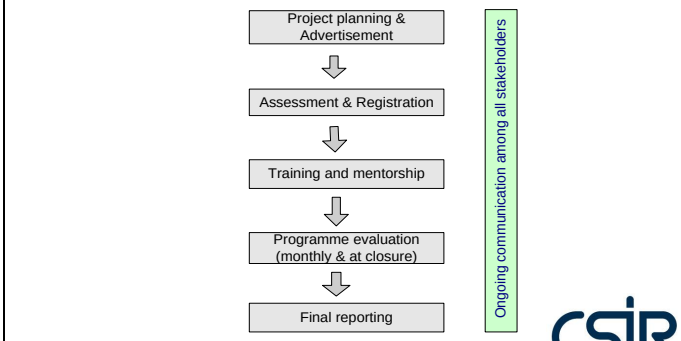


HOW THE MODELS WORK

Structure of IECDM



Work the Model Works (Implemetation phases)



Contractor Capability Evaluation Tool

CAPABILITY EVALUATION TOOL FOR SME CONSTRUCTION CONTRACTORS

This evaluation tool is structured to align the sections on the Manual for Small Construction Contractor (MSCC) with the SACEM model. The tool covers the following critical knowledge and skills areas: *Legal registration of business; Skills and experience of Management; General business and Entrepreneurial skills; Marketing and Tendering; Project and Site management; Contract management; Quality and OHS&E; and Financial and Accounting management*.

Scoring scale (1-5):
1: Poor Performance - VERY LITTLE or NO EVIDENCE of capability (systems, processes, resources) or results in this area. Contractor needs highly intensive assistance.
2: Fair Performance - LITTLE evidence of capability (systems, processes, resources) or results in this area. Contractor needs intensive assistance.
3: Acceptable (average) Performance - SOME capability (systems, processes, resources) or results exist in this area. Contractor needs some assistance.
4: Good Performance - GOOD capability (systems, processes, resources) or results in this area. Contractor may need minimal assistance.
5: Excellent Performance - EXCELLENT capability (systems, processes, resources) or results in this area. Contractor does not need assistance.

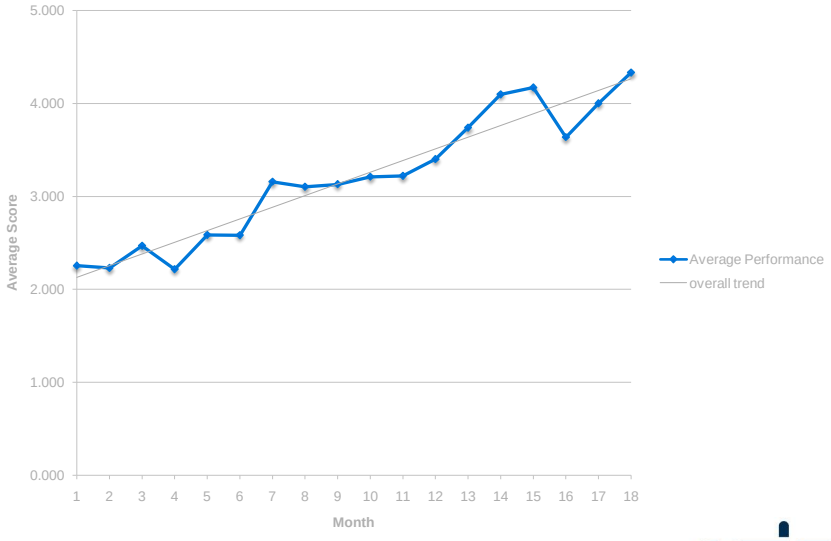
Section of manual	Performance Area	Performance Criterion	SACEM Reference	Score (Scale:1-5)	Comments
1: Running a small business	A: Administration and entrepreneurship	Compliance with **legal requirements** (e.g. cipro; SARS; CIDB/NHBRC)	Leadership		
		Management's understanding and **experience of the construction industry** and the contracting business.	Leadership		
		Insurance matters: obtained as relevant.	Leadership		
		Development of a **business plan**	Strategy and planning		
		General **office administration** (meetings, document filing, etc)	Administration		
		Evidence of a **unique, bold, clear vision** by management	Leadership (entrepreneurship)		
		Evidence of a **determination to succeed** by overcoming problems; **innovation**	Leadership (entrepreneurship)		
	B: Financial / credit management	Access to **bridging finance, loans and guarantees**	Information and resource mgt		
		Basic understanding of **financial and accounting system** (income statement, balance sheet and cash flow statement)	Information and resource mgt		
		Access to **materials and suppliers' credit**	Information and resource mgt		
		Office administration system (bookkeeping, accounting and document management system, etc)	Information and resource mgt		
	C: Contractual obligations	**Types of contracts**: Understanding and application	Information and resource mgt		

Contractor Capability Evaluation Tool

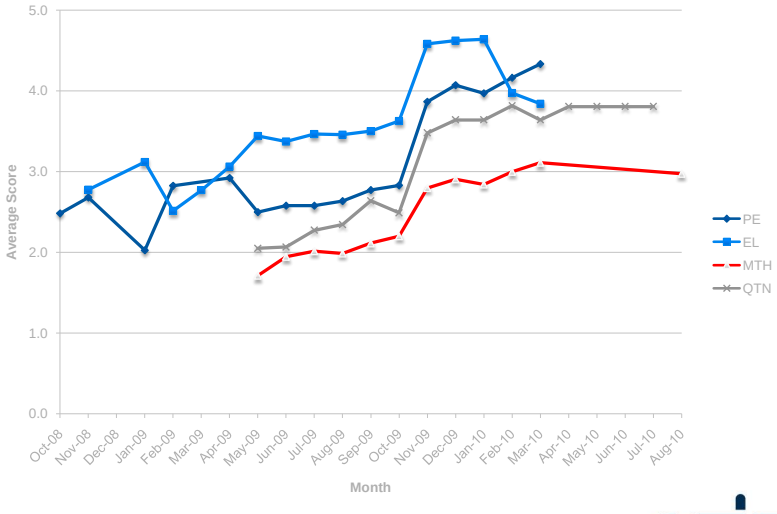
5. Business Results	Financial results (quantifiable measures)	**Profitability** over past 2 years	Business results		
		Positive cash flow over past 2 years	Business results		
	Non financial results (quantifiable measures)	**Productivity** (multi-factor productivity)	Business results		
		Quality of work	Business results		
		Occupational Health, Safety & Environment	Business results		
			Percentage out of maximum 200 points:		
Overall assessment summary and recommended development action:					
Note: **1** = score of 0-20% of total points; **2** = 21-40%; **3** = 41-60; **4** = 61-80; **5** is above 80%.					

MONITORING, EVALUATION & REPORTING

Overall Average Performance of Contractors



Average Group Performance of Contractors



Summary & discussion

- CSIR has developed TQM-based models for contractor skills development;
- The models support sustainable business development through training, mentorship and impact assessment;
- RRA needs to factor in the skills development strategy in its plans to create and maintain road infrastructure in the region;
- With minor modification, the RRA can adopt the models to address skills capacity in the region.

Skills are critical….let's get it right !!

Thank you

Sihle's email: sdlungwana@csir.co.za
Mobile:082 882 6331

Workshop Contributions and Resolutions

Regional Research Alliance Proposal Development Workshop

Held in Pretoria

on

29 – 30 September 2011

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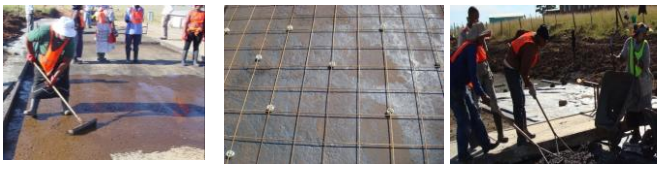
Proof of Concept



www.csir.co.za

 Slide #

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Proof of Concept

- Nucleate Consortium of Partners
- For the Ultimate Rolling-Out of
- Labour-based
- Ultrathin continuously reinforced concrete pavements
- In SADC and Beyond
- Using a Public-Private-Partnership (3Ps) approach

What Are Your Expectations of the project?

- Provide employment
- The project will be promoted/marketed
- Affordability
- Human Capital Development
- Funding

What Are Your Expectations of the project?

- Deliver alternative low cost road infrastructure in rural areas and townships
- Develop skills and create employment opportunities
- Develop road infrastructure to boost trade and service delivery
- Establish demonstration UTRCP road projects to bench mark and sell the technology

What Are Your Expectations of the project?

- Research project leading to sustainable low cost roads
- Engagement of RRA members with appropriate partners
- Detailed report of previous work
- Formation of a team of champions to roll out the technology

What Are Your Expectations of the project?

- Guidelines how to build a road in Bots or Zim using UTRCP under local conditions
- Formulation of standards for UTRCP
- Proposal that can be funded by a government department, private sector/funding agency
- If our research programme is successful I expect this technology will be applied to main roads.

Why do you want to be involved? What do you see as your role?

- Build a better understanding of the technology, add to the body of knowledge in the construction process
- Approach stakeholders for familiariastion wit UTRCP and hence funding
- To contribute knowledge of local conditions and opportunities/needs

Why do you want to be involved? What do you see as your role?

- To further develop UTRCP and promote adoption by stakeholder
- Lobby funders/donors
- To provide technical backstopping, training and project management skills development
- Come up with project proposal that funding organisations expect
- Technology needs to be refined since UTRCP is a major breakthrough

Why do you want to be involved? What do you see as your role?

- To assist in LAB HVS field performance evaluation

Concerns

- Quality of supervision and construction
- Identifying best partners
- Sourcing funding
- Regulation i.e. standards
- Employability
- Acceptability of project by industry
- Still new technology - buy in?

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Concerns

- Testing for R&D is likely to be costly and logistically cumbersome
- Possible conflict of interest
- Commitment from government and others
- Development of maintenance toolkit
- Availability of construction materials close to site

Concerns

- Extensive UTCRP demonstration what is needed to convince adoption of technology by Stakeholders
- Politics
- Need for adequately trained contractors/labour to ensure quality construction
- Afraid that UTRCP will be used for traffic and climate conditions that were never tested for.

What phases should the project go through?

- Quality control
- Politics involvement

- Further development and funding
- Trial sections, evaluation, refinement/finalisation
- Full scale implementation

What phases should the project go through?

- Critical review of current status of UTRCP
- Development of standards and guidelines for UTRCP
- Unlimited roll out of UTRCP
- Material characterisation and testing
- Identification of test sites
- Construction and final design
- First part of road built

What phases should the project go through?

- Monitor and evaluation
- Stage gate process or similar
- Proof of concept
- Consumer acceptance
- Upscale
- Marketing technology transfer

What phases should the project go through?

- The establishment of certain limiting parameters by the limiting foundation conditions i.e. depth, quality of foundation materials
- Trial sections of limited sub-base conditions
- Trial sections of different cross sections
- Establish the significance of an ETB base

What needs to be done; by who and by when?

- Detailed report of UTRCP by end OCT 2011
- Approach works authorities champions by end Nov 2011
- Build demo/stroke test sections CSIR/Contract by march 2012

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What needs to be done by when

- Literature review (prior and evaluation)
- Technical economic appraisal (feasibility studies)
- Technology development
- Testing and validation
- Demonstration project
- Training of contractors and skills development and implementation

What needs to be done; by who and by when?

- Monitoring of continuous reports by all parties by march 2013
- Discussion with partners November 2011 to Jan 2012
- Proposal development (by RRA partners) by end OCT 2011
- Discussion with funders Nov-Jan

What needs to be done; by who and by when?

- A detailed program needs to established
- The length of the location of the section needs to be established
- Material tests decided upon
- Objective of the test decided upon
- A committee of 2-3 nominated to proceed with work once finances are approved

What needs to be done; by who and by when?

- Detailed literature review by CSIR team (J Mapiravana) by Oct 2011
- Technology/Economic by CSIR/BOTEC/SIRDC by end Nov 2011
- Technology Development by RRA members by march 2011
- Demonstration by RRA by end October 2012
- Training contractors by RRA by end Nov 2012

What needs to be done; by who and by when?

- Launch/implementation by RRA by march 2013
- Board approval by November meeting
- Literature- CISR (1month)
- Situational analysis RRA (3months)/Needs in construction

What should be the project deliverables and milestones?

- Guidelines on the application of the technology under Botswana/Zimbabwe conditions (Based on test sites)
- Literature review reports
- Situational analysis report
- HCD outputs
- Patents or any other form of protection of the improvement of the technology

What should be the project deliverables and milestones?

- Bankable proposal
- Conference paper/proceedings/technical report
- 3 roads using technology entry countries in 18 months
- Finalisation of the guideline documents
- Implementation on a wider scale to more climatic/subgrade conditions

What should be the project deliverables and milestones?

- Consultation with stake holders, government departments and SADC
- Documents on UTRCP technology-status report-standard-guideline
- Construction demonstration of the test section
- Source funding through PPP implementation

What should be the project deliverables and milestones?

- Trainees trained
- Test sections complete
- Material sources identified, cement aggregate steel, water
- Source of the funds must be established once the details of the test have been determined
- deliverables-the limiting parameters of foundations for township streets

What should be the project deliverables and milestones?

- Equipment and tools identified
- Equipment and tools procured
- Government and stakeholders approached
- Funding for initial sections in place
- UTCRP performance reports monthly

What should be the project deliverables and milestones?

- Complete appraisal of prior outcomes through demonstrable review of literature
- UTRCP road design that is benchmarked and cost effective
- Trained technicians engineers in UTRCP construction technology
- Development of road construction business with adequate project management skills
- At leas one demonstration project in each RRA member country

What do you see as potential funding arrangements for the project?

- SADC infrastructure desk
- NEPAD infrastructure
- DBSA?
- Development partners-AFDB (NEPAD), World Bank, ILO/UNDP
- Individual government budgets
- Central government/local government

What do you see as potential funding arrangements for the project?

- Private companies/businesses
- Donors (e.g. Bill Gates foundation)
- Calls for application for project funding eg (EU)
- Regional bodies
- Funding agencies JIPSA
- Government, department of transport, economic div, public works, DTI

What do you see as potential funding arrangements for the project?

- Industry, mining, construction
- National roads authorities
- **Cement producing companies**
- **Steel mesh producing companies**
- Aggregate quarry companies ..(test sections)

What do you see as potential funding arrangements for the project?

- As this is a major breakthrough by SA the world bank should be interested, the Development bank of SA and any one of the biggest business on JSE.
- NB before we speak financing the project we must have a detailed program

What should be the next actions on the project? (1)

- RRA board approves proposal before submission for funding
- Lobby Government
- Approach test section sponsors
- Involve communities i.e. community leaders/forums
- Refining of standards guideline documents.

What should be the next actions on the project?

- Trial sections in various traffic or climatic conditions
- Performance evaluations under HVS and real traffic, climatic conditions
- Approach funders/partners or investors
- Seek to implement proposal
- Promote technology world wide as an affordable solution

What should be the next actions on the project?

- Reduce the project proposal to practice once equipment and material is in place
- Submit proposal to RRA, BOTEC, CSIR and SIRDC
- Approve of proposal by RRA board
- Source/structure funding
- Implementation of the UTRC project under RRA

What should be the next actions on the project?

- Action committee should be enacted but before this should be done it must be decided who should be the most appropriate members of this committee