7th Africa Transportation Technology Transfer Conference

The “Africa Transportation Technology Transfer (T2) Conference” is a forum intended to share, exchange and debate experiences, best practices, and new technologies in the provision, maintenance and management of all modes of transport and it is made up of transport professionals from the academic, business, and government sector with a commitment to proffer solutions to critical challenges facing our global society.

Mission of the group

- Updated, increased and exchanged know-how and experiences among professionals, researchers, users and other interested parties in the transport sector.
- Increased knowledge shared in the managing of roads and other modes of transport, the introduction of brand new construction techniques, exchange experiences related to maintenance systems, all of which aims at optimizing construction and conservation costs and to achieve the lowest possible transportation costs.
- Increased knowledge shared about the latest technologies in terms of project, construction and management of pavements, basic works, traffic, transportation, the environment and road safety.

Background

The 7th Africa Transportation Technology Transfer (T2) Conference is aimed at encouraging the transfer of technology among various sectors and/or countries, promoting the search for innovative solutions whereby the managing of road and other transport networks can be effectively solved, as well as allowing participants to suggest proposals leading to improved quality of the transportation systems, lower transportation costs and higher safety in transport operations. Moreover, the forum will help in promoting the need to improve access to marginal roads, reduce the negative impacts of transport infrastructure works on the environment, and to encourage connections among countries in Africa. A forum for sharing and exchange of existing and new approaches on technology transfer that enables countries to develop effective integrated transportation systems, which are safe, efficient, reliable and affordable. The conference format includes Technical Presentation, short courses, workshops as well as Exhibitions on Products, Technologies and Services.

The main objectives of organizing the conference are:

i) To promote Technology Transfer for Developing Sustainable Transportation Systems in Africa.

ii) To promote establishment and operations of Technology Transfer Centers as means for facilitating appropriate effective technology transfer in the transport sector.

iii) To provide a forum for discussion and exchange of views as well as learn experiences of best practices and innovative solutions in the Transportation Industry.

The Ministries of Transport and Infrastructural Development in Zimbabwe in collaboration with the Association of Southern African National Road Agencies (ASANRA) and other stakeholders in the transport sector worldwide is organizing the 7th Africa Transportation Technology Transfer Conference to be held at Elephant Hills Hotel in the touristic City of Victoria Falls, Zimbabwe, from 11th to 15th May 2015.
INTERNATIONAL ORGANISING COMMITTEE
Coordinate:

- Dr. Simon Oladele, PhD, P.E., MASCE, MBIE, MNSE, CEng (COREN)
  Chair – ICTA2014 International Organising Committee
  Organisers: African Transportation Professional Networking Group
- Dr. Ignasio Ngoma, PhD
  Director, Malawi T2 Centre,
  University of Malawi, Malawi
- Eng. Alfred Logie
  International Program Engineer, FHWA,
  USA
- Eng. Hagai K. Bishanga
  Manager, Tanzania T2 Centre,
  University of Dar es Salaam, Tanzania
- Mr. O.M. Chinyere
  Traffic Safety Council of Zimbabwe-CEO (Chairperson)
- Mr. A. Zonde
  A/Chief Research Officer-Department of Roads (Secretariat)
- Dr. Kufazvinei
  Chinhoyi University
- Eng Mushunje
  National University of Science and Technology
- Eng R Muvhunzi
  Chinhoyi University

CONFERENCE TOPICS
The Conference Theme is “Mobilising finance for transport infrastructural development and maintenance for poverty alleviation in Africa”

Papers will be presented on the following topics grouped in Six Thematic Areas
Thematic Area 1: Improving rural accessibility and transport services provisions in Africa

- Transport Services Provision and its Impact on Goods and Services
- Rural User Needs and access to transport services in Sub-Saharan Africa
- Transport services and operators – current patterns And constraints
- Planning transport serviced with stakeholders
- The role of Rural transport infrastructure
- The role government in transport service provision

Thematic Area 2: Innovative maintenance and application of new research technology in overcoming transport challenges in Africa

- Effective Maintenance Systems
- Advanced technologies in improving rural accessibility
- Pavement Overloading Control
- Implementation of technologies
- Training of young researchers in transport sector
- Uses of sustainable energy sources in transport sector (green technologies)
- Labour Based Technology in Maintenance of Rural Roads

**Thematic Area 3: Road safety**

- Institutional Framework in Road Safety Management
- Design Standards for Safer Roads
- Road Safety Audits
- Road Safety Education and Awareness
- Enforcement of Traffic Rules and Regulations
- Urban Road Safety Effective Communication for Promoting Technology Transfer

**Thematic Area 4: Innovations in Pavement Design and materials specifications for construction**

- Appropriate Design Specifications – DCP design method/manual
- Surfacing of Low Volume Roads
- Soil Stabilisation Methodologies
- Use of laterite in road Pavements
- Concrete rods Standards and Specifications
- Use of Sand in Road Construction

**Thematic Area 5: Policy and Financing of the transport infrastructure**

- Policy interventions that have the capacity to increase benefits and mitigate risks for the poor.
- The blockages to developing a pipeline of bankable infrastructure projects in sub-Saharan Africa
- Where there are theoretically bankable projects that have not yet been financed, the principal barriers to financing by institutional investors and commercial banks Africa
- Adequate Maintenance Funding Mechanism

**Thematic 6: Cross cutting issues in the transport sector**

- Role of transport sector in developing effective tourism in Africa
- HIV/AIDS and Human/drug trafficking
- Environmental sustainability in transport management, development and maintenance
- The evidence that improvements in regional infrastructure designed to increase cross-border trade in Sub-Saharan Africa which result in poverty reduction.
- Development of sustainable and affordable alternative forms of urban transport systems.
- Role of ICT in transport Sector.
ACKNOWLEDGEMENT OF SPONSORS
1. Ministry of Transport & infrastructural development
2. University of Chinhoyi, Zimbabwe
3. Department of Roads, Zimbabwe
4. Transport Safety Council of Zimbabwe
5. Association of Southern African National Road Agencies
6. Zimbabwe National Road Administration (ZINARA)
7. National University of Science and Technology, Zimbabwe
8. International Road Federation (IRF) Geneva, Switzerland
9. Africa Community Access Programme (AFCAP), UK

CONFERENCE PROGRAMME

7th Africa Transportation Technology Transfer Conference 2015

**Sunday, May 11, 2015**
14:00-18:00 Pre-Registration of Conference Participants

**Day 1: Monday, May 12, 2015**
07:00-08:00 Registration of Conference Participants

<table>
<thead>
<tr>
<th>Time</th>
<th>Description</th>
<th>Speaker/Title</th>
<th>Organisation &amp; Country</th>
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<tbody>
<tr>
<td>08:00-8:10</td>
<td>Opening Session: Chaired by ENG. Gumbie, Principal Director, Ministry of Transport &amp; infrastructural Development, Zimbabwe</td>
<td>Mr. O.B Chinyere Managing Director</td>
<td>Traffic Safety Council of Zimbabwe</td>
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<tr>
<td>O8:00-08:25</td>
<td>Introductory Remarks</td>
<td>M. Munodawafa Secretary</td>
<td>transport and infrastructure development</td>
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<tr>
<td>08:30-09:00</td>
<td>Official Opening</td>
<td>Honourable Dr. O. Mpofu Minister of Transport and Infrastructural Development Of Zimbabwe</td>
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<tr>
<td>09:00-09:10</td>
<td>Entertainments reflection the conference theme</td>
<td>Cultural group Elephant Hills hotel</td>
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<tr>
<td>09:15-09:45</td>
<td>Key Note address of the conference</td>
<td>Professor Mupunga Science and technology Development Department</td>
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<tr>
<td>09:45-10:00</td>
<td>presentation of gifts, vote of thanks and group photo</td>
<td>ASANRA President CEO Namibia Road Authority</td>
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<td>10:00-10:45</td>
<td>Coffee/Tea break &amp; Exhibitions</td>
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<tr>
<td>10:45-13:00</td>
<td>Conference speakers: Introductory Speech by Susanna Zammataro Mr. C. Chikaura Mr Ieta</td>
<td>Moderated by: ENG. Gumbie, Principal Director, Ministry of Transport &amp; infrastructural Development ,Zimbabwe International Road Federation (IRF) Switzerland Chief Executive Officer of the Infrastructural Development Bank of Zimbabwe AFCAP</td>
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<tr>
<td>13:00-14:00</td>
<td>Lunch Break</td>
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<tr>
<td>14:00-15:30</td>
<td>Room A: PAPER PESENTATION Session 1: Chaired by Dr Kufazvinei (Chinhoyi University Lecturer)</td>
<td>Room B: PAPER PESENTATION Session 2: Chaired by Eng M. Ndoro (Acting Deputy Director Operations)</td>
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<tr>
<td><strong>1</strong> <strong>Understanding Community Severance and its Impact on Mobility in Sub-Saharan Africa</strong>&lt;br&gt;Dr Annabel Bradbury</td>
<td><strong>8</strong> Design of a real time tyre pressure monitoring system.&lt;br&gt;1 D. Simango; 2 Eng R Muvunzi, 3 Eng C. Maware; 4 B. P. Rangi</td>
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<tr>
<td><strong>2</strong> Enhancing public transport safety and security in Ghana: What are public transport operators doing?&lt;br&gt;Enoch F. Sam,</td>
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<tr>
<td><strong>3</strong> <strong>EMPLOYING TRANSPORT TO REVITALIZE RURAL TOWNS: THE CASE OF MTHATHA</strong>&lt;br&gt;Mac Mashiri, *James Chakwizira,&lt;br&gt;<strong>Mathetha Mokonyama,</strong> <em><strong>Bongisizwe Mpondo</strong></em> *<strong>Dalikhaya Mdunge</strong></td>
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<td><strong>9</strong> A Labour-Based maintenance solution for rural roads in Nigeria?&lt;br&gt;Francis Dangare and Robin Workman,</td>
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<td><strong>10</strong> <strong>ROAD TRAFFIC INJURY IN TANZANIA: MOTORCYCLE CRASHES ON LOW-VOLUME RURAL ROADS</strong>&lt;br&gt;Tom Bishop and Simon Kalolo</td>
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<tr>
<td>15:30-16:00</td>
<td>Coffee/Tea break &amp; Exhibitions &amp; Networking</td>
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<tr>
<td>16:00-17:30</td>
<td>Poster paper presentations</td>
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<tr>
<td>18:30-22:00</td>
<td>Exhibitions official Opening and Welcome Cocktail by Secretary Ministry of Transport &amp; infrastructural Development, Zimbabwe</td>
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**Day 2: Tuesday, May 12 2015**
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<tr>
<td>08:00-10:00</td>
<td>Paper Presentation</td>
<td>5. The Vital Role of Practical Training and Demonstration of Innovation and Good Practice in Road Sector Capacity Building</td>
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<td></td>
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<td>Andreas Beusch and Robert Petts</td>
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<td>7 Engagement of the Church in Road Safety Education: the Case of the Association of Christian Churches in Zimbabwe (ACCZ).</td>
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<td>12 Title of paper: Use of Intelligent Transport Systems (ITS) in Road Safety Engineer S Zvekare,</td>
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<td>10:00-10:45</td>
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<td>Opening Session: Chaired by ENG. M. Juma Acting CEO</td>
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<td>Coffee/Tea break &amp; Exhibitions</td>
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<tr>
<td>10:45-13:00</td>
<td>ROOM A: PAPER PRESENTATION SESSION 1: CHAIRED BY ENG R. MUVUNZI (CHINHOYI UNIVERSITY LECTURER)</td>
<td>Room B: PAPER PRESENTATION Session 2: Chaired by Eng X. Ncube (Acting Chief Eng. Bridges)</td>
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<td>13 STUDY TO FIND THE STATUS OF ROAD SAFETY EDUCATIONAL CAMPAIGNS IN BOTSWANA</td>
<td>17 MATERIALS DESIGN &amp; SPECIFICATIONS FOR LOW VOLUME ROADS (LVRS).</td>
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|              | Gomotsegang Khudu\(^1\) and Adewole S. Oladele\(^2\) | A. Zonde  
Research and Central Road Laboratory  
Email: zondea@transcom.gov.zw |
|              | \(^1\)Department of Road Transport and Safety, Botswana; \(^2\)Transportation Technology Transfer Centre, University of Botswana, Botswana | 18 FINANCING AND OPERATING A SUSTAINABLE TECHNOLOGY TRANSFER CENTRE WITHIN AFRICAN TRANSPORT SECTORS |
|              | 15 Suitability of Polycom Stabilizing Aid for road construction: A case study of Kadoma urban section along the Bulawayo-Harare highway M S Magombeyi, P T Chatambudza | Adewole S. Oladele PhD, M. ASCE, MBIE, C.Eng |
|              | 16 Evaluation of the Use of Polymer Modified Bitumen in the production of High Modulus Asphalt for heavily-trafficked roads Julius Komba, \(^1\)Benoit Verhaeghe, \(^1\)Johan O’Connell, \(^1\)Joseph Anochie-Boateng and \(^2\)Wynand Nortje | 19 Where to seek financial, economic and GHG efficiencies, and social benefits for durable and sustainable rural transport provision in developing and emerging regions? Robert Petts (Intech Associates) & Dr Michael Burrow (University of Birmingham) |
| 13:00-14:00  | Lunch Break                                                               | 20 Initiatives in Promoting Innovations in Road Transport Technologies in the SADC Region Through Implementation of the ASANRA Project 5.2 on Synthesis of Innovations in Regional Road Technology By |
### Day 3: Wednesdays, May 13 2015

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<thead>
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<th>Time</th>
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<tr>
<td>08:00-10:00</td>
<td>Paper Presentation</td>
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<td></td>
<td>21 Design of a Railway Crossing Anti Collision Detection System D. Simango</td>
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<td>Opening Session: Chaired by Eng p Paper Presentation Pfukwa Director of Works City of Harare</td>
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<td></td>
<td>22 Design of an optimized recovery system for Used Lead Acid Vehicle Batteries in Zimbabwe P. Chawagarira</td>
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<td></td>
<td>23 A Paper on The Role of ICT in the Transport Sector in Africa Univern Enterprises (Pvt.) Ltd</td>
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<td>10:00-10:45</td>
<td><strong>Coffee/Tea break &amp; Exhibitions</strong></td>
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<td>10:45-13:00</td>
<td>Room A: PAPER PESENTATION Session 1: Chaired by Ms Z. Mashingadze (Researcher Department of roads)</td>
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<td>Room A: PAPER PESENTATION Session 2: Chaired by Eng M. Chigaure (Acting Chief Eng. Maintaince)</td>
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<td></td>
<td>25 <strong>LOW COST MOBILITY DISCOURSES IN SOUTH AFRICA: A REVIEW OF EVIDENCE</strong></td>
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<td></td>
<td>James Chakwizira(^1) &amp; Mac Mashiri(^2)</td>
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<td>29 Integral Bridges – Minimising Transportation Network Disruption Eng. M Marerwa</td>
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<td>30 <strong>Transport and land planning – Simulation of the impact – Information: Praxis and Vision</strong></td>
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<td><em>Vidal Roca,</em></td>
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<td>13:00-14:00</td>
<td><strong>Lunch Break</strong></td>
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<td>14:00-16:00</td>
<td>Room A: COURSES/WORKSHOPS</td>
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<td>Room C: COURSES/WORKSHOPS</td>
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<td>16:00-17:00</td>
<td><strong>Coffee/Tea break &amp; Exhibitions &amp; Networking</strong></td>
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<tr>
<td>18:30 -22:00</td>
<td><strong>Conference Dinner, presentation of Awards &amp; official closing ceremony</strong></td>
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**Day 4: Thursday, May 14 2015**
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<tr>
<td>08:00-10:00</td>
<td>Site 1 visit conducted by Lafarge research institute &amp; Provincial Road Engineer Mat North</td>
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<td>10:00-11:00</td>
<td>Refreshments &amp; discussions at site</td>
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<tr>
<td>11:00-13:00</td>
<td>Site 2 visit conducted by Geotextile reseal demonstration &amp; Provincial Road Engineer Mash Central</td>
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<td>13:00-14:00</td>
<td>Lunch &amp; Discussions</td>
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<tr>
<td>14:00-15:00</td>
<td>Site Visit 3 Conducted by Instant pothole repair mix &amp; Provincial Road Engineer Mat South</td>
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Understanding Community Severance and its Impact on Mobility in Sub-Saharan Africa
Dr Annabel Bradbury
TRL Limited
abradbury@trl.co.uk

Community severance, or the traffic barrier effect, is a well-established phenomenon of transport planning in developed countries where large or busy roads that pass through settlements can have the effect of driving a wedge through a community by limiting people’s ability or desire to move through that area. This can reduce accessibility to key services and damage local social networks and community ‘cohesion’. In Sub-Saharan Africa, the community severance effects of high volume roads passing through communities on vulnerable people (women, young and elderly people) in both rural and urban settings have not been thoroughly explored, and this is a vital area of research in understanding travel patterns and how planners can mitigate against these effects.
New or existing transport schemes such as roads and railways can have detrimental social impacts on communities. Where an existing road has become busier over time the increased volume and speed of
traffic may also create a real or perceived barrier to people in reaching important services and facilities. Transport infrastructure can impact on people’s health and wellbeing by:

- Limiting access to key services (such as health, education, employment opportunities and markets for food)
- Limiting access to rural transport services
- Increasing the risk of road traffic accidents
- Reducing air quality and increasing dust particulates
- Increasing traffic noise
- Trip delay, trip diversion and trip suppression

Three key severance effects have been identified:

1. Physical barriers
2. Psychological or perceived barriers – i.e. perceived danger that prevents people from crossing the road
3. Social impacts – such as the disruption of community cohesion and inhibition of social interaction

TRL undertook a literature review to define the concept of community severance for vulnerable people in Sub-Saharan Africa and explore how rural communities experience community severance. This paper will examine evidence of community severance occurring in developed and developing countries, with empirical examples provided from Ghana and South Africa.

Enhancing public transport safety and security in Ghana: What are public transport operators doing?

Enoch F. Sam, Department of Geography Education, University of Education, Winneba, Ghana. Email: efsam@uew.edu.gh/esamgh@yahoo.com

Abstract
Public transport experience ought to be pleasant for all passengers. It is undeniable that the fundamental factor underlying pleasant travel is passengers’ overall safety and security. Even though public transportation poses a higher safety and security risk as it involves a larger number of commuters at a time, ensuring the safety of public transport riders as well as maintaining the perception that riding on public transport is safe ought to be of particular importance to transit operators. To achieve this requires that public transport operators institute measures to address the safety and security concerns of their passengers. This paper seeks to discover how public transport operators in Ghana have addressed or are addressing the safety and security concerns of passengers and what strides these measures have made upon their implementation if any.

EMPLOYING TRANSPORT TO REVITALIZE RURAL TOWNS: THE CASE OF MTHATHA

Authors:
Mac Mashiri, *James Chakwizira, **Mathetha Mokonyama, ***Bongisizwe Mpondo, ***Dalikhaya Mdunde

Gwarajena TRD, 25A Barnstable Road, Lynnwood Manor Village, Tshwane; Tel: +27 12 348 5008, Mobile: +27 72 122 9394, E-mail: macmashiri@telkomsa.net

*University of Venda, Thohoyandou, P/Bag X5050, Thohoyandou, 0950
**CSIR: Built Environment, Meiring Naude Road, Scientia, Brummeria, Tshwane
***SAFIRI (PTY) LTD, 1 Melrose Boulevard, Suite 13, Melrose Arch, 207
Abstract

Mthatha, located in King Sabata Dalindyebo Municipality (KSD) in the Eastern Cape Province of South Africa is a rapidly growing rural town. Its sphere of influence is geographically much wider than the administrative boundaries of KSD. Mthatha is thus a regional rural town servicing a hinterland characterised by significant structural problems that tend to impede rural communities from fully accessing services, resources, markets and information. In order for the regional rural development agenda to take root, the paper argues that KSD needs to carve out a pragmatic and proactive leading role for Mthatha in support of shared growth for KSD and the region. It further contends that KSD needs to nurture and accentuate the role of Mthatha as a regional centre offering not only higher order services, but also significant employment opportunities to a potential growth region underpinned by appropriate investment packages. Transportation necessarily plays a decisive role in this vanguard role for town.

However, from a transportation perspective, the paper observes that poor planning for this growth has led to failure symptoms such as severe road traffic congestion, conflicting vehicle-pedestrian movements, increased number of uncoordinated small-scale freight vehicles and severe parking shortages (e.g. while peak capacity required for CBD parking is 2285 spaces equivalent to 12km of road space, Mthatha only has a fraction of this staggering requirement). Productivity in Mthatha is thus negatively impacted by this ever-present congestion, exacerbated by road infrastructure conditions (it has been determined that 90% of Mthatha’s surfaced road network has deteriorated beyond pothole repair requirements especially in the CBD). Thus circulation (and by extension doing business) within the CBD is decidedly cumbersome, while movement through town is interminable – generating a relatively significant carbon footprint for a town of its size.

Using primary data collected in KSD between 2011 and 2012, this paper enumerates and assesses the transportation challenges impeding productivity in Mthatha with a view to determining the gaps in the current approach in terms of type and intensity of intervention options as a departure point for crafting a much more robust implementation framework that will enable Mthatha to lead the regeneration of the region. This framework incorporates a transport model for Mthatha CBD, which could easily be deployed in small towns in sub-Saharan Africa particularly those with limited capacity to administer large transport models.

Key Words: Sustainable rural and urban development, productivity, congestion, low-cost mobility, access, poverty eradication, job creation, Mthatha CBD.

LOW COST MOBILITY DISCOURSES IN SOUTH AFRICA: A REVIEW OF EVIDENCE

Authors:
James Chakwizira & Mac Mashiri

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Tel: +27 (0)15 962 8585; Fax: +27(0)15 962 8587; Email: james.chakwizira@univen.ac.za

2Gwarajena TRD, 25A Barnstable Road, Lynnwood Manor; Tel: +27 12 348 5008, Mobile: +27 72 122 9394, E-mail: macmashiri@telkomsa.net

Abstract

The transportation challenge facing rural and urban communities on a daily basis in South Africa is real, substantial and complex. The challenge in itself resonates in competing, parallel and at times divergent low cost mobility discourses in terms of the best way to resolve the challenge. Literature review confirms that numerous rural communities in South Africa are still not connected to the main rural network and are
at best provided with unreliable access to socio-economic opportunities. The existence of constrained mobility and difficulties in accessing goods and persons has led to marginalisation, exclusion and isolation of peripheral and rural communities from the mainstream economy. Development critics point to this lack of access as one of the most stubborn indicators of poverty. There is “no magic or silver bullet” to delete the problem and hence the need for continued dialogue aimed at presenting alternative ways to tackling the challenge. Consequently, the challenge for transport policies, strategies, programmes and projects is clearly to achieve a much better level of general mobility and accessibility for all, at a much lower cost. Non-motorized transport modes and the construction of low volume gravel roads are examples of interventions that provide such options. In this paper, we illustrate the importance of the need for complete transportation multi-level and stakeholder friendly interventions and actions approach in order to rid rural South Africa of the negative impacts of incomplete and inadequate mobility and accessibility architecture. Making use of a desktop review of secondary data, this paper showcases as well as assess seminal work in South Africa running the gamut from demonstration projects, workshops, design fiestas, to a non-motorized transport policy. The intention of this extensive literature review is to determine gaps in the current approach and by extension therefore act as a departure point for crafting a much more robust low cost mobility implementation framework.

**Key Words:** Non-motorized transport, low-cost mobility, access, poverty eradication, South Africa

**A Labour-Based maintenance solution for rural roads in Nigeria?**

**Francis Dangare and Robin Workman, August 2014**

Nigeria has a large network of rural, earth and gravel roads. Estimates of the Local Government Authority (LGA) roads range between 130,000km and 200,000km. There is practically no organised maintenance carried out on these roads. As a result many roads are in very poor condition and in need of rehabilitation. In this respect the rural road asset in Nigeria is devaluing every year.

This problem has been recognised by the government in Nigeria, but there are inadequate resources for the LGA’s to carry out routine maintenance or rehabilitation. There are also issues of ownership between the three main bodies that have responsibility for road maintenance, the Federal Roads Maintenance Agency (FERMA), the States and the LGAs. The DFID funded Nigeria Infrastructure Advisory Facility (NIAF) has been working with the Nigerian Government to find a solution to this problem. This paper will report on the results of the pilot labour-based maintenance programme that was established and comment on the feasibility of carrying out community road maintenance on a community basis in Nigeria.

Three States were selected for the pilot study: Kano, Zamfara and Anambra. The purpose was to improve the rural road network, whilst providing employment opportunities, enhancing livelihoods, stimulating the local economy and providing improved access to key services. The programme was based around training local supervisors and workers (beneficiaries) to carry out maintenance, whilst establishing a system of reliable payment and monitoring the results of the programme. A main focus of the programme was also to employ at least 5% of women in the predominantly Muslim northern states (Kano and Zamfara).

A number of issues were encountered whilst carrying out the pilots, including finding enough roads in appropriate condition for routine maintenance, participant capacity and selection, payment systems, tools supply and participant performance. In addition there were institutional issues that had to be addressed. All of these will be explored in more detail in the paper. Following the initial pilots and an assessment of
the programme, it was decided to carry out further work in the areas of labour-based rehabilitation trial sections and wet season training:
One of the main issues was that the majority of roads were in very poor condition, such that it was not practical to apply labour-based maintenance. The defects were simply too extensive to be tackled by local community labour. The LGAs and States agreed that it would be useful to carry out a trial using labour-based methods to rehabilitate trial sections of road in all three States. This proved to be very successful, so long as the appropriate tools and materials were provided.
When the programme was initially devised it was assumed that maintenance would be curtailed during the wet season (June to September). In fact this is the most crucial time to undertake routine maintenance, so an additional training course was developed to train the participants in how to maintain roads during heavy rains. This was especially pertinent given the extensive flooding that occurred in Nigeria during the 2012 rains.
Overall the programme established comprehensive training courses in labour-based road maintenance and wet-season working, as well as in rehabilitation. There is certainly potential for using labour-based methods to maintain roads in Nigeria, but the institutional issues will make it difficult to establish an efficient and sustainable system. Nigeria has a massive asset in its rural road network that is essential for the country’s progress and there is a significant challenge to ensure that this asset is not devalued to the extent that it restricts Nigeria’s development.

ROAD TRAFFIC INJURY IN TANZANIA: MOTORCYCLE CRASHES ON LOW-VOLUME RURAL ROADS

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ABSTRACT
Over 1.2 million people are killed on the world’s roads each year, and a further 20 to 50 million are injured. Road traffic injury is the leading cause of death among young people aged 15 to 29 years. Low- and middle-income countries are hardest hit, losing up to an estimated 2% of GDP as a result of crashes.
Africa has the world's most dangerous roads, with a death rate of 24.1 per 100,000 of the population. This compares to a global average of 18.0 per 100,000, and is despite the fact that Africa is the least motorised of the world's regions: Africa has only 2% of the world's vehicles but 16% of the world's road fatalities.
Official figures for Tanzania show that around 4,000 people are killed on the roads each year, although it is widely thought that there is under-reporting in this number.
The use of motorcycles is revolutionising rural access in many African countries, including Tanzania. But this revolution has a price, with RTI rates among motorcycle drivers as high as 63 per 100 drivers per year.
Through detailed crash investigations, risk assessments, interviews and inspections, this Research aimed to determine the causes and circumstances of motorcycle crashes on low volume rural roads in Tanzania, to inform the development of targeted road safety policies and interventions. The research investigated the factors that contribute to motorcycle crashes, including those related to road design and condition, road user behaviour and motorcycle condition.
Key findings of the research include: Road user behaviour, including drivers and other road users, is the most common contributory factor in motorcycle crashes on low-volume rural roads.
The design and condition of low-volume rural roads are also common contributing factors.
Motorcycle drivers understand what constitutes risky behaviour, and understand actions that they can take to reduce risks, but many continue to drive dangerously.

This research was carried out under the first phase of the African Community Access Programme (AFCAP), and was completed in June 2014. It is anticipated that further research will be carried out between now and the date of the T2 conference. An introduction to the further research will be included with the presentation of this paper.

28th August 2014

Integral Bridges – Minimising Transportation Network Disruption
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Abstract
Forms of bridge design are increasingly aligning themselves with whole life maintenance needs and the mitigation of associated costs. The integral form of bridge design has gained widespread application with Authorities keen to minimise transport network disruption and associated maintenance costs over the design life of their bridge structures. This paper reviews the multiple variants of integral bridge configurations, highlighting their qualities and ideal applications. A more detailed review of an integral form with flexible abutments is presented and typifies the dynamic design approach to improving bridge configuration in response to both function and maintenance needs. Areas of potential further research on both form and applicability in a developing network are suggested.

Keywords:
Bridge, design, maintenance

TITLE: The Vital Role of Practical Training and Demonstration of Innovation and Good Practice in Road Sector Capacity Building
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ABSTRACT
The development of indigenous human resources capacity for the road sector involves structured education and training in various engineering and management related skills. Important supportive functions include credible accreditation systems, an ‘enabling’ career progression environment, professional mentoring, ability for personnel to obtain relevant practical skills and experience and continuing professional development (CPD) initiatives.
Many African countries have developed university and technical college level capacity and courses to meet the theoretical technical needs of the national workforce. However, recent research by the Royal Academy of Engineering, UK in association with the Africa-UK Engineering for Development Partnership (October 2012), found that across the Sub-Saharan Africa region the engineering sector suffers from a shortage of skilled and experienced engineers.
The study found that key causes of low capacity include: a lack of government investment in engineering skills development right along the pipeline; out-of-date curricula and teaching methods at universities, resulting in graduates lacking required skills; weakness of professional institutions, leaving professional engineers unsupported and resulting in insufficient or non-existent registration processes; lack of knowledge transfer from foreign engineering firms; failure by the private sector to provide sufficient CPD; and ‘brain drain’ of engineering talent to other sectors and other countries.

Taking a wider perspective for the rural transport sector, there is also a substantial and critical deficit in the capacity to deliver practical demonstration of recent innovations in appropriate technology road works and good practice, and the training relating to these topics for technical and other sector personnel. This is a serious shortcoming and crucially threatens to jeopardize the achievement of affordable and sustainable rural transport in developing and emerging nations.

The paper discusses some of the reasons for the deficit in Practical Training and Demonstration of Innovation and Good Practice in Road Sector Capacity Building, and the challenges ahead in building the local/regional capacity for this vital function. Recommendations are made regarding how the local capacity to deliver these functions could be enhanced.

**Engagement of the Church in Road Safety Education: the Case of the Association of Christian Churches in Zimbabwe (ACCZ).**

**Abstract**

The purpose of this paper is to explore and validate the role of the church in propagating road safety education with particular reference to the Association of Christian Churches in Zimbabwe (ACCZ). Due to the debilitating recurrent road carnage crises, there is need to evolve effective and sustainable ways of educating the public about road safety. The church can play a critical role in road safety education if engaged holistically. Zimbabwe, which has a population of about 13 million (2012 Census Report), is argued to be 75% a Christian country. The ACCZ has a membership of 700 churches which translates to about 3 million congregants. What with the advent of religious tourism in Zimbabwe and the concomitant affective teaching and learning of doctrine in church, the church can be an untried and tested yet effective mode of road safety education and awareness. Using the same affective methods of teaching and learning, the church can inculcate a road safety culture into its congregants.

This study used the narrative approach to qualitative interpretive research by analysing ten (10) narratives of the current ACCZ office bearers obtained by snowball sampling. The participants, who are entirely the clergy, gave personal accounts of how the church can be engaged in road safety education and thus help tame the traffic jungle in Zimbabwe thereby saving thousands of lives in this UN Decade of Action for Road Safety. The use and analysis of the narratives, which is argued to be not only an effective and powerful knowledge transfer method but also a producer and transmitter of reality, has generated a model of the engagement of the church in sustainable road safety education.

The paper discovered that the affective methods of teaching and learning a religion are more effective behaviour change tools that can be used to propagate sustainable road safety education. In light of this, a systematic and concerted approach to engagement of the church in road safety education needs to be developed and cascaded. The traditional road safety education and awareness methods (road block campaigns, mass media campaigns, road safety education in schools etc) seem to require re-thinking in light of new approaches like the wholesome meaningful engagement of the church in road safety.
education in this era of religious tourism in Zimbabwe. Thus the church can be a very effective road safety agent for all the three phases of the road crash matrix sequence: pre-crash; crash; and the post-crash phases.

Title of paper: Use of Intelligent Transport Systems (ITS) in Road Safety

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Abstract:
The number of deaths and injuries on our roads in Africa is continuing to increase each year. Road traffic deaths in sub-Saharan Africa are predicted to rise by 80% by 2020, according to a World Bank report. It is evidently clear that improving road safety is the biggest challenge facing the Transport sector in Africa. With increasing car ownership in Africa, it is anticipated that this challenge will not diminish if it is not tackled with vigour. It is imperative that in addition to traditional road safety countermeasures in use in Africa, innovative ways of improving road safety such as the use of Intelligence Transport Systems (ITS) should be implemented in Africa as is the case in some low and high income countries (LHICs) where ITS is having a positive effect on road safety.

This paper discusses the use of ITS in improving road safety in LHICs. Findings from a literature review of the use of ITS in road safety countermeasures in LHICs is presented in this paper. A detailed review of a number of before-and-after studies involving ITS based road safety countermeasures is undertaken thereby providing rich evidence of the effectiveness of ITS in road safety. African countries especially members of the Association of Southern African National Road Agencies (ASANRA) would be able to learn lessons from tried and tested ITS based road safety improvement initiatives being used elsewhere. This will promote knowledge and technology transfer in Africa.

This paper will also include a set of practical recommendations outlining out how national road authorities in Africa can make use of the evidence gathered in this paper and adapt some of the ITS based road safety countermeasures for use on their road network.

STUDY TO FIND THE STATUS OF ROAD SAFETY EDUCATIONAL CAMPAIGNS IN BOTSWANA

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Abstract
Responsibility for reducing road-related injuries and fatalities lies in the hands of a large number of diverse groups. Collectively, the ultimate goal is to reduce casualty rates. Safety performance must be measured on more than one front, which is why acquiring data from other sources is so important. One type of data that is often overlooked in many jurisdictions is that derived from public surveys. Public surveys are now routinely used to help decision makers in almost every area of public policy development except road safety. For the most part, the three “Es” of road safety—enforcement, engineering, and education—are funded from the public purse through taxes and fees, yet these funds often are disbursed without the benefit of public advice or opinion. In the few jurisdictions where surveys are regularly used to measure and promote road safety, the populations seem to have a more mature and consistent attitude toward road safety issues, partially evidenced by a media that is more interested in road-safety issues. This study used public surveys to determine not only general attitudes towards road safety but also, and more specifically, to measure indicators such as driver experience with enforcement, their self-reported driving behaviour, their perception of the likelihood of being detected and fined for contravening the rules of the road. Many of these surveys were conducted as part of independent research projects, while others form part of ongoing rolling poll and omnibus surveys that enable long-term trend tracking. The information extracted provides police, government, and other agencies with valuable data to help measure the effectiveness of their programs and to develop improvement strategies. The information also generates more media interest, elevating the issue of road safety within the public consciousness. The study experience has shown that in addition to monitoring public awareness and self-reported behaviour, properly structured surveys can also help establish road safety priorities and stimulate interest in road safety. While public surveys are not without their limitations as an analytical tool, properly conducted, they add depth and context to existing program evaluations and performance-monitoring exercises.

**Keywords**: Road safety, Traffic education, public survey, crash data, Transport, Botswana

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**Suitability of Polycom Stabilizing Aid for road construction: A case study of Kadoma urban section along the Bulawayo-Harare highway**

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**Abstract**

Most of the roads in Zimbabwe have exceeded their design-life spans, thus requiring huge sums of money for either reconstruction or rehabilitation. Amongst the major highways to be rehabilitated is the Kadoma urban section along the Harare-Bulawayo highway. One innovative material developed in Australia that permits the reduction of pavement construction costs is Polycot Stabilizing Aid (PSA), which is polymer based. PSA has become popular in construction industry and is being used as a stabilizing agent with short curing time in many parts of the world including Asia, South America and Africa, but not in Zimbabwe. Stabilization of soil mechanically or chemically modifies natural soil deposits to improve their engineering properties. The objective of this paper was to evaluate the suitability of PSA in stabilizing local pavement materials for a 10m-width road rehabilitation with a design life of 25 years. The methodology involved four stages which
include initial road condition assessment, including visual condition surveys and traffic counting; detailed pavement assessment, including testing of in-situ pavement material, natural gravel from burrow pit and stabilized gravel and using Dynamic cone penetrometer (DCP) and Falling weight deflectometer (FWD) test results done in 2010 and 2012; develop alternative rehabilitation designs of the road pavement based on polycot and cement stabilized materials properties and their economic analysis based on initial and maintenance costs. Parameters tested were Modified American Association of State Highway and Transportation Officials (AASHTO) maximum dry density (MDD), optimum moisture content (OMC), swell, plasticity index (PI), grading module, grading, unconfined compressive strength (UCS), and California bearing ratio (CBR). The percentages of PSA used were 0.7%, 1%, 2%, 3% and 4%, while 2% was used for cement stabilization, based on natural gravel properties. The results of the material characterization show that the unbound borrow pit material was a G5 class material. There was a general increase in maximum dry density and a decrease in optimum moisture content with increasing percentage of PSA, with natural gravel having higher density than a blend of in-situ road material and natural gravel. All percentages of Patented on the natural gravel improved parameters such as UCS, CBR, OMC, PI, MDD, and swell such that the material class improved from G5 to G1. Visual condition survey results showed the presence of various structural and functional defects in both extent and degree. In addition, the Pavement Number Method showed that the residual life of the pavement ranged from 3.0 - 4.7 Million Equivalent Standard Axles (MESA), which converts to 1-2 years. Since the test pits were dug more than two years ago, in 2010, it implied that the pavement had exceeded its design life and needed to be either rehabilitated or reconstructed. The application rate of 0.7% of PSA was found to have the same stabilizing effect as 2% of cement on the natural gravel from the borrow pit. We presented the three design options to rehabilitate the road to accommodate the 25-year traffic of 11.4 MSEA that include use of a new PSA stabilized natural gravel base, and blended bases consisting of in-situ recycled road material and natural gravel mixed in the ratios of 1:1 and 1:3. The cost per kilometer comparison results showed that PSA designs were 37 % cheaper than cement stabilized designs. We noted that PSA enables the recycling of in-situ pavement material, which precludes the environment from degradation by excavation and stockpiling of cut-to-waste in-situ road materials. PSA is soluble in water, and can be applied as a solution together with compaction water to reduce labour and mixing equipment requirements, unlike cement, which has to be mixed with gravel first before adding water. Furthermore, PSA maintains the flexibility of the material after stabilization, which prevents cracking of the road pavement, reduces carbon footprint, especially if it replaces cement and saves on compaction water, and associated hauling distances. We recommend that further research be done on gravels of different properties and use of lower PSA application rates from 0.1% to 0.6%.

**Keywords:**
Blending; Cement; Compressive strength; Cost savings; Curing; Rehabilitation; Stabilization;

| Title of the paper: Evaluation of the Use of Polymer Modified Bitumen in the production of High Modulus Asphalt for heavily-trafficked roads |
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Abstract:
Enrobé à Module Élevé (EME) technology, a High Modulus Asphalt (HiMA), has been introduced to South Africa to provide an optimum solution for the design and construction of heavily trafficked roads. Implementation of EME technology in South Africa started in August 2011, when a trial section consisting of an EME base layer was constructed on the heavily trafficked South Coast Road in Durban. However, difficulties in obtaining 10/20 or 15/25 penetration grades of bitumen suitable for production of EME have impeded the more regular use of the technology. This motivated the South African asphalt industry to explore alternatives, such as the use of modified binders, to produce asphalt mixes with comparable properties to those of EME.

National Asphalt, a major South African asphalt producer introduced the use of Ethylene Vinyl Acetate (EVA) polymer-modified bitumen for the production of HiMA. The modified bitumen was used to produce two types of HiMA mixes: one for a base course and one for the wearing course. The mixes were designed in accordance with the South African interim procedures for the design of EME (Sabita Manual 33). In November 2012, a trial section consisting of the EVA-modified HiMA base and wearing course layers was constructed on road M7 in eThekwini (Durban). The objective of this paper is to evaluate the performance of the EVA-modified HiMA against that of the South Coast Road EME (unmodified bitumen) based on the results of a laboratory testing programme and a field performance monitoring programme conducted over a period of two years. The effects of polymer modification will be presented in the paper. Based on the results, recommendations on the future use of HiMA will also be presented.

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MATERIALS DESIGN & SPECIFICATIONS FOR LOW VOLUME ROADS (LVRS).

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ABSTRACT
The cost of building a km of a road has escalated thereby necessitating the use of alternative cheaper designs so as to maximize use of the available limited resources. This requirement is emphasized on rural feeder roads where traffic figures translate to less than 0.03 million standard Axles.

The Ministry of Transport of Zimbabwe embarked on research project to establish the possibility of using low quality materials in constructing LVRS in 1995. Two research projects were carried out, the secondary and rural feeder road project. The Technical Administration of the projects was the Transport Research Laboratory (TRL-UK).

The design of a pavement in natural gravel varies from one region or country to another depending on a multiplicity of factors. Analysis of the relationship between the performance of natural gravels as pavement layers and volumes of traffic and the prevalent climate is of great importance for the designer to achieve cost-effective results. Experimental sections have been constructed where the existing alignment has been followed. A single base layer was then placed on top and compacted to 93 % Mod AASHTO
before laying a single seal surface dressing with 10-13mm aggregate. It should be noted that these LVRS are still in a good serviceable condition, though periodic resealing maintenance works have to be undertaken.

This review paper outlines a pavement design and specifications for materials used on construction of LVRS. The specification is the use of the CBR test on pavement materials instead of the conventional Texas tri-axial test, the CBR test is easier to perform, faster and easier to decentralize but the DCP design method is an alternative to the more traditional laboratory CBR based method of design. The method makes use of optimizing the material properties in terms of the required strength at the designed moisture and density condition based on material properties obtained from DCP testing.

FINANCING AND OPERATING A SUSTAINABLE TECHNOLOGY TRANSFER CENTRE WITHIN AFRICAN TRANSPORT SECTORS
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Abstract
The benefits of establishing and operating Technology Transfer (T²) Centre in each of the African countries cannot be overemphasized. However, lack of sustainable financing of T² Centre operations and programmes is a major challenge facing existing T² centres within African transport sectors. Effective utilisation of the available technology transfer centre services has not been fully reached. This is due to the Centre not being able to adequately market its services and achievements to stakeholders and the public in general. Majority of transport stakeholders are not aware of the services provided by the T² Centres.

There has been continuous increase in stakeholders demand for T² services, which does not match with the available T² Centre capacity in terms of staff, systems for documentation and dissemination of information, office equipment and office space. This paper proffers solution addressing issues for sustainability of the T² Centre services by financing and enhancing the operations of existing T² Centres in Africa through improvement of capacities of T² Centres as well as networking among T² Centres with other Transportation Resource Institutions worldwide.

Keywords: Transportation, Technology Transfer, Sustainability, Funding, Transport Sector

Where to seek financial, economic and GHG efficiencies, and social benefits for durable and sustainable rural transport provision in developing and emerging regions?
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ABSTRACT
The paper explores various aspects of the Rural Road sector in developing and emerging nations. It focusses on the potential for improving asset management practices and further developing the currently embryonic road transport networks to achieve durable infrastructure and sustainable mobility while minimising Green House Gas (GHG) emissions and environmental impacts. The approach is to reference accepted good practice and identify common existing shortcomings from observed deficiencies and experience in procedures and implementation.
No attempt is made to quantify or prioritise the relative importance of the various issues. However the outline assessment indicates where further detailed research and analysis could help realise significant efficiency gains for the sector and benefits to rural communities.

Issues addressed include:

- Key features of the sector (lack of universal access, underdeveloped networks, low investment, poor conditions)
- Asset Management Issues (asset values, contribution to economy and social well-being)
- Policy and Strategy framework
- Asset management practices
- Use of local resources and capacity (including SME development)
- Environmental compatibility (resilience) and minimising GHG emissions
- Appropriate standards, specifications and performance/cost Norms
- Good practice guidelines
- Road maintenance capacity and practice (implementation options)
- Axle loading issues
- Construction quality control and supervision
- Seeking replacements for high GHG cement and bitumen binders and sealers
- Vehicle efficiencies (including recyclable vehicles, improved utilisation, ‘shared’ assets)
- Integrated Rural Accessibility Planning to reduce mobility needs
- Cross-sector cooperation
- Justifying investments and expenditures, and performance monitoring
- Research and development, capacity building
- Knowledge exchange and development
- Relevance to the Sustainable Development Goals (SDGs)
- The way ahead
- Conclusions and Recommendations

Initiatives in Promoting Innovations in Road Transport Technologies in the SADC Region Through Implementation of the ASANRA Project 5.2 on Synthesis of Innovations in Regional Road Technology

By

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Abstract

The Southern African Development Community’s (SADC) road network is central to the economy of the region. It is the dominant mode of transport carrying approximately 80 percent of the region’s total trade in goods and services, about 20 percent of the region’s cross-border trade and providing the only form of access to most rural communities. Road transport services are critical inputs in the production of most other goods and services and are essential for the operation of the regional economy, for the development of regional markets and for intra-regional trade. However, inefficient management coupled with inadequate funding led to deteriorated road conditions and increased transport costs in many SADC
countries in relation to international trends. Member States have adopted road sector reforms since 1990s to address these challenges one of which is the establishment of the Association of Southern Africa National Road Agencies (ASANRA) in 2001 with the goal of enhancing regional policy coordination and road transport systems integration in order to improve intra-regional road transport efficiency and lower transport costs. In order to achieve its objectives, ASANRA identified six focal programme areas one of which is Regional Technology Transfer and Capacity Building under which Technology Transfer was identified as a key towards harmonisation of available knowledge and experiences within the member states through synthesizing of the technologies from various stakeholders.

Member states and stakeholders are aware that there is a vast amount of experience, knowledge and documentation regarding proven technologies, techniques and best practices within SADC. But the technologies, techniques and best practices is fragmented and dispersed in locations that are not actively updated or signposted and therefore not readily available for decision makers and practitioners. As a result, ASANRA decided, in FY 2011/12, to implement the “Project on Synthesis of Innovations in Regional Road Technology” whose objectives were to i) Identify, populate and categorise road transport technology relevant for and developed in the region; ii) Evaluate progress in application of the technology; and iii) Prepare Regional Road Technology Innovation Strategy (RRTIS) including action plan and monitoring and evaluation (M&E) system for sustainable application of the technology in the region. The project covered all countries within the SADC region with the project output being the i) Database of Regional Road Technology and; ii) Regional Road Technology Innovation Strategy (RRTIS) including action plan and monitoring and evaluation (M&E) system. The study captured about thirty road technology titles each of which has been developed in more than one country. This paper presents and discusses the implementation of the project, the challenges faced, and identified gaps and shortcomings in promoting innovations in road technologies. Also, the project outputs are presented with recommendations on the way forward in promoting innovations in road technologies in a sustainable manner.

**Key words:** Innovations, Technology, Transport, Documentation, Best Practices, Road Network

**ABSTRACT**

Most railway crossings in the transport network of National Railways of Zimbabwe are open systems with passive warning devices. The system has very low credibility to provide motorists a warning signal about an oncoming train at the railroad crossing. With the vehicle anti-collision system of this proposed design, road vehicles in the vicinity of a railway crossing are alerted as a train approaches the crossing. A signaling device operating in conjunction with a GPS receiver located in the train emits a signal to a receiver located at the railway crossing. The signal is sent continuously at predetermined intervals to provide the railway crossing control system with sufficient data. The railway crossing processes the information and transmits an alarm signal to approaching road vehicles as the rail vehicle approaches the crossing. A wireless sensor network has been proposed which also emits signals to be received by vehicles with onboard warning systems in the vicinity of grade crossing. The signal emitted by the
crossing is received by the road vehicle which provides various levels of alarms depending on how close the rail vehicle is to the crossing

Design of an optimized recovery system for Used Lead Acid Vehicle Batteries in Zimbabwe
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ABSTRACT
In this paper, a study was undertaken in an attempt to predict the outcome of enforcing product oriented legislation in Zimbabwe to facilitate optimum recovery of Used Lead Acid Battery waste in the country. Used Lead Acid Battery are an end-of-life product group which when improperly handled can pose fatal health and environmental problems due to a number of materials used in their construction. This study attempted to model the recovery of spent vehicle batteries for recycling purposes in the country, targeting high recycling levels that have been reached in other countries approaching 97% recycling rate. A mathematical model, in particular Weighted Goal Programming is thus used to model the multi-objective scenario that seeks to achieve two contrasting objectives, on one extreme side an economic objective to keep the costs of such a programme low and on the other extreme side an environmental obligation of reducing environmental pollution and human exposure. The deliverables of the study included the development a mathematical model that was then used to determine optimum facility location between three candidate sites in Zimbabwe and also to determine the optimum flow of materials between the recycling facility and the source

Transport and land planning – Simulation of the impact – Information: Praxis and Vision

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The information technology development with GIS and navigation systems has provided new opportunities and opened new horizons in the field of transport and land use planning during the last decades. The vision and purpose of these tools should be to keep transparency in the analysis and to reliable forecast the impacts within the decision making process. The new available open data sources are continuously pushing into this direction.
It is not just about the development of planning projects but also about the understanding and modeling of planning processes from a strategic approach to the final operation details in a consistent manner. Within this framework modeling technology plays a key role.
Information and modelling systems are available since decades. However, the methodological know-how and experience with this technology is often absent. This article shows some of the basic principles of model development and illustrates them with some real examples.
The key message is: we can model our future if we are able to consistently forecast the impacts of projected measures.