iTRARR

INTERNATIONAL TRANSPORT & ROAD RESEARCH

CONFERENCE REPORT, 2016

KENYA ROADS BOARD
KRB

AfCAP
Africa Community Access Partnership

MTRD
MATERIAL TESTING AND RESEARCH DEPARTMENT

MINISTRY OF TRANSPORT, INFRASTRUCTURE, HOUSING & URBAN DEVELOPMENT
www.transport.go.ke

INTERNATIONAL TRANSPORT AND ROAD RESEARCH CONFERENCE 15TH TO 17TH MARCH, 2016

SAROVA WHITESANDS HOTEL, MOMBASA, KENYA

THEME:

Transport Solutions to Transform lives:
From research and innovation to uptake and implementation

Innitiative between KRB, MTRD and AFCAP

TABLE OF CONTENTS

Foreword

The Government of Kenya recognizes that an efficient transportation system is key to attracting investment into the region, improving competitiveness and promoting trade and is pleased to host the 1st International Conference on Transport and Road Research.

The Conference dubbed iTRARR Conference 2016 marks an important milestone for the Ministry of Transport, Infrastructure, Housing and Urban Development as it explores ways to enhance the quality of our transport infrastructure. It is in recognition of the importance of research and innovations in providing transport solutions that the Ministry has hosted this conference themed "Transport Solutions to transform lives in the region: From Research & Innovation to uptake and implementation"

Transport services encompass roads, railways, civil aviation, maritime transport and ports, multi-modal transport, freight administration and management and play a key role in fostering trade relations. It is regrettable to note that intra Africa trade is very low currently less than 12%. Other challenges facing our region include poor quality and inadequate infrastructure, inefficient public transport systems, poor connectivity across various transport modes which result in high transport costs thus lowering our competitiveness on the global arena.

The impact of transport infrastructure development and maintenance will be limited unless these programmes are continuously informed by research to ensure best practices and state of the art technologies are used to build and maintain better roads.

There is also the challenge of a huge funding gap to address maintenance and development backlog of infrastructure projects to support the growing population in the urban areas. Robust research should provide cost effective solutions to these problems.

The RMI (Road Maintenance Initiative) of the 1990's contended that for many African countries money for road maintenance may not be the problem but rather the willingness of the political class and policy makers to prioritize road maintenance. It is common in our countries to allocate huge sums of money for development while funds for maintenance remain static if not reduced. Clearly there is need for researchers to advise implementers on a model we will use to get the buy in of politicians and other policy makers.

The diminishing availability of natural construction materials and the continually increasing demand for more and better roads in Sub-Saharan Africa calls for more research on optimal ways of utilizing the marginal resources available.

Sharing of knowledge on the challenges being faced in the transport sector will be key in formulating customised

solutions for each country in Sub-Sahara Africa. Thus, this Conference offers an invaluable opportunity for consultation and exchange of ideas, highlighting the major efforts that will lead to enhanced transport and road research.

There have been many important transport research projects funded by programmes such as the DFID (Africa Community Access Programme), SIDA, AfD, other donor agencies and national budgets that have been undertaken to advance the Africa-specific knowledge-base for the provision of road infrastructure and the associated transport services, especially in rural areas. However, the valuable knowledge generated from the various projects is fragmented and uncoordinated; and resides in different organisations (including donor agencies) in different countries throughout Sub-Saharan Africa and beyond.

The results of such research ought to have been disseminated through a range of ways including manuals, application guidelines, conference papers and scientific journals. This calls for wider discussions on a number of technology transfer issues in the sector; as well as examining the wider issues of mainstreaming transport research effectiveness and uptake. Issues to be considered include:

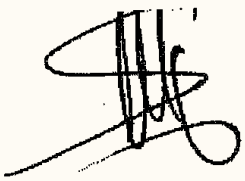
a) Ownership of research and the role of the user;
b) Increasing use and access to electronic media;
c) Feedback mechanisms and forums used, including the effectiveness of workshops, seminars and focus groups;
d) Need for effective networking through linkages established by key technology transfer groups;
e) Role of professional groups and the tertiary education system;
f) Collaboration with academia, reputed research institutions and industry players;
g) Role of international development partners such as DFID, AfD, World Bank etc.; and,
h) Funding mechanisms and constraints.

Despite the obvious importance of transport both socially and economically to Sub-Saharan state's economies, the source of research funds is meagre and inconsistent.

The three days conference provides an opportunity for over 300 transport practitioners and researchers from various economies to discuss policy issues and best practices. To fastrack transport and sustain research, researchers should ensure effective dissemination and application of their results as widely as possible.

In conclusion, the resolutions made in this conference should not be in vain but be of assistance to our institutions and transport sector players to improve lives as the theme of the conference goes "Transport Solutions to Transform Lives: From Research and Innovation to Uptake and Implementation".

Eng. Jacob Z. Ruwa
Executive Director,
Kenya Roads Board



Eng. Stephen K. Kogi
Chief Engineer (Materials)
Ministry of Transport, Infrastructure, Housing & Urban Development

Acknowledgement

The 1st International Conference on Transport & Road Research was hosted by Kenya Roads Board in collaboration with Materials Testing and Research Department of Ministry of Transport, Infrastructure Housing & Urban Development and AFCAP. I wish to acknowledge the concerted efforts of these Agencies in organizing such a successful conference. Many thanks to the presenters and reviewers of papers because without you this conference would not have taken place. To our sponsors and exhibitors we are very grateful for your generosity and contributions in kind to support the transport research agenda in the country; without your support this conference would not have been possible.

I wish to recognize and thank the Joint Organizing Committee drawn from KRB and MT&RD for ably coordinating all activities of the conference;

(i) Eng. Jacob Z. Ruwa – Executive Director, KRB/Joint Co Chair
(ii) Eng. Stephen K. Kogi – Chief Materials Engineer/Joint Co Chair
(iii) Eng. Benjamin K. Maingi – Programme Director
(iv) Eng. Joachim Mbarua – Chairman, Technical Committee
(v) Eng. Margaret N. Ogai – Project Manager
(vi) Eng. Wilson K. Kosgey – Vice Chair, Technical Committee
(vii) Mr. Abdallah Kulah – Alternate to Chief Engineer (Materials)
(viii) Ms. Rosemary Wangui – Chairperson, Publicity & Logistics Committee

My sincere gratitude goes to all our distinguished delegates for finding time to prepare and attend this conference. This conference gave us an opportunity to network with our international friends in research. It is my expectation that you nurture this network of friends and colleagues for the benefit of research and development in our countries.

Finally I would like to thank the Principal Secretary, State Department of Infrastructure, Ministry of Transport, Infrastructure Housing and Urban Development for supporting this conference.

Eng. Benjamin K. Maingi,
General Manager, Planning & Programming,
Kenya Roads Board

Eng. Jacob Z. Ruwa

Eng. Jacob Z. Ruwa is the serving Executive Director of Kenya Roads Board since December, 2014. He holds a B.Sc. in Civil Engineering, is a registered member with Engineers Registration Board and Institution of Engineers of Kenya and has over fifteen years' experience in road planning, design, construction and maintenance. He has previously served as Deputy Principal of the Kenya Institute of Highways and Technology a school well known for the Labour based road management that gave rise to the Roads 2000 Programme.

Eng. S.K. Kogi

Eng Stephen K Kogi is a Civil Engineer with a Master's degree in Business Administration. He is the Chief Engineer of the Materials Testing and Research Department in the Ministry of Transport, Infrastructure, Housing and Urban Development, Kenya. The Department mandated with monitoring the quality of materials and methods used in road construction and other infrastructure, as well as research on performance of various types of constructions, methods, and geotechnical studies.

Eng Kogi is also the President of the African Road and Transport Research Forum (ARTReF). ARTReF comprise African member countries whose aims and objectives are to promote research and innovation in roads and transport through networking, coordination, collaboration, knowledge transfer and the provision of advice on policies for sustainable development in Africa.

Eng Kogi has vast experience in Highway Engineering, specializing in Roads Design, Construction, Rehabilitation and Maintenance and related research. He is a registered engineer in Kenya and a corporate member of the Institution of Engineers of Kenya.

Eng. Benjamin K. Maingi

Eng. Benjamin Maingi is the General Manager, Planning and Programming – Kenya Roads Board. He holds BSc Civil Engineering and MSc in Highway Engineering, from Birmingham University (UK). He is a registered Engineer and member of the Institution of Engineers of Kenya. He is also a member of Kenya Geotechnical Society. In management and corporate governance, he is a member of the Institution of Directors of Kenya (IoD).

Eng. Maingi has more than thirty years practical experience in roads construction and maintenance in tropical countries having worked in both public and private sectors and has managed projects funded by various international agencies. He has been a Consultant for the World Bank for 3 years in the Kenya Urban transport Infrastructure Programme.

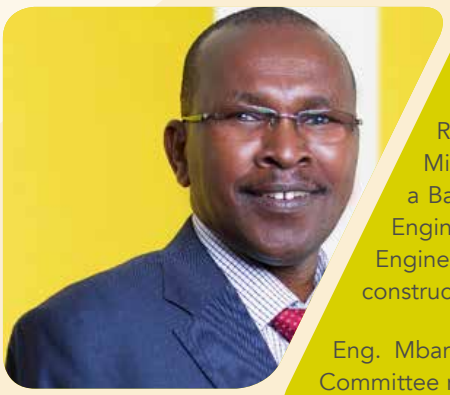
He is a renowned Materials Engineer and is also well versed in monitoring and evaluation of delivery of roadworks through Technical, Performance and Financial Audits. In addition he has vast experience in Planning, Programming and overall Project Management.

Eng. Margaret Ngotho Ogai

Eng. Margaret Ogai is currently employed at Kenya Roads Board as Manager Contracts in the Planning Department. She holds a B.Sc. in Civil Engineering and Master of Business Administration. She is a Registered Engineer and member of the Institution of Engineers of Kenya.

Has over 25 years' experience in both private and public sector in road management encompassing road design, construction supervision, monitoring roadworks programmes, contract management and procurement. She has also been involved in various inter-ministerial committees to formulate policies for management of the road sub-sector in Kenya.

In the Joint Organising Committee, her role was Project Coordinator and she was responsible for preparation of budgets, work-plans and monitoring progress and also acted as the liaison officer to AFCAP.



Eng. Joachim M. Mbarua

Eng. Joachim M. Mbarua is a Principal Superintending Engineer and Head of the Research and Standards Branch at Materials Testing and Research Department, Ministry of Transport, Infrastructure, Housing and Urban Development. He holds a Bachelor of Science in Civil Engineering, University of Nairobi and is a Registered Engineer with Engineers Board of Kenya and Corporate member of Institution of Engineers (Kenya). Eng. Mbarua has over 23 years overall experience in design and construction supervision of bitumen and gravel standard roads and associated drainage.

Eng. Mbarua served in the Joint Organizing Committee as Chairman of the Technical Committee responsible overseeing the call for papers, paper reviews and approvals

Eng. Wilson Kosgey

Currently serving as Manager, R2000 and Research in Kenya Roads Board, Eng. Wilson K. Kosgey holds a Bachelor of Science degree in Civil Engineering. He is a registered engineer with the Engineers Board of Kenya and member of the Institution of Engineers of Kenya. He has over 17 years' experience as a Highway Engineer in Kenya and the East African Region. Eng. Kosgey is also a counterpart expert in the Review of the Kenya's Low Volume Design Guideline with Transport Research Laboratory (TRL) of the United Kingdom. Eng. Wilson K. Kosgey is a representative of Technical Sub-committee in JOC responsible selection and approval of conference papers, identification of project site visits, conference programme and rapporteur for the conference.

Mr. A.J. Kulah

Mr. A.J. Kulah is the Technical Administrator - Materials Testing and Research Department, Ministry of Transport, Infrastructure, Housing and Urban Development. He holds a BSc (Hons): Physics and MSc (Physics) – Nuclear Applications in Civil Engineering both from the University of Nairobi. As a member of the JOC, he was alternate to Chief Engineer (Materials)

Ms. Rosemary Wangui

Ms. Wangui holds an MBA (Strategic Management) from the University of Nairobi and a B.Ed. from Kenyatta University and a Chartered Institute of Public Relations Diploma. She is currently the Public Relations Officer at Kenya Roads Board and has over 15 years' experience in strategic management and public relations. Ms. Wangui served in JOC as the Chairman of the Publicity and Logistics Committee overseeing registration of delegates, procurement, security and publication of conference materials.

Sponsors

Bamburi
cement
Part of you. From the start

THE WORLD BANK

KINCONSULT ASSOCIATES LTD
Consulting Engineers

MTRD
MATERIAL TESTING
AND RESEARCH DEPARTMENT

Exhibitors

Kenya National
Highways Authority

Bamburi
cement
Part of you. From the start

...bye bye potholes

roughton

If you like it... Crown it!

Acronyms and Abbreviations

AADT	Average Annual Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
ADB	Africa Development Bank
AfCAP	Africa Community Access Partnership
AfD	French Development Agency
AM	Asset Management
ANE	Administração Nacional de Estradas (National Roads Administration)
ARTReF	African Roads Transport Research Forum
BADEA	Arab Bank for Economic Development in Africa
BS	British Standards
BRT	Bus Rapid Transit
CESA	Cumulative Equivalent Standard Axles
CBR	California Bearing Ratio
DANIDA	Danish International Development Agency
DCP	Dynamic Cone Penetrometer
DfID	Department for International Development
EAC	East Africa Community
EARTTDFP	Eastern Africa Regional Transport, Trade and Development Facilitation Project
EIRRs	Economic Internal Rate of Return
EN	European Norm
FIDIC	International Federation of Consulting Engineers
GIS	Geographic Information System
GEM	Growth through Effective Road Asset Management
GNSS	Global Satellite Navigation System
GoK	Government of Kenya
GoZ	Government of Zimbabwe
GPS	Global Positioning System
GSM	Global System for Mobile
HDM-4	Highway Development and Management Model
HRBs	Hydraulic Road Binders
ICT	Information Communication Technology
IQL	Information Quality Level

iTRARR	International Transport and Road Research
JOC	Inter-Agency Joint Organizing Committee
KeRRA	Kenya Rural Roads Authority
KeNHA	Kenya National Highways Authority
KURA	Kenya Urban Roads Authority
KIPPRA	Kenya Institute of Public Policy Research
KRB	Kenya Roads Board
KTSSP	Kenya Transport Sector Support Project
KNWA	Kenya National Workshop Agreement
LBT	Labour Based Technology
LVSRs	Low Traffic Volume Sealed Roads
MoTIHUD	Ministry of Transport, Infrastructure, Housing and Urban Development
MTRD	Material Testing and Research Department
NACOSTI	National Commission for Science, Technology and Innovation
NEMA	National Environmental Management Authority
NMT	Non Motorised Traffic
NPVs	Net Present Value
NTSA	National Transport Safety Authority
NUTRIP	National Urban Transport Improvement Project
ORN	Overseas Road Note
PMU	Project Management Unit
PPPs	Public Private Partnership
PWDs	People Living With Disabilities
RAs	Road Authorities
RAC	Road Agency Costs
RAMS	Road Asset Management System
ReCAP	Research for Community Access Partnership
RD	Road Deterioration
R&D	Research and Development
RDM III	Road Design Manual Part III
RMI	Road Maintenance Initiatives
RMMS	Road Maintenance Management System
RMS	Road Management System
RWE	Road Works Effects
RUE	Road User Effects
SGR	Standard Gauge Railway
SSA	Sub-Sahara Africa
SUMATRA	Surface and Marine Transport Regulatory Authority – Tanzania
URRAP	Universal Rural Roads Access Program
VOC	Vehicle Operating Cost
Vpd	Vehicle per day

EXECUTIVE SUMMARY

1.1 Introduction

Kenya Roads Board in collaboration with Materials Testing and Research Department (MTRD) and DfID funded African Community Access Partnership (AFCAP) hosted the first International Conference on Transport and Road Research in Kenya dubbed iTRARR Conference 2016 from 15th to 17th March 2016 in the Sarova Whitesands Hotel, Mombasa. The conference was attended by more than 200 delegates from 24 countries from Africa, South East Asia and Europe.

The overall aim of the Conference was to enhance coordination of transport related research efforts within the region and the theme of the conference "Transport Solutions to transform lives in the region: From Research & Innovation to uptake and implementation".

1.2 Conference proceedings and Sessions

The conference was officially opened by Eng. Philemon C. Kilimo, Road Secretary who represented the Principal Secretary, Ministry of Transport and Infrastructure. The 3 day conference covered 5No. Plenary sessions on policy and strategy issues, 8No. dedicated workshops, technical site visits to 4 sites and exhibitions involving 13 exhibitors. The conference programme is attached in Annex 4.2.

Overall the participation at the conference was high, all conference sessions were fairly well attended and the quality of presentations was good. The conference was officially closed by Ms. Rita Kavashe, Managing Director of General Motors Kenya & Director of KRB.

1.3 Key Issues and Conference Recommendations

The conference wrap up and closure session came up with the following resolutions for implementation by research institutions and transport sector players:

1. Enhance knowledge management, dissemination and uptake of transport research in the region.
2. Strengthen linkage between industry and academia
3. Promote regional research fora
4. Enhance stakeholder participation in fund allocation for transport infrastructure to ensure buy in

5. Encourage community participation in implementation of projects and programs in the Transport sector.
6. Promote gender mainstreaming in the Transport Sector.
7. Promote organised public transport systems in the major cities in the SSA region
8. Build capacity for Road Asset Management in the Road Agencies in SSA region
9. Enhance research on alternative new materials such as HRB
10. Promote young researchers
11. Further research on transport safety and security
12. To enhance coordination of research and dissemination of research findings, it is recommended that iTRARR is held every two years

1. INTRODUCTION

In July 2015, Kenya Roads Board (KRB) received an official endorsement from the Ministry of Transport, Infrastructure, Housing and Urban Development to host the 1st International Conference on Transport and Road Research in Kenya in collaboration with Materials Testing and Research Department (MTRD) and DfID funded African Community Access Partnership (AFCAP).

The International Conference on Transport and Road Research dubbed iTRARR Conference 2016 was the first event of its kind in Kenya and was held from 15th to 17th March 2016 in the Sarova Whitesands Hotel, Mombasa.

The conference was a significant event for transport practitioners and researchers from various emerging economies from Africa and South East Asia to discuss policy issues, best practice and research findings across a broad spectrum of transport modes with a view to offering solutions to transform lives in the region. The conference was attended by 223 delegates from 24 countries from Africa, South East Asia and Europe.

The overall aim of the Conference was to enhance coordination of transport related research efforts within the region. The theme of the conference "Transport Solutions to transform lives in the region: From Research & Innovation to uptake and implementation".

The objectives of the conference were;

(i) To enhance coordination of research efforts within the Roads sub-sector in the region

(ii) To disseminate research findings and innovations to road practitioners and to promote uptake and update of research findings amongst road practitioners.

(iii) To provide a forum for sharing of experiences and exchange of ideas amongst road practitioners and researchers and generally facilitate knowledge exchange amongst institutions involved in road transport.

The conference was officially opened by Eng. P.C. Kilimo, Infrastructure Secretary who represented the Principal Secretary, Ministry of Transport, Infrastructure, Housing and Urban Development. The following were key note speeches during the official opening;

- Brief Statement on Hydraulic Road Binders (HRBs) by Main Sponsors Bamburi Cement
- Introduction to Research and Community Access Partnership by Mr. Gerome Rich, Project Director, ReCAP
- State of Transport Research and Knowledge in Sub-Sahara Africa and brief on African Roads and Transport Research Forum (ARTReF) by Eng. S. Kogi, Chief Engineer Materials, MoTIHUD

- Financing options for Road Infrastructure provision by Eng. Jacob Ruwa, Executive Director, KRB
- Provision of transport infrastructure in the region: Opportunities and Challenges by Eng. John Mosonik, Principal Secretary, MoTIHUD

The conference involved 5No. Plenary sessions on policy and strategy issues, 8No. dedicated workshops, technical site visits to 4sites and exhibitions.

The conference was closed by Ms. Rita Kavashe, Managing Director, General Motors Kenya & Director KRB who implored that the resolutions made in the conference should not be in vain but be of assistance to our institutions and transport sector players to improve lives as per the theme of the conference.

2. SESSIONS

2.1 SESSION 1: OFFICIAL OPENING

Highlights of the Session

Eng. Philemon Kilimo, the Infrastructure Secretary, State Department of Infrastructure gave his address on behalf of Principal Secretary, MoTIHUD on opportunities and challenges on the provision of transport infrastructure in the region. He highlighted the need to come up with cost effective and innovative solutions that will address regional and national challenges which include traffic congestion, poor connectivity of various transport modes, lack of efficient public transport systems, rising costs and scarcity of construction materials, dilapidated railway network, inadequate capacity of the port to handle increasing cargo and effects of climate change.

There is also the challenge of a huge funding gap to address maintenance and development backlog of infrastructure projects to support the growing population in the urban areas and robust research should provide cost effective solutions to these problems. To address these challenges the government has embarked on initiatives such as expansion of ports, airports, construction of standard gauge railway and improvement of transit corridors where there are immense opportunities for the private sector to play.

The various regional infrastructure programs the Government of Kenya is undertaking are;

(i) Expansion of the port of Mombasa to increase its cargo handling capacity
(ii) Construction of one stop border posts
(iii) Modernization of the axle load control stations under the East African Regional Transport, Trade and Development Facilitation Project (EARTTDFP)
(iv) The Arusha – Holili – Mwatate and the Malindi – Mombasa – Lunga Lunga / Tanga – Bagamoyo roads
(v) Multinational road projects namely Nyakanazi – Kasulu – Manyovu / Rumonge – Bujumbura road and Lusahunga – Rusumo / Kayonza – Kigali road
(vi) Harmonization of laws for Vehicle Load Control in EAC
(vii) Construction of Standard Gauge Railway from Mombasa to Kigali
(viii) Expansion of Jomo Kenyatta International Airport
(ix) Elimination of Non-tariff barriers among others.

Eng. Jacob Ruwa, Executive Director, KRB outlined financing options for Road Infrastructure provision. He stated that there is need to explore other funding options (increase road maintenance and development budgets through

fuel levy, weight distance charges, tolling, concessions, international transit tariffs, PPPs, infrastructure bonds etc.) to bridge the huge gap in infrastructure funding in Sub-Sahara Africa Region. Current estimates are that only USD 25billion is available against needs of USD 95billion. There is need to prioritize road maintenance in Africa considering that infrastructure budgets have been increasing yet the road condition has continued to deteriorate over the years. Noting that research is usually underfunded due to lack of appreciation of its importance by policy makers, he appealed to researchers to package their messages appropriately to lobby for additional funding.

Eng. Stephen Kogi, the Chief Materials Engineer introduced the members of ARTREF who had attended the meeting. In his address he noted the need to adopt multi-sectoral approach and public private partnerships in transport and road research, dissemination and uptake. He further noted the need to establish appropriate policy and institutional framework to enhance transport and road research including the establishment of autonomous or semi-autonomous executing agencies, Research Institutions, Road Boards and sustainable funding mechanisms. He stated that research can lead to transport solutions and gave the example of Low Volume Sealed Road where guidelines have been developed; the Roads 10,000 project will use LVSR standards. He emphasized the need to train and develop research capacity in human resource noting that most of the researchers are aging. He highlighted the need to leverage Information and Communication Technologies (ICT) in storing, managing and dissemination of information in research institutions for effective knowledge management.

Mr. Gerome Rich, the Project Director, ReCAP outlined the Research and Community Access Partnership which is a DfID funded program in selected countries in Africa and South East Asia. The objective of the program is to improve accessibility of the rural poor.

Eng. Fidelis Sakwa of Bamburi Cement gave a statement as a key sponsor of the conference. He highlighted the firm's involvement in research and also various ongoing infrastructure projects including the Standard Gauge Railway. He stated that the firm has carried out trials on Hydraulic Road Binder Cement and the results would be presented at the Conference. He appealed to the Government to take up new technologies in road construction which would lower costs.

2.2 SESSION 2: POLICIES AND STRATEGIES FOR EFFECTIVE ROAD ASSET MANAGEMENT

2.2.1 Addressing the Road Maintenance Challenge in Africa: What can we do to solve this continuing Problem? By M.I Pinard

(i) Highlights of the Presentation

- By the end of 1980s, 2 million km of road worth approximately USD 150 Billion had been constructed in Africa. The investment has not been matched with adequate maintenance provisions and by the year 2000, 33% of the road asset had been lost due to lack of maintenance.
- Based on economic analysis, maintenance of existing roads results into the highest return on investment with an Internal Rate of Return of 40% compared to 20% and 10% for Rehabilitation of existing roads and construction of new roads respectively.

The implications of underfunding maintenance include increase in transport costs, loss of road asset value etc.

- Factors to consider in order to preserve the road asset include political environment, institutional arrangements, financing and management options, technical and operational considerations, sustainable road preservation and development.
- Embracing and improvement of Road Maintenance Initiatives (RMI) developed in the past should be encouraged to prevent loss of institutional memory.
- There needs to be a multi-dimensional approach in solving road maintenance challenges.

(ii) Discussions and Outcomes

It was noted that political goodwill is critical for implementation of effective road asset management. In order to ensure buy-in by the political class, it was imperative that effective communication through well written objective reports on selected maintenance projects, presentation of transport indicators and highlighting consequences of delayed maintenance should be presented to politicians to minimize interference during prioritization of maintenance projects.

2.2.2 Economic Growth through Effective Road Asset Management by Robert Geddes

(i) Highlights of the presentation

- Following the advent of the Road Management Initiative (RMI) in the 1990s, significant progress has been made in the maintenance of main roads in a number of countries in Africa.
- The improvements are a result of the establishment of road funds and semi-autonomous road authorities. However, relatively less progress has been made with the maintenance of local roads providing access to rural communities.
- The Africa Community Access Programme (AfCAP) is funding a research and capacity building project on asset management for rural roads in order to achieve economic and social benefits for local communities. Three countries from sub-Sahara Africa will participate in the first phase of the project but there are possible opportunities for others in subsequent phases. A fourth Country (South Africa), with established rural road asset management system, will provide a benchmark for best practice.
- The project will provide technical assistance to achieve improvements in asset management performance on a selected network of rural roads within each participating country.
- The performance will be measured against a new framework for rural road asset management that is being developed as part of the study with measurements also taken of the road network condition and the impact of the road condition on the rural economy.
- These data will be discussed with road sector stakeholders in the project areas and in regional meetings of the participating countries.
- The data will be used as part of an influencing strategy to achieve improvements to the management of rural roads and build a maintenance culture.
-

(ii) Discussions and Outcomes

The conference suggested that maintenance be introduced in the curriculum in Universities.

2.2.3 Development of Optimal Road Maintenance Fund Allocation Framework by Prof. Jennaro B. Odoki

(i) Highlights of the presentation

- The development of the proposed road maintenance allocation formula is based on principles of full cost recovery, economic efficiency and equity.
- The Fund Allocation Framework is in 3 stages:
- Stage 1- allocation by road surface types (vertical allocation)
- Stage 2- allocation by surface type between the road network jurisdictions
- Stage 3- allocation of the funding per road network and surface type to the designated authorities within each district, town council, municipal, and sub-county.
- It is recommended that Road Fund Boards should consider the proposed ''Three-Stage Allocation'' which addresses the weaknesses with the traditional methods of road maintenance fund allocation.
- In order to reduce biases in road fund allocation, it was also recommended that a Multi-Criteria analysis based on stakeholder views is formulated to ensure buy-in.

(ii) Discussions and Outcomes

The Conference recommended that MCA approaches are applied to formulate road fund allocation.

2.2.4 An Investigation on the Influence of Institutional Capacity & Applicability of Technology in Implementation of URRAP: The Case Study of Tigray Region by Daniel H. Gebre

(i) Highlights of the Presentation

- Under Low Volume Roads, (LVR), Universal Rural Roads Access Program, (URRAP) is a new program in Ethiopia aimed to access the rural community and to afford all weather access road to markets and public services. The principles of URRAP were Institutional capacity, Technological applicability, Social and Environmental acceptability, Financial and Economic viability.
- The study however focused on two principles namely institutional capacity and technological applicability on implementation of URRAP.
- The program was introduced in 2012 throughout Ethiopia and specifically in Tigray in 34 administrative units known as weredas. From 34 weredas, 6 projects in six different weredas were selected for the study with 4 projects being successful and 2 others failing.
- The main Influence Factors determined were terrain of the road, type of subgrade soil, Community Participation and Coordination, structures along the roads and work ethics.
- Recommendations: (i) Need to carry out preliminary geometric design (ii) Agreement or contract for community work (iii) Develop manual to bridge the gap in coordination between the parties.

2.3 SESSION 3: ENGINEERING DESIGN IMPROVEMENTS

2.3.1 Low Standard Bitumen Surfaced Roads: A Case Study on Mackenzie – Kandara (D415) Road, A.O. Ndege & J.M. Mbarua (MTRD - MoTIHUD)

(i) Highlights of the Presentation

- The main objectives of the project were:
  i. Construction of a sealed pavement and surfacing for low traffic volume using labour intensive construction methods;
  ii. Compare performance of alternative stabilizers with cement;
  iii. Develop construction specifications for appropriate standard bitumen surface roads constructed by labour.
- Design traffic used was less than 500,000 cumulative equivalent standard axles (CESA) hence being classified as Low Traffic Volume Sealed Road (LVSRs) or Low Standard Bitumen Surfaced Roads. This was the first Pilot project in Kenya.
- Pavement design review was based on Chapter 12 and 13 of the RDM III's appropriate specifications and other technical documents. There were three trial sections comprising of Cement improved Gravel, Consolid and Emulsion Treated Gravel.
- Key finding: The subgrade, based on the structural analysis is most critical indicating inadequacy in strength.
- Recommendations: (i) Further monitoring of the section in order to determine performance and conclusive construction specifications for labour intensive low cost bitumen surfaced pavements (ii) Further research on labour based construction technique, modified subgrade and the cold mix asphalt need to be carried out to complement this research and (iii) Need for improved quality control on roads to be constructed to similar standards.

(ii) Discussions and Outcomes

During discussions it was reported that the Cost-Benefit analysis was carried out for the project. The benefits from the project is a reduction in cost per km in road construction and job creation to the local community. It was also recommended that the term "relaxed" standards is referred to as "appropriate" standards.

2.3.2 Prediction of CBR using DCP for local Subgrade Materials by Gebremariam G. Fekele

(i) Highlights of the Presentation

- The study was carried out to establish a relationship between California Bearing Ratio (CBR) and Dynamic Cone penetrometer (DCP).
- Analysis was based on Regression Analysis which yielded the following model:
  $\log_{10} CBR = a + b \log_{10} DCP$
- The Study indicated:
  i. CBR value can be predicted from DCP test. A better relationship exist for Fine Grained soils than for Coarse Grained soils
  ii. Even though DCP test has some limitations, it is an easy and time saving procedure.

Discussions and Outcomes

There is need to carry out more studies on the relationship between the DCP and CBR test.

2.3.3 Asphaltic Concrete Pavement Design Incorporating Life Cycle Analysis – Case Study of Benin by John Bernard Koranteng-Yorke

Highlights of the Presentation

- Most pavement design approaches lack critical evaluation of the life cycle and performance of the designed road pavement.
- Current practice in road pavement design and the maintenance are not coterminous.
- Mechanistic-Empirical design approach was adopted because of its capacity to design for uncontrolled traffic situation and other inherent advantages (projected traffic loads exceed 10 Million ESALs).
- Kenlayer was found to be most suitable design tool.
- The residual life of the existing pavements were assessed to inform the appropriate type and level of intervention required.
- The three HDM-4 sub-models (Road Deterioration (RD); Road Works Effect (WE); and Road User Effects (RUE), were calibrated using actual data from Benin.
- The results showed rehabilitation to be the best option as it gave the highest NPVs, NPV/RAC ratios and EIRRs.
- The study concluded:
  i. With this approach, the life cycle cost of the road investment can be known before construction starts.
  ii. Proper planning and programming of maintenance activities during the design life of the pavement can be assured.
  iii. The approach can be used to monitor and update maintenance management system of Road Agencies.

2.3.4 Position Paper on the Status of Application of Hydraulic Road Binders in Kenya and Study of the Potential by Fidelis Sakwa & Eng Protus Murunga.

(i) Highlights of the Presentation

- The two common and approved chemical stabilizers in road works in Kenya are Cement and Lime. However, Hydraulic road binders (HRBs) are commonly used in European Countries (BS EN 13282).
- HRBs are manufactured just like Portland Cement but with a wider flexibility in the constituents.
- The main reasons for considering use of HRBs in Kenya for stabilization include cost, flexibility in blending, and setting time among others.
- In Aug 2014 - KNWA 2569-1: 2014 Hydraulic Road Binders-Composition, specifications and conformity criteria was formulated based on BS EN 13282-1:2013.
- Joint research was carried out by Bamburi Cement Ltd. and Norken International Ltd with an Objective of exploring through laboratory, the effectiveness of HRBs as a chemical stabilizer for use in road works.
- The investigation concluded that HRB formulations tested are effective in enhancement of soil strength and reduction of soil plasticity which are a key objectives of stabilization.
- The study recommended that Field trials be undertaken to validate the findings of the laboratory trials

(ii) **Discussions and Outcomes**

It was clarified that Bamburi Cement did not involve MoTIHUD in the research because their research was purely for confirmatory tests before involving MoTIHUD.

2.3.5 Baseline Survey on Research Undertakings in the Roads Sub-Sector in Kenya by Eng. Peter Otaya

(i) Highlights of the Presentation

- The research was carried out between November 2014 and July 2015 with the following objectives:
  i. To review and compile a comprehensive summarized listings of past and current research undertakings within the roads sub-sector.
  ii. To develop an implementation plan for the establishment of a centralized knowledge base of research undertakings within the road sub-sector.
- Key findings: The country has a comprehensive National Research policy in place. National Commission of Science Technology and Innovation (NACOSTI) is body mandated to coordinate and regulate research in the country.
- The current transport and road research is fragmented and the sector does not have a clear road research policy or agenda.
- Bodies carrying out road related research are: Materials Testing & Research Department (MTRD), MoTIHUD, Road Authorities, KRB, Universities, Kenya Institute of Public Policy Research (KIPPRA) andcement manufacturers. Also East Africa Community (EAC), SSTAP are involved mainly in transportation policy research.
- Currently, MTRD does not have adequate institutional capacity and autonomy to undertake road research effectively.
- There is inadequate funding of road research programmes in the country.
- Level of collaboration/ coordination and linkages between the industry and academia on road research matters in the country is low.
- A lot of road research has been carried out by MTRD since 1959 to date. However, it was observed that there was poor management of the research knowledge including dissemination of findings.
- **Recommendations:**
  i. MoTI should spearhead the development of a Transport Research policy.
  ii. MTRD be transformed to an autonomous Transport Research Centre, progressively, so as to also cater for transport by rail, air, marine, pipeline, etc. in future.
  iii. Establishment of Knowledge Centre for storage of all road related research in the country.

(ii) Discussions and Outcomes

It was clarified that the findings and recommendations of various research undertakings are incorporated into Special Specifications of particular projects.

2.4A.1 SESSSION 4A: A NEW SPECIFICATION FOR THE EFFECTIVE MANAGEMENT OF RURAL ROADS

2.4A.1 Economic Growth through Effective Road Asset Management (GEM) by Kingstone Gongera

(i) Highlights of the Presentation

- The study involved a review of road asset management practices in Ethiopia, Malawi, Mozambique, Tanzania, Uganda, Zimbabwe and Western Cape in South Africa.

Summary of findings from the case studies:

- There are very few examples of sustainable asset management practices in sub Saharan Africa
- Government tend to favour new construction and neglect or underfund maintenance
- Political interference is common and undermines efficiency
- Contracting out of maintenance work has not resulted in improved capacity within the private sector; this is largely due to the small contracts and short term duration. This limits contractors in expanding their human and capital capacity.
- Bureaucratic procurement procedures undermine continuity of maintenance works
- Generally inadequate funding for road maintenance and low priority in particular for rural roads has remained a major handicap to improving rural access.

2.4A.2 Monitoring social and economic impacts of rural roads by Camilla Lema

(i) Highlights of the Presentation

- About 34% of rural population in Africa live within 2 km of an all-weather road.
- Efficient and reliable rural transport infrastructure will lead to improved mobility, access to socio-economic services and opportunities, and generally improved conditions for economic growth and poverty reduction.
- Socio-economic benefits of rural roads improvements are difficult to justify. Conventional methods of valuation are inadequate to capture benefits in low traffic volumes and non-economic benefits.
- Aims to provide a good indication of how to monitor/measure systematically the possible outcomes of well-maintained rural roads, serve as an influencing evidence-based strategy to improve rural road agency performance and influence political leaders to give greater priority for rural road network management.
- Transport infrastructure Output indicators - length of rural road maintained as a proportion of the project network
- Transport infrastructure Outcome indicators are road condition (roughness index), level of service (e.g. elimination of road closures / reduction in travel days lost) and direct employment creation in road maintenance (gender disaggregated worker-days/km of road maintained)
- Transport services Outcome indicators are traffic levels, traffic composition, vehicle operating costs and Road safety (accident incidents/rates)
- Transport services Impact indicators are availability of public transport and usage, frequency, access to transport services (average time to reach public transport), fares on public transport, availability of freight and transport cost savings, change in transport modes (passengers and freight) and travel time savings.

2.4A.3 Asset Management Systems for Rural Roads in the Western Cape, South Africa by Eng. Mervin Henderson

(i) Highlights of the Presentation

- The Western Cape has a network of paved and unpaved roads that promotes and supports economic development:
- Nearly 62% or 10,042 km of the road network can be considered low volume roads AADT<250 vpd
- Unpaved (gravel) roads are nearly 60 % or 9 ,908 km of the managed network
- Minor unpaved roads not under the managed network:15,398 km
- Asset Management (AM) in Western Cape was achieved through knowing what was needed (objectives); implementing strategies that are cost effective, long lasting with an appropriate Level of Service in terms of adequate accessibility and mobility, promotes safety, reduces costs for the road user & the Branch and supports the outcome of increased economic development in under-developed areas; maintaining alignment, known as 'line-of-sight' from the Branch's objectives all the way down to activities on the road
- Fundamental to asset management is the balancing of investments required to maintain the level of service provided by existing assets with investments required to meet future capacity demand
- Good Asset Management involves the optimising of cost, risks, performance, resources and benefits over the whole asset life, within any absolute constraints

2.4A.4 Framework for Self-Assessment of Performance in Rural Roads Asset Management by Michael Burrow

(i) Highlights of the Presentation

- Road Asset Management Framework involves Strategic Planning, Programming, Operations Management and Work Activities
- Factors to Consider in Road Asset Performance Management are technical, institutional and external

(ii) Discussion and Outcomes for Session 4A

- The attitude and culture of doing right things need to be first addressed in most of the countries before best practices are applied
- Political input should be considered together with technical feasibility before a holistic road prioritization is finalized to enhance project acceptability
- Emergency maintenance interventions need to be factored during funds allocation for road maintenance/ interventions
- Encourage use of technology in monitoring of road network performance and study the modelling impacts before any intervention

2.4B SESSION 4B: ENHANCING PUBLIC TRANSPORTATION SYSTEMS IN LARGE CITIES IN AFRICA

2.4B.1 Ropeways in urban environment by Dr. Eustace Mwarania

(i) Highlights of the Presentation

- Aerial cable transit is an efficient, sustainable mass transportation system that should be adopted in Africa to ease prevalent congestion experienced in many cities.
- As compared to other modes, cables have the highest safety record. Only one accident so far has been reported in Singapore where a cable was cut. In Kenya Likoni Cable Express (LCE) a clearance of 85m has been provided as the standards of Kenya Maritime Authority and Kenya Defense Forces for safety purposes.
- The target population is every commuter due to the high efficiency.

(ii) Discussions and Outcomes

- In December 2015 KEBS approved a draft standards Draft Kenya National Working Agreement (DKNWA) 2623-1/2:2015 and MTRD was involved in formulation.
- The government need to formulate policy and regulatory framework for ropeways transport system in Kenya
- The Matatu owners will be part of stakeholders by buying shares in the rope ways transport system for wider project acceptance. The PPP department of treasury is following up on harmonization of public projects.

2.4B.2 Analysis of Introduction of Bus Rapid Transit (BRT) in Urban Areas: Case Study of the BRT link between Harare and Chitungwiza, Zimbabwe by Samson Shumba

(i) Highlights of the Presentation

- In late 1990s there was decline of the Zimbabwe United Passenger Company (ZUPCO) and the liberalisation of transportation policies has seen the minibuses (kombis) era taking over, influx of small capacity vehicles leading high volumes and congestion.
- Chitungwiza has a few industries to provide jobs for the local population thus many people travel to Harare for work.
- From traffic counts, 80% is private cars and 16% kombis and there are few alightings and boardings in between Harare and Chitungwiza
- Demand calculation was carried out using equations from Bus Rapid Transit Planning Guide Part II – Operational Design by the ITDP, 2007 and a fleet of 69 articulated buses was found adequate to cater for the morning peak demand.
- Cities and towns need to reserve land for purposes of mass transit in their land use planning.

(ii) Discussions and Outcomes

- There is need for organized public transportation systems in major cities in Sub Sahara Africa which cater for the vulnerable groups such as physically challenged, children.
- Proper management of the public transport systems should be ensured to attract all classes of commuters and thus reduce congestion in our roads.

2.5 SESSION 5: MONITORING PERFORMANCE OF TRANSPORT NETWORKS

2.5.1 *Configuration and Calibration of HDM-4 Kenya Workspace by Prof. Jennaro Odoki*

(i) Highlights of the Presentation

- The reliability of HDM-4 Analysis Results depends on how well data provided represent the real conditions being analysed as understood by the system and how well the predictions of the model fit the real behaviour and the interactions between the various factors and conditions to which it is applied.
- Areas identified for improvement (Configuration) in the HDM-4 Kenyan workspace include Climate zones, Speed-flow types, Traffic-flow patterns, Accident classes and rates, Aggregate data and defaults, revision of the equivalent standard axle load factors (ESALF) given in the workspace, definition of Non-Motorised Transport modes and inclusion in the Vehicle Fleet module, definition of representative traffic growth rates and inclusion of Typical case studies relevant to Kenya road network development and maintenance.
- The major challenges being encountered relate to availability of complete data sets, in particular the lack of appropriate time series data on road pavement performance and traffic, for the calibration of road deterioration models; and
- The Kenyan case study has demonstrated how HDM-4 can be established as a comprehensive decision support tool for use by the road agencies in Kenya;
- The configuration of the HDM-4 will enable the road agencies to carry out medium to long-term planning of development and maintenance expenditure and investigate investment choices on Kenyan roadsThere is need for Kenya to adopt one configured and calibrated HDM-4 workspace in order to improve the accuracy of investment modelling and guide investment decision making in the sector.

2.5.2 *Implementation of a Multi-Sectoral Programme - Key Lessons Learned from Northern Corridor Transport Improvement Project (NCTIP) by Eng. S.K Kogi*

(i) Highlights of the Presentation

- The Project Development Objectives (PDOs) were:
  i. To increase the efficiency of road transport along the Northern Corridor to facilitate trade and regional integration;
  ii. To enhance aviation safety and security to meet international standards;
  iii. To promote private sector participation in the management, financing and maintenance of road assets; and
  iv. To restore vital infrastructure and public assets damaged as a result of the 2007 post-election crisis.
- The project combined three sub-sectors in the transport sectors including Roads, Aviation, and Maritime being an integrated transport project and having a flexible Project design.
- The key lessons learned included:
  i. Efficient coordination and oversight through a Project Oversight Committee (POC) improves performance
  ii. With support by the government an integrated transport project approach can produce positive results
  iii. Flexibility of project teams and World Bank ensured timely response to unexpected situations despite the project spanning three different governments.
  iv. The establishment of autonomous roads authorities improved professionalism and governance.

2.5.3 *Can Humans Predict The Future? Consequences of Inaccurate Traffic Forecasting By Endale, A.A*

(i) Highlights of the Presentation

- Ethiopia faces various challenges in upgrading and improving its road network which include limited resources, inadequate information on road construction materials and inadequate traffic/axle load studies.
- Traffic forecasting is important for pavement design. Inaccurate forecasting leads to either over-design (denying other areas resources) or under-design (leading to premature failures).
- The results of the study showed that:
    i. There is significant differences in growth rates forecasted by various methods.
    ii. There are Variations in growth rates/trends over the years, and sometimes non-linear.
    iii. There are different design traffic classification depending on VEF and growth rates, hence different pavement structures.
    iv. There is need to advocate for routine axle load studies on all road classes and long-term round the clock traffic count stations.
- The following questions were paused:
    i. Owing to the difficulty in forecasting traffic, should design periods be reduced? (adopt stage construction)?
    ii. What axle load percentiles should be used in pavement design? 50th, 75th, 99th?

2.5.4 *Assessment of Drivers' Behaviour at Selected Signalized Intersections in Abuja Metropolis, Nigeria by George Omange*

(i) Highlights of the Presentation

- The consequences of placing traffic signals in unjustified locations include increased Intersection Delay, Crash Frequency, Red Light Violations, High Fuel Consumption and increased VOC.
- The results showed that the driver compliance rate was low because:
    i. Yellow interval duration is 3 seconds which affects the drivers' reaction time.
    ii. Inadequate Stopping Sight distance on Highways
    iii. Undulating Terrain traversed by highway which increase violations (High Gradient/Sharp Curves)
    iv. No mechanisms to apprehend Red Light Violators
    v. No Zebra Road Markings to reduce violations

- The recommendations from the study include:
    i. Countermeasures for Improved Traffic Flow through Signal operation, Motorist information and Physical improvement
    ii. Enforcement which should include Automated/Manual Enforcement Mechanism
    iii. Educational & Public Awareness Campaigns
    iv. Better Management Strategies for Road Traffic & Safety Agencies (FRSC, DTRS and Nigeria Police)

2.5.5 *Enhancing Intra-Regional Trade: Standard Gauge Railway by Kenya Railways by Eng. Solomon Ouna*

(i) Highlights of the Presentation

- Key benefits to accrue from a modern railway:
  i. Transformation of transportation in the region – reduced cost of transport,
  ii. Increased competitiveness in the region,
  iii. Growth of trade and ease of doing business in the region.

- Some of the lessons learnt in the execution of the project include:
  i. Railway development as a multi-disciplinary undertaking requiring coordination to put the many projects together to realise the end product.
  ii. EPC Contractor must be selected very carefully confirming his technical, financial and resource capacity.
  iii. Requires heavy financing raising concern about debt burden.
  iv. Long term benefits of the railway not understood by many stakeholders
  v. Projects require timely and quality delivery of goods and services
  vi. Project is offering opportunity to develop proper procedures for future delivery of similar projects
  vii. Land acquisition issues can make or break infrastructure projects
- Some of the Challenges being faced in the project:
  i. Interference by multiplicity of stake holders
  ii. Cultural considerations – dealing with burial sites and sacred sites
  iii. Misuse of compensation money
  iv. Community Social Responsibility issues

2.6A SESSION 6A: IMPLEMENTING ROAD ASSET MANAGEMENT SYSTEMS IN KENYA

2.6A.1 Road Asset Management System for effective decision making by Eng. F. Gitau

(i) Highlights of the Presentation

- Currently the roads in Kenya are administered by Ministry of Transport, Infrastructure, Housing and Urban Development through Road Agencies, County Governments and Kenya Wildlife Service.
- Maintenance Funding (Fuel Levy) is allocated by the Kenya Roads Board. However, the allocation does not match the needs of the road asset.
- Components of an AMS comprise of goals and policies of the administration, Data, Resources and budget details, Performance models for alternative strategies and programme development, Project selection criteria, Implementation programme and a monitoring and feedback loop.
- Some of the Road management systems currently in use in Kenya are RSIP, RMMS, HDM-4, PMS and GIS. The following Modules associated with RMMS are not used: Network Model, Road Database, Routine and Recurrent Maintenance Module, Periodic Maintenance Module, Budget Split Module, Contract Monitoring Module, Budget Summaries Module, Report and Audit Module and HDM-4 Export Module
- Recommendations towards implementation
    i. Specific AM Policy/Strategy be developed
    ii. Development of Maintenance Standards
    iii. Function-based Road hierarchy system (LOS)

iv. Move RMMS to a server based system (access)
v. Add an AM module to RMMS database
vi. Asset Management plans based on surveys
vii. Development of Human capital
viii. Culture Change

2.6A.2 Road Data Integration challenges by Anthony Kimani

(i) Highlights of the presentation

- A road asset worth a whopping KShs 2.5 trillion and requires to be maintained, improved, protected against loss of asset/value/level of service.
- There are many players and systems requiring and generating large volumes of road asset management data.
- The biggest challenge therefore is to create a robust coordinated and heterogeneous database from diverse sources of Road Agencies' software and equipment and be useful in effective road asset management.

2.6A.3 Overview of Road Maintenance System in use in Kenya by Eng. J. Gakubia

(i) Highlights of the presentation

- Preparation of Work plans, progress and Expenditure reports by the then MOR and KRB was in most cases uncoordinated and resulting in various reports for the same content in different formats for different purpose.
- In 2004 and in an effort to address some of these challenges, MoR, KRB and the Consultants under the SIDA Funded Roads 2000 Nyanza Programme began to formulate a system of compiling the data and producing the required reports in a customised system. This customised system is what over the years has evolved to what is now the RMS.
- The first version of RMS (RMMS 3.0) was rolled out in the former Nyanza Province, currently the Counties of Kisumu, Siaya, Homabay, Kisii and Migori. RMMS was also used in Roads 2000 Central Kenya Phase 1 (AfD).
- KeRRA adopted the RMMS as its Planning, Management and reporting tool for all maintenance works in FY2009/10. KeNHA & KURA started using the system in FY2010/11.
- The system has undergone improvements up to the current version 5.0. There are plans to make the system web based and integrate it with GIS data.
- The following are main structure outputs of current RMS: Road inventory, Road sections, Administrative planning units, Road activities & planning rates, Work Plans, Packaged contracts and details, Progress reports of on-going contracts, Measurements and Payment certificates.
- The current RMS as structured cannot support Needs assessment for the Road Networks, Strategic Planning and Data collection and updating;

2.6A.4 GIS solutions in Road Asset Management by Willy Simmons

(i) Highlights of the presentation

- Integration of GIS can support business functions across an agency works by:
  - i. Integration of different systems together to support the full project and asset lifecycle
  - ii. Enabling fast and easy access to authoritative data and information
  - iii. Enabling insight and data-driven decision making
  - iv. Reducing data duplication, redundancy and errors
  - v. Planning
  - vi. Safety Analysis
  - vii. Executive Dashboards
  - viii. Field Data Collection
  - ix. Asset Management
  - x. Straight Line Diagrams
- GIS as a System of Linear Reference can be illustrated in:
  - i. Collecting data about linear features as point locations along the line as an alternative to expressing the locations using x,y coordinates
  - ii. Linear referencing is the method of storing geographic locations by using relative positions along a measured linear feature
  - iii. Used to record locations as events based on distance measures along linear features
  - iv. Also used to associate multiple sets of attributes to portions of linear features without splitting/ segmenting the underlying lines each time an attribute values change
  - v. Measurements associated with data can be kept current and in sync
  - vi. Data interoperability across the agency is assured
  - vii. Editing of roadway data for non-GIS users via a web browser
  - viii. Sharing across all business units
  - ix. Analyze and report on safety analysis, traffic congestion analysis, and infrastructure maintenance planning
  - x. Workflow management and quality control

(ii) Discussions and Outcomes

- Need to implement RAMS in Road Sector – including PMS, CMS, GIS, decision support tools, and network performance monitoring tools. Proposed road map:
  - Establish a RAMS inter-Ministerial Committee to drive implementation of RAMS and develop strategies and procedures for achieving RAMS
- Monitoring of other structures like bridges need to be considered just like the road carriageway to preserve their asset value.
- With County Governments in place, Road Management System need to be diversified depending on requirement of each level of road classification
- Create a road database center where all data collected and other research carried out can be stored safely to enable retrieval whenever required.

2.6B SESSION 6B: BUILDING CLIMATE RESILIENT INFRASTRUCTURE

2.6B.1 Effective Implementation of Environmental Management Strategies during Road Construction in Kenya. What are the Determinants? By Walter B. Nyatwanga

(i) Highlights of the Presentation

- Environment is intrinsically linked to economic development thus the need for Environmental Management Strategies (EMS) which are environmentally non-degrading, technically appropriate, economically and ecologically viable and socially acceptable.
- Indicators of effective EMS include rehabilitated quarry sites, soil erosion control, re-afforestation and revegetation, dust control, proper solid waste management, and HIV Aids mainstreaming.
- Objective of the study was to find how Project Organizational Structure affects implementation of EMS during road construction.
- Study Design: Descriptive Survey and Qualitative and Quantitative Data
- Findings:
    i. All respondents were men, with two thirds being older than 41 years and with over 15 years of experience
    ii. Environmental Management Plan (EMP) in Road Projects was found to be non-existent. This is mainly attributed to lack of Specialist Staff on site, EMP not being well articulated in the contract and also not being a bill item in the contract.
    iii. Communication channels were found to be efficient

iv. There is inadequate financial allocation for implementation of EMP
v. Delayed payments affect implementation of EMP
vi. All the road projects had EIA License as per requirements of EMCA, 1999.
vii. The sampled road projects undertook Annual Environmental Audits
viii. Most of the respondents had average skills in Environmental Management
ix. Rehabilitation of Quarry Sites, Soil, Water and Noise Pollution Control were found not to be effective.

- Recommendations:
  i. All road projects require full time Environmental and Social Safeguards Specialists
  ii. Include EMS in the BOQs during tendering
  iii. Allocate adequate financial resources in project budget for Environmental Management

(ii) Discussions and Outcomes

- On the issue of Full time Environmentalist on site, best practice was not provided but the presenter noted that it is important to have a full time environmentalist to ensure that environmental issues can be adequately addressed during the life of the project.
- It was noted that EMP assigns responsibilities to ensure compliance to different entities such as the Client, NEMA, Occupational Health and Safety Directorate etc. In case of non-compliance the entities should raise the issue.
- In this paper, punitive measures have been proposed for non-compliance. However, the supervision by some of the agencies e.g. Occupational Health and Safety Directorate, is quite infrequent hence presenting a gap.

2.6B.2 Approach to Climate Strengthening for Low Volume Rural Roads in Myanmar by Dr. J.R Cook

(i) Highlights of the Presentation

- The Challenge is to ensure that the rural roads are made more resilient to climatic threats and impacts and thus reducing the consequent risks to rural development.
- "Best Practice" is not just about immediate physical measures but must be holistic – involving design, construction, and maintenance within a road corridor.
- Climate Strengthening is a logical sequence of procedures within the KfW – Myanmar RIP Framework:

- Impact Assessment includes:
  i. Climate Threats - concentrated rain periods, intense storms, flooding, high winds, Long dry periods, climate change

ii. Road Network Objectives - access for rural population in the project region
iii. Baseline Asset Data - identification of climate-impact hazards and key vulnerable spots
iv. Impact Vulnerabilities

- Adaptation Assessment includes :
  i. Risks assessment - High, moderate and slight
  ii. Asset prioritization
  iii. Adaptation selection for example bitumen sealing, sealed shoulders, lined ditches, concrete pavement at key vulnerable sections etc.
  iv. Capacity assessment
  v. Adaptation design include Slope Resilience Options such as combined geotechnical works and vegetation, retaining walls and surface protection-masonry, concrete, gabion and crib and effective and sustainable side and cross drainage
- Adaptation Implementation includes design modification, Construction, Capacity Development, As-built assessment, Maintenance and Monitoring.
- Best Practice must include Slope Management and Monitoring whereby key high risk areas are regularly inspected and monitored.
- Effective and timely maintenance intervention is as important to climate strengthening as the original design and construction phases.
- Climate strengthening is a valid and necessary intervention provided it is undertaken within a logical selection process of risk assessment and prioritization accompanied by a clear programme of routine and periodic maintenance.

(ii) Discussions and Outcomes

- There is need to have enabling policies on environment and climate resilience and buy-in at top government levels and donors for implementation. At the very start of planning, there has to be budget lines from high levels of government, good policy backing in order to realize the Climate Resilience Options.

2.6 C SESSION 6C: GEOMETRIC STANDARDS FOR LOW VOLUME ROADS

2.6 C.1 A paradigm shift in Geometric Design of Low Volume Rural Roads, By Mike Pinard

(i) Highlights of the Presentation

- The massive demand for Rural Transport Infrastructure (RTI) in the SSA region requires a paradigm shift in geometric design of LVR.
- Proposed design standards should provide adequate service and safety levels on LVRs. However, design should not only be based on AASHTO and ORN 6 (1988) but should be affordable and fit for purpose also catering for variable speeds and non-motorized traffic.
- Proposed basic geometric design standards for LVR:

Road function	Design class	Traffic ADT	Surface type	Roadway width (m)	Passing places
Access	D	100-300	Paved/Unpaved	4.5 – 5.5	As required
	E	20-100	Paved/Unpaved	3.5 - 4.5	As required
	F	<20	Earth/Gravel	3.0 - 3.5	As required

- The proposed design standards should be much more affordable than current LVR design standards and provide adequate service and safety levels when coupled with speed reducing mesures and removal of danger spots.
-

2.6C.2 Road Traffic Injury in Tanzania: Preparation of a district engineers guidance note for motorcycle safety on low volume roads: By George Malekeyo and Tom Bishop

(i) Highlights of the Presentation

- About 90% of rural accidents involve motorcycles and are caused by over speeding, over loading, alcohol and road design.
- Designs should not be too narrow (min 3.8 m) with strengthened shoulders (min 0.5m) and need regular maintenance including storm water management, removal of vegetation and placing road signs.
- Design manuals should always address accessibility with special village treatment for signs, marking and put emphasis on road safety education (behavior change).

2.7 SESSION 7: SITE VISITS TO VARIOUS ONGOING INFRASTRUCTURE PROJECTS

2.7.1 STANDARD GAUGE RAILWAY VISIT

(i) Highlights of the Site Visit

- The site visit commenced at 3p.m. at km 0+000 which is at the port yard with the Resident Engineer (RE) Eng. Mativo briefing the participants. The other stopover was at the intersection with Dongo Kundu Bypass.
- The total length of SGR is 609Km. Construction of the 472Km-long line to Nairobi began in October 2013 and is scheduled to be completed in June 2017. So far 200Km of rail track has been laid. The standard gauge is 1435mm wide as compared to the existing 1000mm wide gauge.
- The Mombasa-Nairobi phase of the project is estimated to cost KES 327bn ($3.27bn). China Exim Bank will provide 90% of the financing while the remaining 10% will be contributed by the Kenyan Government.
- The project is divided into 5 sections with different Resident Engineers for ease of management and to enhance progress but well-coordinated to ensure seamless connectivity.
- SGR project is environmentally conscious and thus has preserved forests and animal movement corridors by providing bridges all through the corridor.
- There will be 2 terminal stations at Nairobi and Mombasa and 7 intermediate stations for passenger access. The passenger train speed is 120Km/hr while that of freight will be 80Km/hr.
- The yard will be reclaimed from the sea using sand due to ease of compaction and environmental concerns. If inadequate, alternative designs with different materials have been provided.
- Bridge beams spanning 32m are constructed in a central place and transported to site while the 64m spanning beams at the intersection with Dongo Kundu bypass are being constructed insitu.
- All piers above 30m height from the ground are hollow.

(ii) Discussions and Outcomes

- There is going to be a railway line from the berths where the ships dock to the railway yard for relaying the cargo to the yard and from the yard to the berths. From the yard onwards, there will be about 16 lines.
- All the designs for trams, terminal and intermediate stations allowed for all facilities to be user friendly to all classes of people including physically challenged. Shops and restaurants in the stations are also well equipped to cater for persons with disabilities.
- Land reclamation as opposed to land acquisition was due to the limited corridor that is being shared with Dongo Kundu Bypass.
- Approximately 30,000 Kenyans are employed at the peak of the works and 6,000 Chinese. Initially this was low due to lack of the necessary skills but training and technology transfers has successfully been done.
- Dongo Kundu bypass intersects with SGR near Mazeras with the rail passing over the road. In Mariakani, there is a link to road A109 for access of the first mile of freight to the terminal. At chainage zero at the yard a road is available also for access of the first mile of freights.
- Initially Road Agencies gave clearances of 5.5m for bridges which was revised to 7.2m and will be effected in all subsequent bridges.
- Although steel sleepers are reusable in case of damage, concrete ones are heavier and more stable and thus withstand heavier loads. In addition steel sleepers are prone to vandalism and corrosion.
- Guardrails are provided in all elevated sections to prevent derailed trains from falling off.
- Compaction is ensured in rock filled sections through proof rolling. Fines are pumped to fill the interstices and proof rolling ensues.

2.7.2 Port Reitz Road

(i) Highlights of the Site Visit

- This project is Design Build (Turnkey Project) using FIDIC Silver Book.
- The scope of works comprise expansion into dual carriageway of a section of Changamwe – Magongo (A109L) Road, Airport Access (C110) Road, Port Reitz Road and Port Reitz Loop. The road project to be improved is 6.4 Km as follows;

Link	Section	Description	Length (Km)
1	Magongo road section	From Changamwe round-about to the Airport Access Road Junction	1.0
2	Airport Access Road	From Magongo road junction to the Airport round about	2.0
3	Port Reitz Road Including Port Reitz Road loop	From Airport Access road junction to the Port Reitz Hospital Gate	3.4
Total Length of Project			**6.4Km**

The total project cost is Ksh. 5.1 billion comprising Ksh. 2.8 billion for works and Ksh. 2.3bn for land acquisition and services relocation.

- Progress of works is at 20% while time elapsed is 60% and the delay is due to land acquisition and relocation of services.
- Challenges and lessons learnt:
  - (i) Lack of full possession of site by the Contractor;
    The Contractor is yet to fully possess site due to delayed land acquisition and relocation of services, this is likely to delay the project completion date.
    The lesson learnt is that the Contractor to be given possession of site after acquisition of land and relocation of services have been concluded.
  - (ii) Delayed release of funds for land acquisition and relocation of services by the exchequer.
  - (iii) Right to vary: Employer is limited on right to vary the scope of works (Toyo Junction) since the Contract Sum does not have provisions for both physical and price contingencies – fixed contract price

The lesson learnt is that during contract negotiations, Employers' requirements should be made clear and well agreed upon to mitigate on inevitable variations.

(ii) Discussions and Outcomes

- The role of Assistant Employer's Representative in the project is contract administration and quality acceptance
- Mitigation against claims and delays in land acquisition.
  At the moment the employer has identified areas of temporary relocations along Magongo section where the contractor has made good progress in construction of retaining walls. For other sections where up to date there has been lack of full possession of site the contractor will submit claims based on contract provision and the client will make a determination.

2.7.3 DONGO KUNDU BYPASS

(i) **Highlights of the site visit**

- The Project is in three packages: Package 1 from Miritini Junction – Mwache Junction and Kipevu Link Road (10.1km) already commenced; Package 2 from Mwache Junction to Mteza including Mteza bridge (8.96km); Package 3 from Mteza to Kibundani junction (6.86km) including right turn viaduct.
- The project includes construction of a weighbridge to capture freight traffic from the Mombasa port, major bridges and viaducts and runs parallel to the Standard Gauge Railway (SGR) and links to the Proposed Mombasa Free Trade Area.
- The project provides the much needed links to the South coast from Mombasa Island and seamless connectivity between the port and SGR. South coast is currently served by the inconveniencing Likoni Ferry Services.

2.7.4 KENYA PORTS AUTHORITY

(i) Highlights of the site visit

- The team visited the first (existing) and second (new) container terminals to understand and appreciate the port infrastructure development.
- The second container terminal is under construction. The terminal will be developed on approximately 100 hectares land that will be reclaimed from the ocean and 3 No berths will be constructed measuring 230m, 320m and 350m long with a depth of approximately 15m below the sea level.
- The port infrastructure developments include integration of ISS with other systems, paving of yards, new modern and computerized equipment (reach stackers, rubber tyred gantries, terminal tractors and container handlers), among others.
- The capacity is estimated at 1.2 million Twenty Equivalent Units (TEUs) annually. The challenge for KPA will be looking for containers to utilize the additional container terminals.
- Phase one of the project is approximately over 80% complete and is estimated at 26 billion, handover will be done by end of March 2016. The Kenya Ports Authority and the Japan International Cooperation Agency have signed an agreement for the funding of Phase two of the second container terminal that will cost approximately 24 billion.
- Other proposed expansions and developments at the port include:
  - (i) Developments of Free Trade Zones, special economic zones and the by-pass road
  - (ii) Integration of the port development with the corridor development
  - (iii) Relocation of the Kipevu Oil Terminal - construction of a new modern oil terminal to replace the current Kipevu Oil Terminal.
  - (iv) Development of ultra-modern cruise terminal
  - (v) Dredging project – Phase II
  - (vi) Development of satellite projects along the coastline
  - (vii) Construction of the first three berths of Lamu Port

2.8 SESSION 8: TRANSPORT SERVICES

2.8.1 Scaling up trail bridge technology: a cost-effective way to enhance access for millions of people in remote areas by HELVETAS (Ms. Agnes Montangero)

(i) Highlights of the Presentation

- This paper deals with rural access using trail bridges and was first introduced in Switzerland by Helvetas NGO in 1950s. The aim of this presentation is to share experiences of Nepal, Ethiopia and Burundi which are the pioneer countries to have carried out successful pilot trail bridges.
- Trail bridges enable safe crossing by rural communities in difficult terrains such as rivers and hilly/ mountainous topography and are used mainly by pedestrians, cyclists, handcarts and animals.
- In Nepal, trail bridge technology has been introduced in the training curriculum of education institutions. It can be transferred to communities and they build the trail bridges themselves
- Helvetas are ready to collaborate with the rest of the world in sharing this technology to assist rural communities cross difficult terrains in their countryside as they go on with their daily activities.

2.8.2 Addressing First Mile Transport Challenges for Smallholder Farmers by Grace Nyambura

(i) Highlights of the Presentation

- The first mile is typically the segment of transport that links the farmers to the nearest motorable rural road or a produce collection point. While we figuratively call this distance the first mile, in actual terms it can range from 0.25km to 5km.
- Communities have many small scale farmers who rely on sale of farm produce to meet their subsistence needs. They also do not have other sources of income

- Most of the produce starts getting spoilt due to lack of transport to the nearest selling point hence leaving them at the mercy of brokers who dictate the buying price.
    (i) There is lack of multi-sectoral planning and policy innovation
    (ii) Recommendations include:
    (iii) Ensuring all weather motor vehicle access for rural roads going into strategic small holder farming areas.
    (iv) Since it is often uneconomical for transporters/traders to collect produce from each individual farm, there is need to develop designated low cost roadside sheds where farmers can assemble and consolidate their produce for collection.

2.8.3 Tanzania Motorcycle rider training: assessment and development of appropriate training curriculum by Caroline Barber

(i) Highlights of the Presentation

- The research objectives were to review current training available for motorcycle riders in Tanzania, work closely with key stakeholders and recommend for a new training curriculum with particular consideration to boda boda riders.
- The Key Findings include
    (i) Very little motorcycle training material available
    (ii) Only two institutions had developed curricula
    (iii) Two more institutions used generic materials used for car driver training
    (iv) No common standard and a significant variance from institution to institution

- Developing the curriculum involved:
    (i) Good practice identified from existing material in Tanzania
    (ii) Further developed by key stakeholders - innovation in the participatory approach
    (iii) Excellent support from SUMATRA, Traffic Police, National Institute of Transport, HelpAge, Amend, ITC (Zambia), etc.
    (iv) Draft curriculum then validated during workshops in late February and March 2015
- The desired Curriculum Outcomes on completion of training include:
    (i) Riding the motorcycle safely and responsibly
    (ii) Carrying passengers safely
    (iii) Ensuring the motorcycle is in a roadworthy condition
    (iv) Complying with Road Traffic Acts and other road safety regulations,
    (v) Complying with all road signs, signals & markings,
    (vi) Delivering good Customer Care
- The Current Status in the development of a new training curriculum is as follows:
    (i) A standard curriculum was developed in 2015 – now needs full implementation
    (ii) SUMATRA is translating the curriculum into Swahili and has been championing adoption
    (iii) SUMATRA organised a national launch event on 1st March 2016

(ii) Discussions and Outcomes

- Training and curriculum development for motorcycle riders be introduced in all countries and disseminated to all riders together with licensing
- Safety gear protection be included in the training curriculum

2.8.4 Labour Based LVSRs implementation: A case study of AFD/ GOK -R2000 Central Kenya project by Henry Orwa

(i) Highlights of the Presentation

- Project seeks to address the challenge of our Rural Roads Network both in design, rational in choice of construction methods, implementation of labour based procedures and maintenance strategy.
- Most rural roads are earth (78 %). They have high maintenance cost and yet are relied on for agriculture. Most have traffic less than 200 vehicles per day.
- There is a high rate of unemployment (70% of the population). The chosen Labour Based Technology (LBT) approach is "pro poor" and it creates significant employment for the local communities living along the roads.
- The current classification for low volume roads (T5) is too wide and hence the reclassification to T5-0 to T5-4 to take care of areas with very little traffic.
- Good gravel is diminishing and where available very costly which also needs to be protected by sealing LVRs.
- LBT also referred to as community based approach is not exclusively labour based but also gives construction methodology for both equipment (quarry excavation, haulage, sub-grade formation) and hand (Site clearance, Drainage works, Emulsion stabilized Material Base and Cold Mix Asphalt surfacing).
- The challenges include:
  - (i) LBT approach requires intensive supervision
  - (ii) Lending rates too high for small scale contractors (costs 25 – 30 million per km)
  - (iii) Slow productivity – on average 1km of completed road per month
  - (iv) Difficulty in enforcing axle road compliance
- The requirements for the implementation of the approach are
  - (i) Appropriate design,
  - (ii) Capacity building for both managers and workers,
  - (iii) intensive supervision,
  - (iv) Maintenance funds

(ii) Discussions and Outcomes

- For a contractor to qualify to bid for LVSRs, they must have attended the relevant training at KIHBT
- The surfacing allows use of emulsions (cold mix asphalt) which have good workability to achieve homogeneity through use of pans.
- Many cross cutting issues (health, gender, environment, employment and road safety) are also addressed.
- Labour based technology in construction be balanced with machine based so that there is a hybrid system of implementing LVSR
- Access roads from small-scale farmers should be done through community based approach using locally available materials but with a well-structured engineering input.

2.8.5 The benefits and challenges of increasing motorcycle use for rural access by Paul Starkey

(i) Highlights of the Presentation

- Motorcycle taxi numbers have increased greatly in many countries in recent years. In Tanzania motorcycle

numbers increased from about 2,000 in 2003 to over 800,000 in 2014.

- Motorcycles are often the commonest means of rural transport. However, they are not common in Southern Africa. Their contribution to transport and development is often rated very highly by people.
- Motorcycles often contribute over 75% of annual passenger market and annual small freight on rural roads. However, they are much more expensive than other transport services (often +50-100%).
- People use motorcycle taxis because they are timelier, convenient (point to point), no alternatives, complement 'conventional' transport services and do not compete directly.
- Risky Areas of motorcycles include behaviour of other road users (drivers, pedestrians, animals), overloading, often operated by risk-taking young men, lack of safety gear and instability when balance is impaired (by potholes, loads, speed, knocks or alcohol).
- The common regulatory problems include:
  - (i) Lack of driving licenses and knowledge of the 'highway code'
  - (ii) Lack of motorcycles registration and road tax
  - (iii) Lack of insurance
  - (iv) Lack of helmets for drivers and passengers
  - (v) Over-loading (multiple passengers and freight)
  - (vi) Risky driving (speed, alcohol, substance abuse)
  - (vii) Motorcycle-based crimes
- Some regulatory options include:
  - (i) Make motorcycle taxis illegal (eg, Ghana, China) [but continues unofficially and often fuels petty corruption of enforcement officials]
  - (ii) Make legal with enforced safety (eg, Rwanda) [Can work in towns
  - (iii) Facilitate self-regulation using operator associations
  - (iv) Encourage 'community enforcement' at local level
  - (v) If motorcycle taxis are banned, what are the alternatives? Better transport services? Three-wheelers?

(ii) Discussions and Outcomes

- Most Motorcycle accidents happen in urban areas and should be discouraged from operating in such areas
- Legislation and enforcement need to be hastened for effective management of motorcycle operation
- School children should not be allowed to use motorcycles as a means of transport to and from schools
- Introduce an integrated intermodal transport system between motorcycles and other modes of public transport.

2.9A SESSION 9A: GENDER MAINSTREAMING IN THE TRANSPORT SECTOR

(i) Highlights of the Presentation

- Gender Mainstreaming means changing gender imbalance in a way that gender relations are transformed and women are empowered.
- Panelists responded to the following questions posed by the Moderator:
- (a) How has gender mainstreaming contributed to transforming gender relations and women's lives?
  - (i) Improvement of economic empowerment of women
  - (ii) Additional income for women
  - (iii) Encouraged women to participate in community decision making meetings
  - (iv) Has encouraged girls to undertake studies in sectors previously reserved for men
- (b) How has gender mainstreaming transformed the institutions that deliver infrastructure and/or rural transport services?
  - (i) Institutions in Kenya have embraced the 1/3 gender rule which dictates that at least 30% of a particular gender must be represented in the work force
  - (ii) Presently, women participate in decision making in institutions. However, they are still under-represented.

- (c) How can we scale up the success stories?
  - (i) Organize trainings / capacity building programmes for women
  - (ii) Development of more policies which encourage empowerment of either gender
  - (iii) More research on the challenges that affect women in their professions and development of solutions to these challenges
  - (iv) Regulation of boda boda which has tremendously impacted on the lives of women in a positive way to make them more safe, reliable and affordable
  - (v) Encourage women to form groups / societies so that their demands can be articulated
  - (vi) Ensure effective implementation of policies already developed
  - (vii) Development of mentorship programmes and business incubation for emerging women consultants and contractors.
- (d) What indicators can we use to assess the success of gender mainstreaming and its impact?
  - (i) Data collection in terms of numbers from both private and public sectors to assess the number of people who have benefitted from gender main streaming programmes
  - (ii) Assessment of the level of poverty/ Socio-economic surveys before and after implementation of the programmes

(ii) Discussions and Outcomes

- Cultural and religious barriers discourage women from undertaking highly technical fields or heavily manual work which are perceived by the society to be more suitable for men. However, within the construction industry there are activities that can be carried out by women.
- It was clarified that that women empowerment does not lead to negative effects such as alcoholism/ idleness by men particularly in Central region in Kenya. Gender Mainstreaming is a policy to encourage more participation by the "weaker" sex and currently in Transport sector, women are underrepresented.
- More research needs to be carried out to determine why fewer women as compared to men undertake professional engineering registration in Kenya and where the women who do not undertake registration go.
- Noting that it will not be possible to transform lives without the full involvement by both men and women, it was recommended that more research on the challenges faced by women in Transport Sector needs to be carried out.

2.9B SESSION 9B: TRANSPORT AND SAFETY

2.9B.1 Effect of Fatigue on Driving: A Case Study in Cape Metropolis by Dr. Ogunleye-Adetona

(i) Highlights of the Presentation

- Road accidents are the 8th killer in Ghana and rates of both fatalities and injuries are increasing;
- Factors causing accident can be environmental, technical or vehicle related and human factors. Human factors account for between 70% - 90%;
- Causes of fatigue include long working hours, insufficient sleep, long stress periods and boredom. It affects the human elements of reaction time, loss of focus, veering off lanes, delays in reaction time, road rage.
- Conclusions include:
    i) There is a relationship between fatigue and accidents
    ii) Fatigue due to own making factors
    iii) Drivers are also aware of consequences of fatigue

2.9B.2 An Assessment of Non-motorized and Public Transport Challenges for People with Disabilities in Nairobi City by Paul Owino Odak

(i) Highlights of the Presentation

- Mobility is also about social, political and economic factors
- 4.6% of Kenyans live with disability as at 2007. Availability and access of transport to PWD affects modal choice, travels times during the day, places of living to be reduce on travel times.
- Of the Total majority of 42% of PWDs who travel to their workplaces, 21% proportion travel by walking while about 12% of them use tricycle. This is also true for the school goers where a proportion of about 10% travel by walking.
- Some footbridges have no ramps for wheel chair users, bollards placed at entry points with less than 0.5m meters wide opening hence not adequate for entry, steep ramps.
- Public transport vehicles have accessibility problems on entry and the buses have no special seats for PWDs.
- Recommendations include:
    i) Urban designs should incorporate PWD in all aspects
    ii) Revise KS 372 -2011 to incorporate PWDs considerations
    iii) Revise and streamline all transport policies and legislations to organize public transport systems in major cities.
    iv) Even in absence of laws, designs should be done using engineering best practices
    v) Enact laws for prevention of violation of NMT facilities by other modes
    vi) Provision of PWD facilities can be implemented and added in designs at minimal costs.

2.9B.3 Linking Knowledge and Practice: A Case of Boda Boda Motorcycle Safety in Kenya by Dr. Gladys M. M. Nyachieo

(i) Highlights of the Presentation

- Large increase in numbers after zero-rating of all motorcycles below 250cc in 2008. From 6,250 in 2006 to 140,215 in 2010. Other reasons are inability of current transport system to fully meet the commuters' transportation needs, high levels of unemployment among the youth and entry into the boda boda business is very easy.
- There is lack of documented information on motorcyclists formally trained despite the increasing cases of motorcycle accidents among boda boda riders. Formal rider training leads to acquisition of riding skills and safety knowledge.
- Where formal training for riders is low, there is no adequate road safety information available
- An interview schedule was used to collect data from the 370 riders. Additional information was obtained through Focus Group Discussions (FGDs) and key informant interviews (KIIs)
- 62% trained, 38% untrained. 66.5%, 29.2% and 4.3% with low, moderate and high safety knowledge respectively.
- Inadequate motorcycle safety knowledge has implications to the general safety of riders and their passengers.
- The recommendations include:
    i) Improving rider skills and motorcycle safety knowledge through introduction of rider specific government subsidized riding schools.
    ii) NTSA and other stakeholders concerned with road safety to promote motorcycle safety education and awareness.
    iii) NTSA to ensure a standard training manual for all schools offering rider training.

2.9C SESSION 9C: TRAFFIC MANAGEMENT

2.9C.1 Enhancing mobility in Kenyan counties through strategic policy formulation by Dr. Romanus Opiyo

(i) Highlights of the Presentation

- The focus of most African countries is to reduce infrastructure gap. However, most countries do not have good policies which are essential in ensuring good infrastructure and use of the same.
- A key emphasis is laid on the County Governments in Kenya as they are the primary development areas for the country. We ask ourselves what informs provisions, services and management of transport infrastructure at County level.
- Various policy documents that impact on transportation were reviewed including Constitution, Kenya Roads Act 2007, KRB Act, NTSA Act etc.
- Findings from the study include:
    i) Most counties are yet to formulate transport policies and still rely on existing by laws
    ii) Interventions in place usually neglect rural areas.
    iii) There is poor linkage of land use plans with transport projects.
    iv) The National Government has good existing legal framework.
    v) County Governments are key in transforming livelihoods.
- Formulation of good transport policies will have a critical role in transformation of livelihoods of Kenyans through provision of well managed transport systems as well as enhancing county and inter county mobility and accessibility.

(ii) Discussions and Outcomes

- The Counties should guarantee job security for all professionals and offer attractive packages in order to attract and retain staff.
- The counties should integrate their policies with those of the National Government.
- There is a proposal to enact a law in which all County elected leaders meet a minimum academic qualification of degree in order to enhance informed decision making and policy formulation.
- Counties should adopt a participatory approach in policy formulation with key emphasis on strategic environmental analysis.

2.9C.2 Potentials of GNSS and GSM technology in road traffic and speed management in Kenya by Mr. Charles Kigen

(i) Highlights of the Presentation

- Road transport is critical in every country and more so road safety. Poor road safety results to death, injuries and loss of properties.
- Speed deterrence is achieved through various ways including speed enforcement on busy roads, random police checks, public awareness etc. In Kenya there are speed cameras, stationery enforcement, speed bumps, rumble strips, penalties among others put in place to curb speeding.
- Challenges of speed management in Kenya include lack of public support, lack of enhancement personnel, speed limiters manipulation, corruption etc.
- Available accident statistics in Kenya depict a worrying trend with many lives being lost and serious injuries suffered from year to year. Road safety can be improved through application of GNSS and GSM technology.
- A GPS system is fitted in the vehicle to capture vehicle details, location, time, speed and relay to a server connected to internet for transmission to any part of the world. An automatic SMS is also generated and sent to relevant authorities/regulators.
- Benefits of GNSS and GSM System include speed deterrence, functions round the clock, not subjective, requires less personnel, keeps vehicle maintenance records and transmits emergency information instantly through the system.
- More consultations should be done towards system adoption in Kenya for road safety management.

(ii) Discussions and Outcomes

- NTSA is charged with the mandate of road safety in Kenya and should spearhead the sensitization of road users on safety.
- There is no policy is in place governing erection of speed control bumps. Designs of highways should incorporate NMT facilities to enhance safety.
- Speed management is a behavioral challenge in Kenya and thus effective sensitization should be effected in order to realize good results.


ITRARR
INTERNATIONAL TRANSPORT AND ROAD RESEARCH CONFERENCE & EXHIBITION 2018
ITRARR

3. SUMMARY OF KEY ISSUES AND CONFERENCE RECOMMENDATIONS

The following were the key issues and recommendations from the conference:

1. Enhance knowledge management, dissemination and uptake of transport research in the region through establishment of knowledge base center for collating and dissemination of research findings based on best practices from other parts of the world.
2. A multi-sectoral approach to transport and road research to fast track innovation, research findings dissemination and uptake and for ease of coordination and collaboration with stakeholders in the Industry, Academia and research Institutions.
3. Enhance stakeholder participation in fund allocation for transport infrastructure to ensure buy-in particularly by use of Multi-criteria Analysis approach. Research should come up with innovative and sustainable ways to finance development and maintenance of infrastructure projects to close the huge funding gap by use of tools like HDM4 to justify increase in road user charges like road maintenance levies
4. Encourage community participation in implementation of projects and programs in the Transport sector. Transport Projects' development are multi-disciplinary undertakings requiring extensive consultations to realize the end product – these must be coordinated and the public sensitized in order to understand, support and own the project.
5. Build capacity for Road Asset Management in the Road Agencies in Sub Sahara Africa region
6. Further research on transport safety and security to come up with effective and innovative solutions to address region and national challenges including traffic congestion, poor connectivity of various transport modes, lack of efficient public transport systems, rising costs and scarcity of construction materials, dilapidated railway network, inadequate capacity of the port to handle increasing cargo and effects of climate change
7. Enhance research on alternative new materials such as Hydraulic Road Binders (HRBs). Field trials to evaluate the efficacy of Hydraulic Road Binders in stabilization of pavement layers in order to guide the review of the current specifications
8. Promote organized public transport systems in the major cities in the SSA region
9. Promote regional research fora
10. Promote gender mainstreaming in the Transport Sector.
11. Promote and encourage young researchers
12. Enhance coordination of research and dissemination of research findings, it is recommended that iTRARR is held every two years.

4. ANNEXES

ANNEX 4.1	-	*LIST OF ATTENDANCE*
ANNEX 4.2	-	*CONFERENCE PROGRAMME*
ANNEX 4.3	-	*CONFERENCE PLENARY ABSTRACTS*
ANNEX 4.4	-	*LIST OF EXHIBITORS AND SPONSORS*
ANNEX 4.5	-	*LIST OF JOC MEMBERS AND RAPPORTEURS*

4.1 LIST OF ATTENDANCE

The total number of participants in the conference were 223 including 39 presenters. The lists of attendance and group photo below.

Name	Organisation	Country
Caroline Visser	ReCAP - PMU	Netherlands
Gerome Rich	ReCAP - PMU	UK
Leslie Roy Sampson	ReCAP - PMU	UK
Jasper Russell Cook	ReCAP - PMU	UK
Paul Henry Starkey	ReCAP - PMU	UK
Chandra Bahadur Shrestha	ReCAP - PMU	Nepal
Edson Madeira	ReCAP - PMU	Mozambique
Paulina Agyekum	ReCAP - PMU	Ghana
Nkululeko Leta	ReCAP - PMU	SA
Caroline Barber	Transaid	UK
Granie R Jayanlath	Road Development Authority	Sri Lanka
Alemgena A. Araya	Alert Engineering	Ethiopia
FELEKE, Gebremariam Gebresilassie	Mekelle University	Ethiopia
Gebre, Daniel Hagos	Mekelle University	Ethiopia
Monzur Sadeque	LGED	Bangladesh
Dr. J.B. Koranteng-Yorke		Ghana
Prof Jennaro Odoki,		UGANDA
Matheka, Duncan	Amend / Machakos Level 5 Hospital	Kenya
Malekela, George	Amend	Tanzania
Bishop, Tom	Amend	Tanzania
Priyanthi Fernando		Sri Lanka
Mark Rubarenzya	Uganda National Roads Authority	Uganda
Philip Marlow	AFCAP	South Sudan
Alemayehu Endale	ARTReF	Ethiopia
Actor Zonde	ARTReF	Zimbabwe
Jeremiah Bairiak	ARTReF	South Sudan


Kenya Airways
The Pride of Africa


5Y-KZD

Name	Organisation	Country
Ignasio Ngoma	ARTReF	Malawi
Adewole Oladele	ARTReF	Botswana
Francis Afukaar	ARTReF	Ghana
Omange George	ARTReF	Nigeria
Benoit Verhaeghe	ARTReF	South Africa
Kerstin Urban	ARTReF	Namibia
Hilario Tayob	ARTReF	Mozambique
Thomson Banda	ARTReF	Zambia
Tamba Amara	ARTReF	Sierra Leone
Mrs Jun Hada		Nepal
Dr. Ogunleye Adetona		Ghana
Mervyn Henderson	Roughton	South Africa
Azni November	Roughton	South Africa
Camilla Lema	Roughton	South Africa
Michael Pinard	Roughton	South Africa
Robert Geddes	Roughton	South Africa
Kingstone Gongerah	Roughton	South Africa
Charles Bopoto	Roughton	South Africa
Simon Gillet	Roughton	South Africa
Michael Burrow	Roughton	South Africa
Akram Ahmedi	Roughton	South Africa
Gurmel Ghataora	Roughton	Kenya
Eng. C. T. Wanjohi	Ag. GM	Kenya
Eng. J. K. Mwangi	Manager - PALWECO	Kenya
Mr. Hillary O. Akwiri	Engineer - AfD/AFCAP	Kenya
Mr. Nicholas Kibe	Senior Transport Economist	Kenya
Mr. Kenneth Wando	Manager - Survey	Kenya
Eng. S. M. Kathindai	Manager - Materials	Kenya
Eng. K. O. Nyakuti	Manager - Design	Kenya
Eng. Sayo Mbavu	Sn. Engineer - Structures	Kenya
Ms. Angela Murigi	Engineer - Construction	Kenya
Mr. Walter O. Nyariki	Engineer - Design	Kenya

Name	Organisation	Country
Mr. Robert Mule	Engineer - Maintenance	Kenya
Eng. B. M . Masila	RM - Kilifi	Kenya
Eng. A. N. Ndunda	RM - Machakos	Kenya
Eng. E. W. Mwangi	Ag. RM - Nyamira	Kenya
Ms. Angela Odera	Engineer - Maintenance	Kenya
Mr. Pius Nyamila	KIHBT	Kenya
Mr. James M. Manyara	Resident Instructor - KIHBT	Kenya
Eng. Onchoka Ontomwa	KIHBT Nairobi	Kenya
Peter Ngamau	KIHBT Nairobi	Kenya
Benard Ngugi	KIHBT Nairobi	Kenya
Caroline Kamunya	KIHBT Nairobi	Kenya
Willy Simons	ESRI	Kenya
Irene Opondo	ESRI Account Manager	Kenya
Eng. Caren Oyola	Senior Engineer	Kenya
Richard Kyalo		Kenya
Eng. Anthony Mwai	Regional Manager	Kenya
Eng. Mike Gumbi	Regional Manager	Kenya
Eng. Endelinah E. Kaimuri	Senior Engineer	Kenya
Eng. Edwin Limo	Regional Manager	Kenya
Eng. Onesmus Kemoi	Regional Manager	Kenya
Eng. Benjamin Asin	Senior Engineer	Kenya
Eng. W. R. Oginga	Manager (D&C)	Kenya
Eng. Priscilla J. Ng'etich	Senior Engineer	Kenya
Eng. Merin Koitalek	Senior Engineer	Kenya
Jenniffer Korir	Engineer	Kenya
John Cheboi	CCCO	Kenya
Paul Mose		Kenya
Richard Yagan	Engineer	Kenya
Ms. Rita Kavashe		Kenya
Eng. Jacob Ruwa	KRB	Kenya
Eng. Stephen Ndinika	KRB	Kenya
Mrs. Ruth Bita	KRB	Kenya

Name	Organisation	Country
Ms. Lucy Gathika	KRB	Kenya
Mr. Rashid Mohamed	KRB	Kenya
Mr. Michael Karanja	KRB	Kenya
Eng. Benjamin Maingi	KRB	Kenya
Eng. S Kogi	MTRD	Kenya
Eng. Margaret Ogai	KRB	Kenya
Eng. Joakim Mbarua	MTRD	Kenya
Eng. Wilson Kosgey	KRB	Kenya
Mr. Abdallah Kulah	MTRD	Kenya
George Juma	KRB	Kenya
Eng. Hudson Kihumba	KRB	Kenya
Eng. David Orwenyo	KRB	Kenya
George Waithaka	KRB	Kenya
CPA Margaret Muinde	KRB	Kenya
Paul Kibet	KRB	Kenya
Goddfrey Njeru	KRB	Kenya
William Ong'ondi	KRB	Kenya
Eng. Victor Odiwuor	KRB	Kenya
Eng. Tom Omai	KRB	Kenya
Eng. Susan A. Owuor	KRB	Kenya
Eng. Rose Ng'ang'a	KRB	Kenya
Martin Agumbi	KRB	Kenya
Anthony Kimani	KRB	Kenya
Livingstone Karanja	KRB	Kenya
Nelson Nyamao	KRB	Kenya
Christine Akinyi	KRB	Kenya
Grace Nyambura Muhia	IFRTD	Kenya
Albert Ndege	MTRD- MOTI	Kenya
Walter B. Nyatwanga	KeNHA	Kenya
Dr. Eustace Mwarania	TRAPOS	Kenya
Paul Owino Odak	KURA - Senior Surveyor	Kenya
Dr. Romanus Opiyo		Kenya

Name	Organisation	Country
Dr. Gladys Moraa Nyachieo	Kenyatta University Lecturer	Kenya
Charles Kigen	Moi University	Kenya
Winnie Mitullah	University of Nairobi	Kenya
Eng. Julius Gakubia	KeRRA	Kenya
Anthony Kamaka		Kenya
Phillip J. Mainga	Kenya Railways	Kenya
Eng. Francis Gitau	MOTI	Kenya
Eng. Hillary Cherop	MTRD	Kenya
Eng. Julius Musakala	MTRD	Kenya
Henry Orwa	Norken International	Kenya
Eng. Tom Opiyo	ITEC Engineering	Kenya
Eng. Rosemary Kungu	IEK Council Member	kenya
Eng. Jane Mutulili	Women Engineers Chapter	Kenya
Eng. Emelda Odhiambo	Women Engineers Chapter	Kenya
Huldah Chepkoech Rotich	JKUAT	kenya
Alfred Muiruri Kimani	JKUAT	kenya
Maureen Nkirote Nturibi	JKUAT	kenya
Lydia Pauline Kariuki	University of Nairobi	kenya
Kinisu A. Colin S.	University of Nairobi	kenya
Brian Mwenda Njue	University of Nairobi	kenya
Maxwell Wachira	University of Nairobi	kenya
Joyce Munuve	University of Nairobi	kenya
Kelvin Mwanzia	Moi University	kenya
Teresia Wanjiru Njoki	Moi University	kenya
Roy Kiprop Korir	Moi University	kenya
Mahat Abdikadir Ludir Luqman	Technical University of Mombasa	Kenya
Eng. K. O. Nyabuto	KENHA	kenya
Eng. J. K. Kaburia	KENHA	kenya
Eng. Ngala Achieng	KENHA	kenya
Raphael Korir	KENHA	kenya
Eng. Monica A. Abonyo	KENHA	kenya

Name	Organisation	Country
Julius K. Giti	KENHA	kenya
Paul Washiali	KeNHA (South Rift)	Kenya
John Mwiti Mbae	KeNHA Ass. Eng	Kenya
Eng. Howard A. M'Mayi	KeNHA	Kenya
Eng. Protas Murunga	Norken International	kenya
Benard Koskei	Bamburi Cement	kenya
Fidelis Sakwa	Bamburi Cement	kenya
David Mathu	NCA -Research &Business	kenya
Eng. Stephen Nyangau	NCA	kenya
Mr. Paul Kere	Ministry of Environment	Kenya
Mr. Evans Kirwa	NatConsult Engineers Ltd	Kenya
Norman Muraya	LAPPSET	Kenya
Niraj Acharya	Trail Bridges	Nepal
Bhagat Bista	Trail Bridges	Nepal
Alem Shumiye	HELVETAS Swiss Intercooperation	Ethiopia
Serge Sindimwo	Trail Bridges	Burundi
Georges Hakizimana	Trail Bridges	Burundi
Agnes Montangero	Trail Bridges	Switzerland
Isabel Baier	Trail Bridges	Switzerland
Mr. Kennedy Kamumbu	Kiambu County	Kenya
Mr. John Wachira	Kiambu County	Kenya
Eng. Lukas Wahinya	Kiambu County	Kenya
Mr. Joshua Kinoti Irea	Kinconsult	Kenya
Mr. Peter Otaya Nalyanya	Kinconsult	Kenya
Gideon Saburi	Chairman - Technical University of Kenya	
Eng. Butichi Ramadhan	KAA - Isiolo Resident Eng.	Kenya
Mr. Joseph Ndungu	Economist I	Kenya
Comm. Simon Joni Ndubai	Vice Chairman	Kenya
Ernest Kwame Obeng	Director, Ministry of R & Highways	Ghana
Eng. Peter Kosgey	Kericho County	Kenya
Mr. Maurice odera		
Ithana, Taapopi	Namibia Roads Authority	Namibia

Name	Organisation	Country
Johana Kipkorir Cheruiyot	Narok County	Kenya
Robert Ndumia	Nyandarua County	Kenya
Maurice Sande Odera	Private Consultant	Kenya
Mr. Eliud Ochieng	C.E.C Transport & Inf. Homa Bay County	Kenya
Eng. Christopher Muhande	Mombasa Southern Bypass Project	Kenya
Ms. Stella Jane	Parkside Road Safety Awareness	Kenya
Eng. Alfred Masha Nyanje	KPA	Kenya
Josiah Korir	C.E.C Nandi County	Kenya
Eng. Alex Buigut	Nandi County	Kenya
Deribachew Mezgebu	Ethiopia Roads Authority	Ethiopia
George Ogutu	MTRD	Kenya
Peter Makau	MTRD	Kenya
Tom Odhiambo	MTRD	Kenya
Caroline Wamai	MTRD	Kenya
Christine Nzai	MTRD	Kenya
Rebecca Angwenyi	MTRD	Kenya
Eric Omoro	MTRD	Kenya
Waweru Mutuiri	MTRD	Kenya
Eng. Joseph Wanjohi	MTRD	Kenya
Flora Nyaga	MTRD - Mbs	Kenya
Eng. Charles M. Muriuki	MTRD	Kenya
Benard Masiga	MOTI	Kenya
Eng. Gabriel Kamau	Muranga County	Kenya
Craven Naidoo	Bentley Systems	Kenya
Hanif Rana	Kisumu County	Kenya
Samuel Ondola	Kisumu County	Kenya
Eng. George O. Juma	Kisumu County	Kenya
Arch. Ojwang Benard	Kisumu County	Kenya
Mungeria Kirimania	Kiri Consult Ltd	Kenya
Samuel Ongoncho	Kisii County	Kenya
Anthony Kiarie	Crown Paints	Kenya
Benard Shumba	Crown Paints	Kenya

Name	Organisation	Country
Grace Ocholla	Co-op Bank	Kenya
Mark M. Mwongera	Co-op Bank	Kenya
Godfrey Ang'weya	Co-op Bank	Kenya
M. Maywo	SGR	Kenya
Deanne Tonui	SGR	Kenya
Maryanne Wanjiku	SGR	Kenya

4.2. CONFERENCE PROGRAMME

TIME	
14:00 – 18:00	**Monday 14th March 2016: Registration of Delegates and issuing of conference materials**
	DAY 1: Tuesday 15th March 2016
08:00 – 9:00	Registration and Exhibition official opening
09:00– 10:30	**Plenary Session 1: Conference Official Opening** **Venue: MAKUTANO AMPHITHEATRE** Session Chair: Eng. P.C. Kilimo ▪ **Overview of TRARR Conference Arrangements** by Eng. Benjamin Maingi, Joint Organizing Committee ▪ **Brief Statements by Main Sponsors: World Bank, Bamburi Cement, Cooperative Bank** ▪ **Introduction to Research and Community Access Partnership** by Mr. Jerome Rich, Project Director, ReCAP ▪ **State of Transport Research and Knowledge in Sub-Sahara Africa and brief on African Roads and Transport Research Forum (ARTReF)** by Eng. S. Kogi, Chief Engineer Materials, MoTIHUD ▪ **Financing options for Road Infrastructure provision** by Eng. Jacob Ruwa, Executive Director, KRB ▪ **Provision of transport infrastructure in the region: Opportunities and Challenges** by Eng. John Mosonik, Principal Secretary, MoTIHUD ▪ **Welcome Address** by Hon. H. Joho, Governor of Mombasa County ▪ **Official opening of the Conference** by Hon. James W. Macharia, Cabinet Secretary, MoTIHUD
10:30 – 11:00	Group Photograph, Networking coffee break and exhibition tour
11:00 – 12:50	**Plenary Session 2: Policies and strategies for effective Road Asset Management** **Venue: MAKUTANO AMPHITHEATRE** Session Chair: Eng. P. Mundinia, Director General, KeNHA ▪ **Addressing the Road Maintenance Challenge in Africa: What can we do to solve this continuing problem?** By M.I. Pinard ▪ **Development of optimal road maintenance fund allocation framework** by Jennaro B. Odoki and Michael M. Odongo ▪ **Economic Growth through Effective Road Asset Management** by Robert Geddes and Kingstone Gongera ▪ **An investigation on the Influence of Institutional Capacity and Applicability of Technology in Implementation of URRAP: The cases study of Tigray Region.** By Daniel H. Gebre* and Alemgena A. Araya** **Plenary discussions and Way Forward**
12:50 – 13:00	**Introduction to conference site visits** by Eng. J. Mbarua, Technical Sub-Committee Chairman
13:00 – 14:00	Networking lunch

14:00 – 15:30	**Plenary Session 3: Engineering Design improvements** **Venue: MAKUTANO AMPHITHEATRE** Session Chair: Eng. S. K. Kogi, Chief Engineer Materials ▪ **Low Cost Bitumen Standard Roads in Central Kenya: A Case Study on Mackenzie – Kandara (D415) Road** by Albert Ndege ▪ **Prediction Of CBR using DCP For Local Subgrade Materials** by Gebremariam G. Feleke* and Alemgena A. Araya** ▪ **Asphaltic concrete pavement design incorporating life cycle analysis – case study of Benin"** by John Bernard Koranteng-Yorke ▪ **Position Paper on the Status of application of Hydraulic Road Binders in Kenya" by Bamburi & Norken** ▪ **Overview of Research Baseline Study: Status of road related research in the country** by Eng. Otaya **Plenary discussions and Way forward**
15:30 – 16:00	**Tea Break**
16:00 – 17:30	*Breakout Sessions:*

Workshop 4A: A New Specification for the Effective Management of Rural Roads (AFCAP sponsored)

Venue: MAKUTANO AMPHITHEATRE

Time	Item
5 mins	Introduction
10 mins	Maintenance of Rural Roads in Africa: 2015 Status Update
5 mins	Clarifications on the presentation
15mins	Presentation on Draft Specification (see separate abstract)
5 mins	Clarifications on the presentation
10 mins	Comments by panel of experts
30 mins	Facilitated discussion with questions/ comments from the participants
10 mins	Summary of key points arising

Workshop 4B: Enhancing public transportation systems in large cities in Africa

Venue: BARAZA HALL 1

Session Chair: Prof. Winnie Mitulla, Director IDS

Time	Item
5mins	**Introduction**
	Presentations:
20mins	**Introducing a Bus Rapid Transit system in Nairobi** by Eng. M. Njonge, Nairobi Metropolitan Authority
20mins	**Ropeways in the Urban Environment** by Dr. Eustace Mwarania
20mins	**An Analysis of the Introduction of Bus Rapid Transit (BRT) Systems in Urban Areas: Case Study of the BRT Link between Harare and Chitungwiza, Zimbabwe** by Samson Shumba
30mins	Plenary Discussions
5mins	Workshop resolutions and way forward

19:00	Welcome Cocktail

<table>
<tr><td>TIME</td><td colspan="3">DAY 2: Wednesday 16th March 2016</td></tr>
<tr><td>08:00 – 8:30</td><td colspan="3">Registration and Exhibition tour</td></tr>
<tr><td>08:30– 10:30</td><td colspan="3">Plenary Session 5: Monitoring performance of transport networks

Venue: MAKUTANO AMPHITHEATRE

Session Chair: Eng. S. Ndinika, General Manager, KRB

▪ Configuration and Calibration of HDM-4 Kenya Workspace by Prof. Odoki
▪ Implementation of multi-sectoral program: Key lessons learnt from Northern Corridor Transport Infrastructure Project by Eng. J. Theuri, World Bank Financed Projects Coordinator, MoTIHUD
▪ Can Humans Predict the Future? Consequences of Inaccurate Traffic Forecasting by Endale[1], A. A.; Otto[2], A.; Melaku[3], A.
▪ Assessment of Drivers' Behavior At Selected Signalized Intersections in Abuja Metropolis, Nigeria by George Omange
▪ Enhancing Intra-Regional Trade: Standard Gauge Railway by Kenya Railways
▪ Plenary discussions and Way forward</td></tr>
<tr><td>10:30 – 11:00</td><td colspan="3">Networking coffee break and exhibition tour</td></tr>
<tr><td>11:00 – 12:45</td><td colspan="3">Breakout Sessions:</td></tr>
<tr><td></td><td>Workshop 6A: Implementing Road asset management systems in Kenya (KRB)

Venue: BARAZA HALL 1

Session Chair: Eng. B.K. Maingi

<table>
<tr><td>5 mins</td><td>Introduction</td></tr>
<tr><td>10mins</td><td>Road Asset Management systems for effective decision making by Eng. F. Gitau, MoTIHUD Dept. CER</td></tr>
<tr><td>5mins</td><td>Roads data integration challenges by A.M.V. Kimani, KRB GIS Admin</td></tr>
<tr><td>10mins</td><td>Overview of Road Maintenance System in use in Kenya by Eng. J. Gakubia, Manager Maintenance, KeRRA</td></tr>
<tr><td>10mins</td><td>GIS solutions in road asset management by Willy Simons, Managing Director, ESRI EA</td></tr>
<tr><td>10mins</td><td>Recap of key issues and proposed solutions by Prof. J. Odoki, RSIP Consultant</td></tr>
<tr><td>45mins</td><td>Plenary Discussions</td></tr>
<tr><td>10mins</td><td>Summary and Key recommendations</td></tr>
</table></td><td>Workshop 6B: Building climate resilient infrastructure

Venue: BARAZA HALL 2

Session Chair: Eng. Rosemary Kungu, IEK Council Member

Cost effective sustainable slope protection solution of rural roads at flooding regions by Md. Abul Kalam Azad

Effective Implementation of Environmental Management Strategies during road Construction in Kenya. What are the Determinants? by Walter B. Nyatwanga

Plenary Discussions

Summary and Key Recommendations</td><td>Workshop Session 6C: Geometric Standards for Low Volume Roads and Implications for Road User Safety (AFCAP)

Venue: MAKUTANO AMPHITHEATRE

Session Chair: Leta Nkululeko, ReCAP

A. Introduction (10mins)

B. Presentations (60mins):

1) A Paradigm Shift in Geometric Design of Low Volume Rural Roads by Jon Hongve

2) Alternative surfacings (bituminous and non-bituminous) on LVR and their appropriateness or otherwise for rural road users

3) Road traffic injury in Tanzania: Preparation of a district engineers' guidance note for motorcycle safety on low volume roads by Tom Bishop

C. Plenary Discussions (20mins)

D. Summary and Key recommendations</td></tr>
</table>

12:45 – 13:45	Networking lunch			
14:00 – 18:00	**Session 7: Site visits to various ongoing Transport Infrastructure Projects (Assemble at 13:45 at buses)**			
	A. Construction of Port Reitz and Dongo – Kundu roads	B. Expansion of Mombasa Port	C. Construction of Mombasa – Nairobi Standard Gauge Railway	D. Haller park: restoration of ecosystems

TIME	**DAY 3: Thursday 17th March 2016**
08:00 – 8:30	Registration and Exhibition tour
08:30– 11:00	**Plenary Session 8: Transport services** **Venue: MAKUTANO AMPHITHEATRE** Session Chair: Eng. J. Ogango, Director General, KeRRA ▪ **Scaling up trail bridge technology: a cost-effective way to enhance access for millions of people in remote areas** by HELVETAS ▪ **Addressing First Mile Transport Challenges For Smallholder Farmers** by Grace Nyambura Muhia ▪ **Tanzania motorcycle taxi rider training: assessment and development of appropriate training curriculum** by Caroline Barber ▪ **Labour based LVSRs implementation: A case study of AFD/ GOK R2000 Central Kenya project** by Mr. Henry Orwa ▪ **The benefits and challenges of increasing motorcycle use for rural access** by Paul Starkey **Plenary discussions and Way forward**
11:00 – 11:30	Networking coffee break and exhibition tour

11:30 – 13:00	**Workshop Session 9A: Gender mainstreaming in Transport Sector (AFCAP)** **Venue: MAKUTANO AMPHITHEATRE** Session Chair: Mr. Simon Ndubai, Vice Chair, National Gender and Equality Commission **Sharing of Experiences on Gender Mainstreaming in Transport Sector by panel of transport sector stakeholders (45mins)** **Plenary Discussions (30mins)** **Summary and Key Recommendations (15mins)**	**Workshop Session 9B: Transport and Safety** **Venue: BARAZA HALL 1** Session Chair: Eng. Tom Opiyo, member of Association of Consulting Engineers of Kenya **The Effect of Fatigue on Driving: A Case Study in Cape Coast Metropolis** by Dr. Ogunleye-Adetona **An Assessment of Non-Motorized and Public Transport Challenges For People with Disabilities in Nairobi City** by Paul Owino Odak **Linking Knowledge and Practice: A Case of Boda Boda Motorcycle Safety In Kenya** by Dr. Gladys Moraa Nyachieo **Plenary discussions and Way forward**	**Workshop Session 9C: Traffic Management** **Venue: BARAZA HALL 2** Session Chair: Eng. M. Karanja, Kenya Association of Manufacturers **Enhancing Mobility in Kenya Counties through Strategic Policies Formulation** by Dr. Romanus Opiyo **Benchmarking Best Practices in Addressing Traffic Congestion in Sub Saharan Africa Cities** by Eng. Meshack Ochieng and Prof. O. O. Mbeche **Potentials of GNSS and GSM Technology in Road Traffic and Speed Management in Kenya** by Charles Kigen **Plenary discussions and Way forward**
13:00 – 14:30	Networking lunch		
14:30 – 15:30	**Plenary Session 10: Wrap up and closure of conference** **Venue: MAKUTANO AMPHITHEATRE** **Summary of Key Issues and Conference Recommendations** by Eng. S. Kogi **Vote of Thanks** by Conference Participant **Presentation of Awards** **Official Closure of the Conference**		
19:00	Gala Dinner		

TIME	**DAY 4: Friday 18th March 2016**
10:00 – 13:00	Organized Tours to local sites of interest/ shopping
13:00 – 14:00	LUNCH
14:00 – 16:00	Organized Tours to local sites of interest/ shopping

4.3. CONFERENCE PLENARY ABSTRACTS

i. Economic Growth through Effective Road Asset Management by Robert Geddes and Kingstone Gongera

ABSTRACT

Following the advent of the Road Management Initiative (RMI) in the 1990s significant progress has been made in the maintenance of main roads in a number of countries in Africa. The improvements are a result of the establishment of road funds and semi-autonomous road authorities. However, relatively less progress has been made with the maintenance of local roads providing access to rural communities. These roads are under the responsibility of regional or local authorities.

The Africa Community Access Programme (AFCAP) is therefore funding a research and capacity building project on asset management for rural roads. The purpose of the project is to achieve economic and social benefits for local communities in rural areas as a result of improved performance in road asset management.

Three countries from sub-Sahara Africa will participate in the project. A fourth country, with established rural road asset management systems, will provide a benchmark for best practice. If the project is successful it is expected that there will be subsequent phases which will enable the participation of additional countries.

The project will provide technical assistance to achieve improvements in asset management performance on a selected network of rural roads within each participating country. The performance will be measured against a new framework for rural road asset management that is being developed as part of the study. Measurements will also be taken of the road network condition and the impact of the road condition on the rural economy. These data will be discussed with road sector stakeholders in the project areas and in regional meetings of the participating countries. They will be used as part of an influencing strategy to achieve improvements to the management of rural roads and build a maintenance culture.

The purpose of the paper is to inform stakeholders in the region of this strategically important research project. Feedback will be obtained from stakeholders on the innovative approaches that will be adopted. This will strengthen the project methodology, ensuring that it achieves meaningful and sustainable change.

ii. Addressing the Road Maintenance Challenge in Africa: What can we do to solve this continuing problem? by Mike Pinard

ABSTRACT

In all countries, roads are a major national asset worth billions of dollars. They represent the wealth of nations and are central to every country's economic growth and development. Yet, despite the compelling evidence to support the case for road preservation through adequate maintenance, the sub-sector faces numerous challenges, including the imbalance between the rate of deterioration and the level of funding allocated for maintenance of the existing infrastructure, a tendency to give priority to new construction over maintenance and, above all, the apparent lack of a maintenance culture in many countries. This unacceptable situation does beg the question – why, despite the obvious benefits of preserving what has been constructed, has the maintenance of roads continued to be an unresolved enigma? And what can be done to improve road perservation practice in Africa.

4.3. CONFERENCE PLENARY ABSTRACTS

The paper firstly highlights the critical importance of well-maintained road infrastructure for facilitating socio-economic growth, development and poverty reduction in any country. It then presents typical issues affecting road maintenance in Africa and discusses the crucial issue of funding requirements versus funding allocations. The paper then draws attention to important lessons learnt from past practice as a basis for proposing a more holistic, integrated approach than hitherto to road preservation based on a postulated 'road perservation pyramid'.

The paper then summarises the main conclusions reached and key recommendations made for improving the sustainability of road preservation practice in Africa, including the development of a national score card to determine the extent and severity of road infrastructure problems in the sector.

iii. Prediction of CBR Using DCP For Local Subgrade Materials by Gebremariam G. Fekele and Alemgena A. Araya

Abstract

There is lack of correlation between Dynamic Cone Penetrometer (DCP) and Soaked California Bearing Ratio (CBR) for local subgrade materials. The aim of this study is to develop relationships between DCP and soaked CBR, DCP and unsoaked CBR, soaked CBR and unsoaked CBR for fine and coarse grained soils.

This paper presents relationships between DCP and CBR for local Subgrade materials. The relationship developed in this research considers subgrade material's behavior and largely saves time and cost of preliminary and detailed engineering works of road projects. A series of DCP tests in the field, soaked CBR at OMC, and unsoaked CBR at field conditions in the laboratory are conducted. Based on the field and laboratory test results relationships between soaked CBR and DCP, unsoaked CBR and DCP, and soaked CBR and unsoaked CBR are established for fine and coarse grained soils.
Eng. Fekele holds an MSc. degree in Civil Engineering (Road and Transportation Engineering) from Mekelle University, BSc. degree in Civil Engineering from Mekelle University and an Advanced diploma in Construction Technology from Maichew Technical College. An Ethiopian national, Eng. Feleke currently lectures at the School of Civil Engineering, Ethiopian Institute of Technology-Mekelle, Mekelle University.

The relationship developed between DCP and CBR value for fine grained soil shows better than that of for coarse grained soil.

iv. Development of optimal road maintenance fund allocation framework by Dr. Jennaro Odoki

Abstract
Road maintenance needs in many countries are huge and available resources are not sufficient to allow all desired maintenance activities and interventions to be carried out. In any given planning period it is therefore important to consider the financial resource constraints through prioritization with the goal of achieving maximum impact and value-for-money on road maintenance expenditure. Optimal fund allocation is required both in situations with funding shortfalls and in situations with adequate funding. This is because offering a lot of resources does not necessarily mean fulfilling different points on the risk reward spectrum and misallocation could result in wastage. Limited resources also have to be maximized for optimal returns.

4.3. CONFERENCE PLENARY ABSTRACTS

This paper describes the development of an equitable, transparent, fair and justifiable approach to allocation of road maintenance resources. The framework comprises a set of mathematical formulae that can be adapted for use by a Road Fund Board to allocate road maintenance funds vertically between road classes and horizontally between designated agencies responsible for each class of road. The key research element is the investigation of the key relationships between road user charges and road agency costs based on the principles of efficiency and equity. It introduces a novel approach to reduce biases in road maintenance fund allocation in a country.

To test the validity and demonstrate the application of the framework developed, a worked example has been presented to allocate an assumed available budget and the results. The framework developed provides an objective way of investing in road network preservation by balancing between efficiency and equity and thereby improve decision making in road asset management.

v. *A paradigm shift in Geometric Design of Low Volume Rural Roads by J. Hongve*

Abstract

It is widely recognized that provision of basic road infrastructure is a key factor for economic growth and poverty reduction in the rural areas of Africa. Recent (2013) estimates by the World Bank indicate that approximately 63% of the total population of Sub-Saharan Africa (SSA), equating to more than 500 million people, are located in rural areas with only 34% living within two kilometres of an all-season road. Moreover, if SSA agricultural potential is to be realised, the size of the rural road network would need to be increased by a factor of about 5 – 6 times. Much of this increase would be in the form of low volume roads (LVRs) with traffic volumes typically up to about 300 vehicles per day (vpd).

With the limited resources that are available for provision of LVRs, it is crucially important that appropriate and affordable geometric design standards are adopted. However, it appears that little research has been carried out to develop standards for roads that essentially fulfil an access function, with acceptable levels of service, at least cost and to as many rural communities as possible. Indeed, current standards tend to follow conventional practice based on the design speed concept, resulting in levels of service that are often far in excess of what can be economically justified or is necessary for the provision of basic access.

The purpose of this paper is to promote the adoption of a more appropriate geometric design philosophy for LVRs that is rational and more affordable than hitherto, and with acceptable levels of road safety in what is a generally low speed environment.

The paper briefly reviews current approaches to geometric design of LVRs and highlights their shortcomings as a basis for motivating a case for the adoption of more appropriate and affordable standards, including road safety measures. The paper concludes that unless there is a paradigm shift in the approach to geometric design of LVRs that is embraced by engineers and practitioners and manifested in government policy, the rural population in Africa will be denied their human rights and opportunities for social and economic development. Jon Hongve – Bio

4.3. CONFERENCE PLENARY ABSTRACTS

Civil Engineer with more than 25 years' experience in the rural road sector from a number of countries in Sub-Saharan Africa and Asia. Experience includes design, construction and maintenance of Low Volume Sealed Roads as well as training of contractors, consultants and government staff. Jon Hongve has been instrumental in the adoption of the DCP Design Method for cost effective design of LVSRs and has played a key role in the training and application of Cold Mix Asphalt and other labour-based bituminous surfacing techniques.

vi. Tanzania Motorcycle Taxi Rider Training: Assessmentand Development of Appropriate Training Curriculum by Ms. Caroline Barber

Abstract

Of the 1.25 million people killed on the roads annually and the 20-50 million people who are injured and/or suffer long term disability, 90% of these occur in low and middle income countries.

In recent years, motorcycle taxis, or "boda bodas", have emerged rapidly as an important means of transport in both urban and rural settings particularly in East Africa. They provide an important means of access to essential services for local communities in hard to reach areas. However there are also legitimate safety concerns.

As part of the Africa Community Access Partnership (now rebranded ReCAP), funded by DFID, Transaid and its partners from the National Institute of Transport in Tanzania (NIT) and the Industrial Training Centre (ITC) in Zambia developed a boda boda training curriculum in preparation for its introduction as the national standard in Tanzania. This was developed in partnership with the SUrface and MArine Transport Regulatory Authority (SUMATRA) in Tanzania. This presentation will explain the innovative participatory approach that was used to develop the curriculum, present the key training modules, update on the current implementation status and allow for important debate on boda boda training standards and safety.

vii. Low Cost Bitumen Standard Roads in Central Kenya; A Case Study on Mackenzie-Kandara (D415) Road by Mr. Albert Owuor Ndege

Abstract

Roads impose logistical, technical and financial burden on most agencies in the sub-sector due to constraints on physical, human, financial and natural resources. Substantial length of un-surfaced, particularly gravel feeder roads in Kenya is increasingly becoming difficult to sustain.
While use of the conventional designs and construction procedures needs to be adhered to, development and application of relaxed specifications in building of LVSRs has better economic and environmental value compared to the traditional gravelling.

Mackenzie – Kandara (D415) Road was constructed under the AfD/GoK Roads 2000 Programme in Central Kenya as a trial section to a single layer pavement standard, using labour intensive methods, and utilizing different stabilizers and pavement materials under eleven (11) different sections to aid the development of design standards and construction specifications for LVSRs.
The performance of the trial section was studied under the base line evaluation indicated initial success in many aspects of the project. Level controls and construction thickness tolerances were however not uniformly achieved in the project with the subgrade not performing as expected.

4.3. CONFERENCE PLENARY ABSTRACTS

Compared to the conventional gravelling of low traffic volume roads, the project objectives were met with the cold mix asphalt surfacing effectively protecting the pavement and subgrade layers from traffic and environmental effects.

viii. *Monitoring and Evaluation of Research Trial Sections: Cases of Laterite Gravel Base Course and Otta Seal Surfacing Options by Mr. Alemayehu Endale*

Abstract

A number of research activities were carried out under the AFCAP I program most of which involved construction and monitoring of trail sections in different parts of Ethiopia. Different materials were used in different parts of the pavement structure and are evaluated how they perform and whether these materials can be used in the construction of low volume rural roads. In this paper monitoring and evaluation activities of the two projects and their results are addressed. They are Laterite gravel as a base course material in low volume sealed roads and demonstration of the use of Otta seal.

Laterite gravel is most abundant in the western part of the country and its behavior differs from other natural gravels with higher plasticity in which, unlike other gravels, its plasticity contributes to its strength when opened to the atmosphere. The use of this material as a base course on a surfaced road was demonstrated on the Assosa-Kurmuk road. Moisture - strength relationship of the pavement is investigated to see the impact of sealing shoulders both in cut and fill sections of the road. Monitoring of the trial section revealed some significantly important results related to the sealing or unsealing of the shoulders in different geometric conditions.

Otta seal surfacing option is the other project in which different sections with different gravels types as surfacing materials are demonstrated. The main objective of this project is to demonstrate the use of otta seal with locally available non-standard materials and evaluate the performance. A minimum of four types of gravels including cinder was used to construct otta seal surfacing on two locations. Unexpected results on the performance of some of materials are observed and lessons are being drawn for future use. In these projects the impact of proper construction techniques was observed how they affect the performance of the pavement during its service life.

The monitoring and evaluation of trial sections have clearly indicated that if locally available materials are properly characterized and modified slightly in the design and construction approach better results can be achieved and the materials can be used in the construction of low volume roads. The results of monitoring of the Assosa-Kurmuk laterite, Combolcha and Combel Otta seal sections have demonstrated good results on the majority of non-standard materials performance which have not been observed before. This paper tries to show the results of monitoring of trial sections and lessons drawn from this effort for further implementation in the design and construction of low volume roads in Ethiopia.

4.3. CONFERENCE PLENARY ABSTRACTS

ix. Asphaltic Concrete Pavement Design Incorporating Life Cycle Analysis – Case Study of Benin by Mr. John Bernard Koranteng-Yorke

Abstract

Most road pavement design methods currently in use do not give opportunity to undertake critical evaluation of life cycle of the performance of the newly design road pavement. In the absence of this assessment, it is always assumed that existing road agency's maintenance management systems will have the capacity to meet the maintenance requirements. The setting of road maintenance policies used in the road maintenance management systems are also not informed by the respective road pavement designs. In some instances, a general rule is used to establish the maintenance policy, say, all asphaltic concrete roads are due for overlay at 10 years interval. The challenge is that current practice in road pavement design and the maintenance are not coterminous. This paper presents an objective methodology using Mechanistic-Empirical (M-E) pavement design approach and HDM-4 life cycle modelling to address these problems using Benin as a case study. The case study has given a practical demonstration of how to select and calibrate the M-E design tool appropriate for Benin condition. Estimation of the Residual Life of the existing road pavements to determine the investment options (rehabilitation, reconstruction, upgrading, etc.) and the selection of appropriate pavement designs were achieved. The selected investment options were optimised by economic analysis with the HDM-4 which was also used to carry out Life Cycle Analysis of the optimised pavement design to establish the maintenance regime. Finally, the financial outlay during the design lives of the respective optimum pavement designs was established.

x. Assesement of Drivers' Behaviour at Selected Signalized Intersections in Abuja Metropolis, Nigeria by Mr. George Omange

Abstract

Traffic control signals offer advantages for regulating traffic at signalized intersections. Non-compliance of traffic signals may increase intersection delay, road crash frequency, red light violation, fuel consumption and vehicle operating cost. The study investigates drivers' behavioural pattern or compliance rate at signalized intersections. The results of field observations conducted at six signalized intersections located in Abuja Metropolis, Nigeria showed that, out of a total of sampled 2100 drivers, 589 (28.05%) drivers ran red lights; 131 (6.24%) drivers have the tendency of violating traffic light; and only 1374 (65.43%) drivers come to complete stop at red. It was observed that taxi drivers have high tendency for running red lights. Regression analysis on data generated was conducted with R2 established to be 0.97; which indicates a very high correlation between the independent variable and dependent variables. The study also reveals that most of the signalized intersections are not well coordinated and the installation of traffic lights on right turn that has a separate flare lane was not necessary. The paper advocates for strategies and policies that would control, enforce and regulate the behaviours of drivers at signalized intersections by relevant government agencies such as the Federal Road Safety Commission, the Nigeria Police and the Department of Road Traffic Services.

4.3. CONFERENCE PLENARY ABSTRACTS

xi. Ropeways in the Urban Environment by Dr. Eustace Mwarania

Abstract

As cities grow, competition for remaining space intensifies. In many cases, it is not possible to expand the existing road networks, which then fail to keep up with increasing traffic numbers leading to severe congestion. It is therefore essential to find new innovative solutions to address present and future traffic problems.

This paper presents urban ropeways, also known as aerial cable cars, as an innovative approach that can make valuable contribution towards resolving this challenge by providing a secondary aerial transport corridor to compliment the ground-based networks. Recent innovations in ropeways technology that make them serious contenders for urban transit will be first explained. This will include faster speeds, larger cabins, non-linear and dual-track systems. The benefits of using ropeways and the functions that they can perform in a network will then be explained. Special attention will be given to their application in decongesting road segments.

Examples of major successful ropeway urban projects across the world will then be described followed by efforts underway to realise urban ropeways within Kenya. Challenges to realising ropeway projects and the opportunities present therein will also be highlighted.

xii. The Effect of Fatigue on Driving: A Case Study in Cape Coast Metropolis by Dr. Ogunleye-Adetona

Abstract

The main purpose of the research was to examine the effect of fatigue on driving in the Cape Coast metropolis. A descriptive design was used in undertaking the study. 50 respondents were purposefully sampled from 5 motor parks in the Cape Coast metropolis, Ghana. The Rosenberg questionnaire format was used to obtain information from the sampled population and then SPSS was then used to analyze the responses/ information collected. The data obtained from drivers and road users revealed that fatigue actually had significant effects on driving and therefore a silent contributor to road accidents and crash. The research also revealed that fatigue experienced by the drivers were their own making because most of them do not have enough rest or sleep and drive for more than 10hours a day. The following recommendations were made to help reduce fatigue occurrence to drivers and to help restore safety on the road; having enough rest, not driving more than 8 to 10hours a day and avoiding alcohol and medicine when driving would go a long way in overcoming fatigue and therefore reduce.

4.4. LIST OF EXHIBITORS AND SPONSORS

4.4.1 List of Sponsors

1. Africa Community Access Partnership (AFCAP)
2. Bamburi Cement
3. Co-operative Bank of Kenya
4. Kenya Commercial Bank
5. Kenya Roads Board (KRB)
6. Kinconsult Associates Limited
7. Material Testing and Research Department (MTRD)
8. World Bank Group

4.4.2 List of Exhibitors

1. Africa Community Access Partnership (AFCAP)
2. Avery East Africa Ltd
3. Athi River Mining
4. Bamburi Cement
5. Crown Paints
6. Co-operative Bank of Kenya
7. Kenya Institute of Highways and Building Technology (KIHBT)
8. Kenya National Highways Authority (KeNHA)
9. Kenya Roads Board (KRB)
10. Kenya Rural Roads Authority (KeRRA)
11. Kenya Urban Roads Authority (KURA)
12. Material Testing and Research Department (MTRD)
13. Roughton

4.5. LIST OF JOC MEMBERS AND RAPPORTEURS

The Joint Organizing Committee

An Inter-Agency Joint Organizing Committee was established to coordinate all activities of the conference. The following members were drawn from Kenya Roads Board and the Material Testing & Research Department.

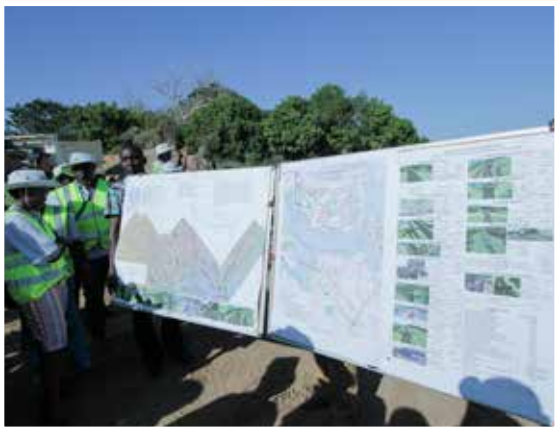
(i) Eng. Jacob Z. Ruwa – Executive Director, KRB/Joint Co-Chair
(ii) Eng. Stephen K. Kogi – Chief Engineer Materials /Joint Co-Chair
(iii) Eng Benjamin K. Maingi – Programme Director
(iv) Eng. Joachim Mbarua – Chairman, Technical Committee
(v) Eng. Margaret N. Ogai – Project Manager
(vi) Eng. Wilson Kosgey – Vice Chair, Technical Committee
(vii) Mr. Abdallah Kulah – Alternate to Chief Engineer Materials
(viii) Ms. Rosemary Wangui – Chairman, Publicity & Logistics Committee

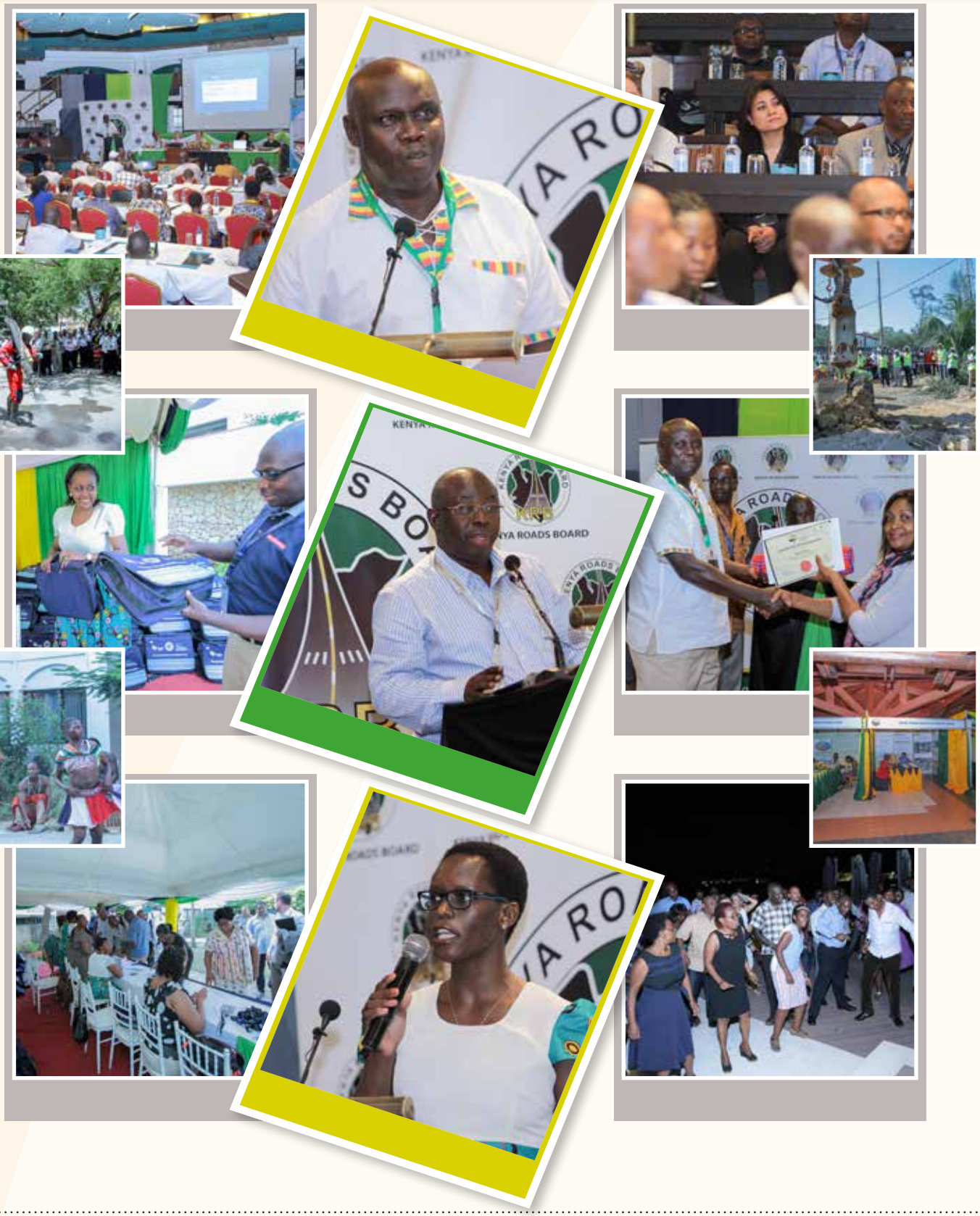
Rapporteurs

The following rapporteurs drawn from KRB, MTRD and RAs captured the key highlights and discussion of each session for incorporation into the conference report and resolutions. The rapporteurs also guided the delegates to the site visits.

(i) Eng. Hillary Cherop, MTRD
(ii) Justus Musakala, MTRD
(iii) Eng. Hillary Akwiri, KeRRA
(iv) Eng. Victor Odula, KRB
(v) Eng. Susan Owuor, KRB
(vi) Eng. Rose Ng;ang'a, KRB
(vii) Eng. Merin Koitalek, KURA
(viii) Eng. Tom Omai, KRB
(ix) John Mwiti Mbae, KeNHA

Pictorial




KENYA ROADS BOARD

iTRARR
CONFERENCE 2016
MOMBASA - KENYA

iTRARR Conference
Kenya Roads Board
3rd Floor, Kenya Re Towers, Upperhill P.O. Box 73718-00200 NAIROBI
Tel: +254 20 4980 000
Website: transportconferencekenya.org
Email: transportconference@krb.go.ke

KENYA ROADS BOARD
KRB

AfCAP
Africa Community Access Partnership

MTRD
MATERIAL TESTING
AND RESEARCH DEPARTMENT

MINISTRY OF TRANSPORT, INFRASTRUCTURE,
HOUSING & URBAN DEVELOPMENT

www.transport.go.ke