Annual Meeting - Bamako, Mali
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The SADC Guideline on Low-Volume Sealed Roads

From Vision to Practice

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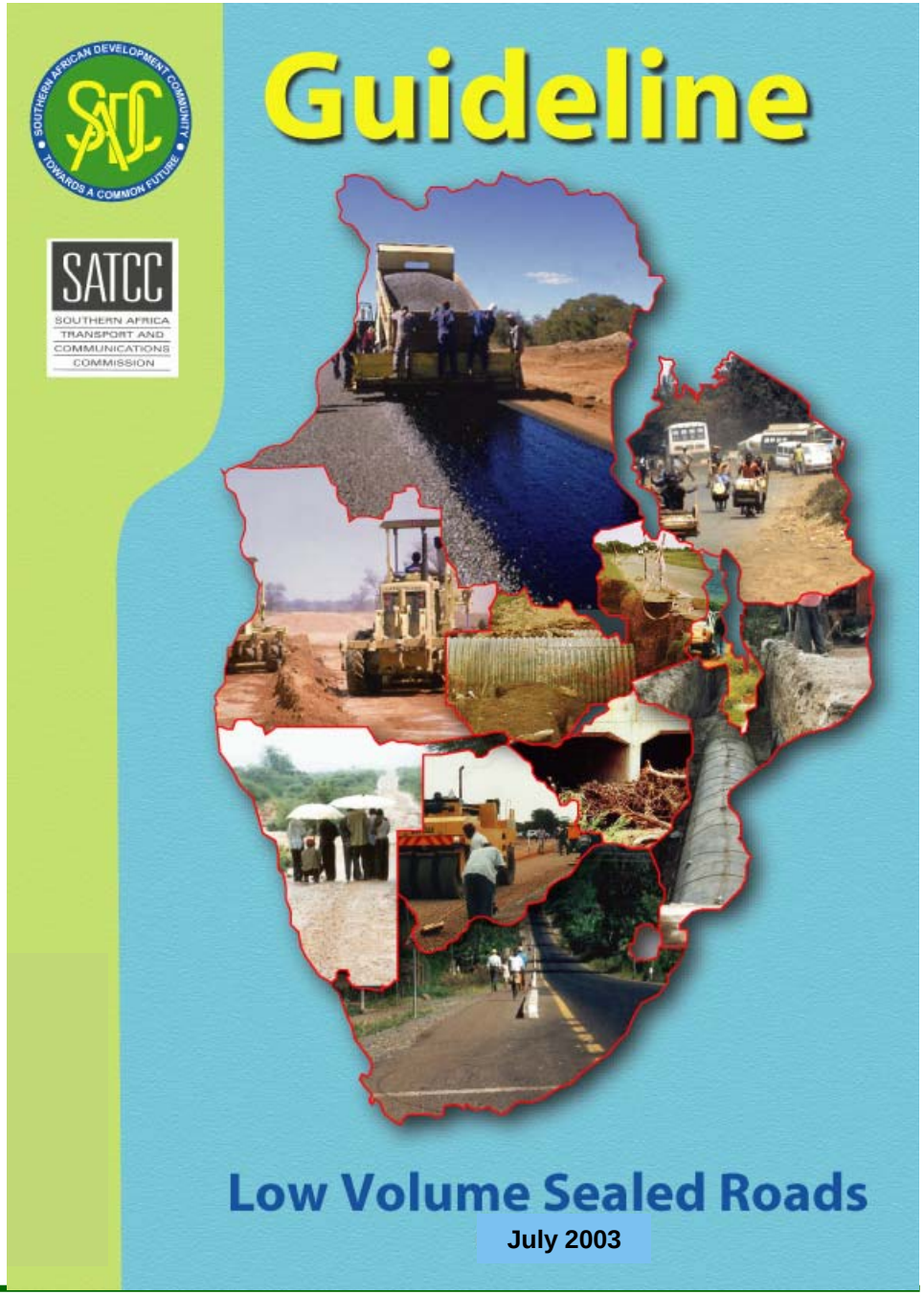


Outline of Presentation

- Introduction
- Examples of Guideline in Practice
- Way Forward

Introduction

Motivation for Guideline

- Traditional approaches to provision of LVSRs have stemmed from technology and research carried out over 40 years ago in very different environments
  - *not surprising that many of the imported approaches, designs and technologies are inappropriate for application in the region.*
- Technology, research and knowledge about LVSRs have advanced significantly in the region
  - *not only question much of the accepted wisdom on LVSR provision but also show quite clearly the need to revise conventional approaches.*
- Unfortunately, there has been little effective dissemination and uptake of the results of research carried out in the region
  - *triggered the need for this SADC Guideline on Low-Volume Sealed Roads*.

Introduction

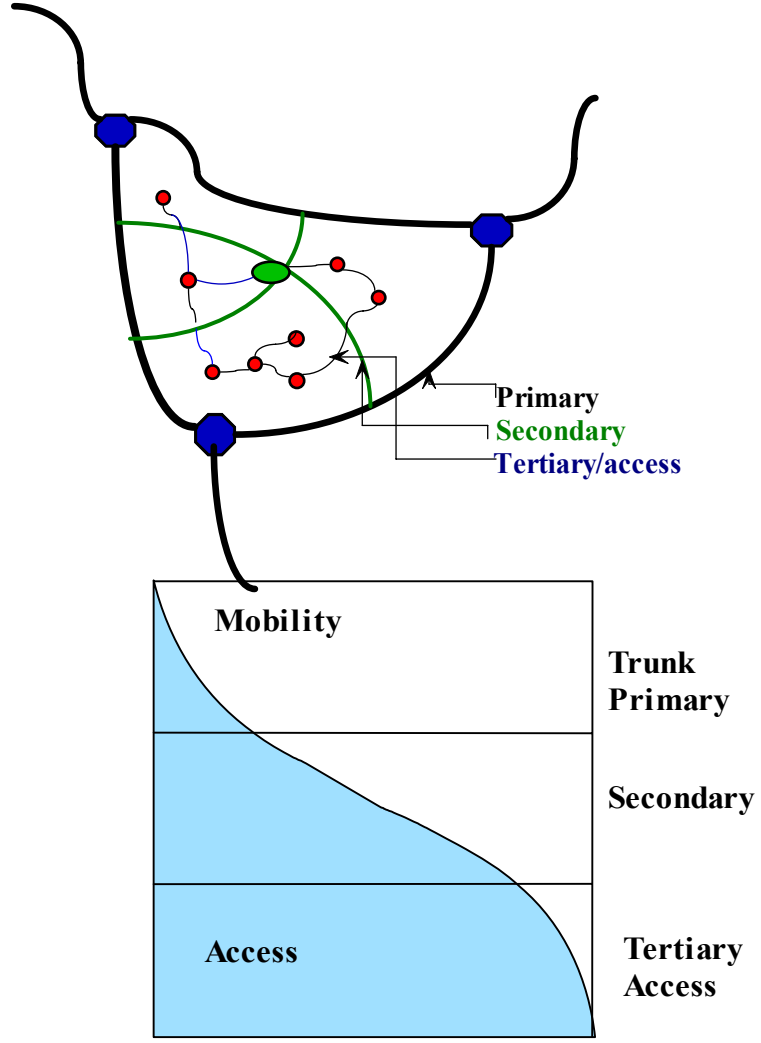
Aims of the Guideline

- Increased delivery of all-weather access for the poor through more appropriate approaches to planning, design, construction and maintenance of LVRs
- Development of Guideline (initiated by SATCC; supported by DFID, NORAD, SIDA)
  - *High level of local participation in compilation of guideline*
  - *SADC member state representation in each of the 19 technical, national and review workshops*
  - *Much higher level of awareness and buy-in than in previous documents of this type.*

Background

Definition of a Low-Volume Road

- Many kinds of low-volume roads serving different functions
  - ➢ may be primary, secondary or tertiary/access
- One characteristic in general:
  - ➢ they all carry relatively low volumes of traffic
    - o typically less than 200 vpd



Introduction

Why low volume sealed roads?

Unpaved roads: dusty, health hazard, pedestrian/vehicle safety; crop, natural habitat and vehicle damage. Is this sustainable? NO!

Unpaved roads: Require continuous use of a non-renewable resource – gravel. This is inherently unsustainable and environmentally damaging. Is this sustainable? NO!

Approx. 175 million cu.m “consumed” annually in SADC region for gravelling purposes

Introduction

Limitations of Gravel Roads

Traditionally Gravel is used for rural access roads.

However:

- They are low (initial) cost and relatively easy to construct
- However, they are expensive to maintain – typically US$1,600/year
- Each Km of gravel road typically looses more than 70 cubic metres of material EACH YEAR
- A range of constraints means that maintenance is rarely carried out, leading to impassability, or the need to repeatedly reconstruct.

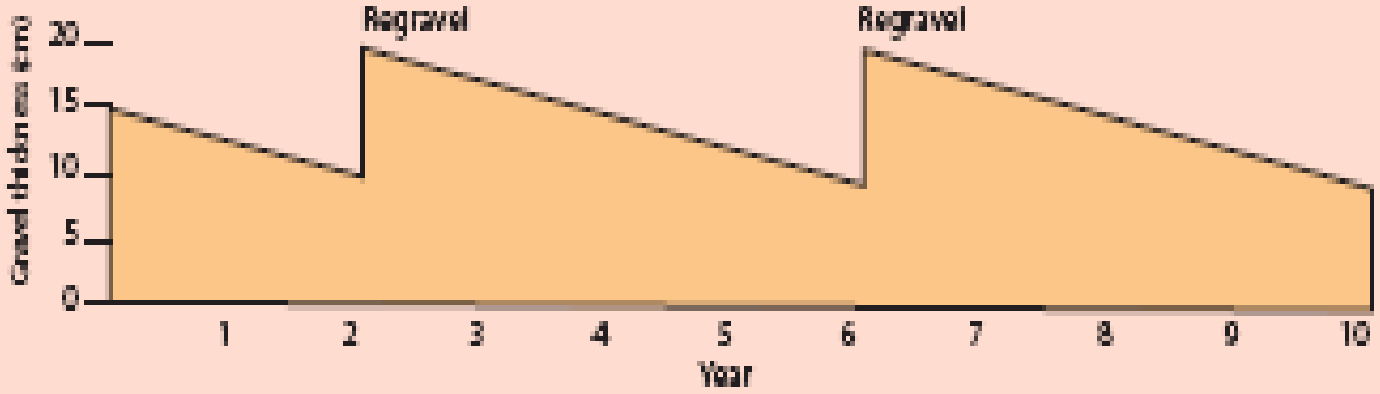
.....*SENSIBLE??? NO!!!*

Introduction

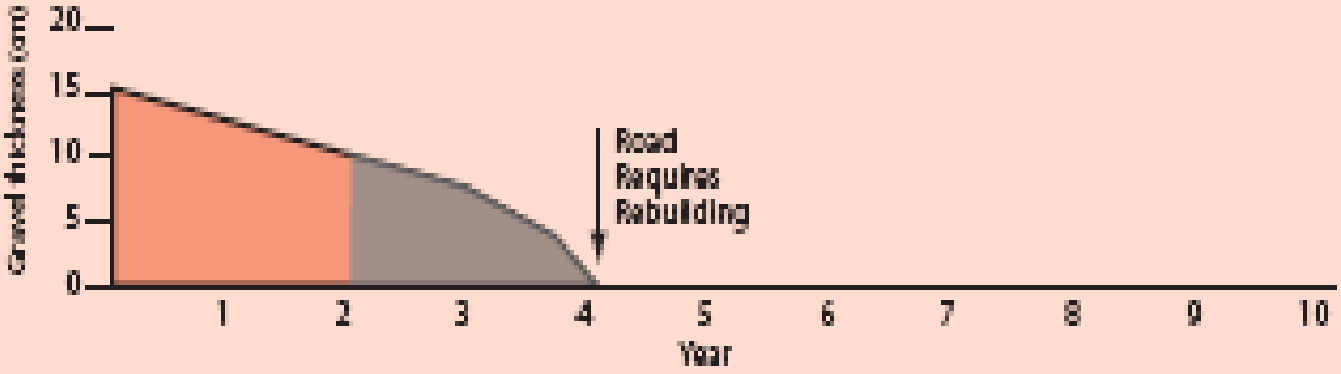
Gravel Maintenance Challenge – Viable?

Introduction

Gravel Maintenance Challenge – Reality



(a) Gravel thickness with preventative maintenance (timely regravelling).



(b) Gravel thickness without preventative maintenance (no timely re-gravelling).

Introduction

The Message

- There is an ‘unhealthy’ and unsustainable reliance on gravel roads to solve the access problems of poor rural communities
- Window of opportunity for using gravel is slowly closing. Need for alternative, more sustainable solutions
- A new approach is required, using a ‘menu’ of more durable, low cost, local-resource-based surfaces, using gravel only where appropriate.
- These techniques are ideal for use by SMEs.

Introduction

The Message (Cont'd)

Poverty is linked to Poor Access

- Rural Economic and Social development needs commercial, educational, health and infrastructure initiatives that rely on GOOD PERMANENT ACCESS.

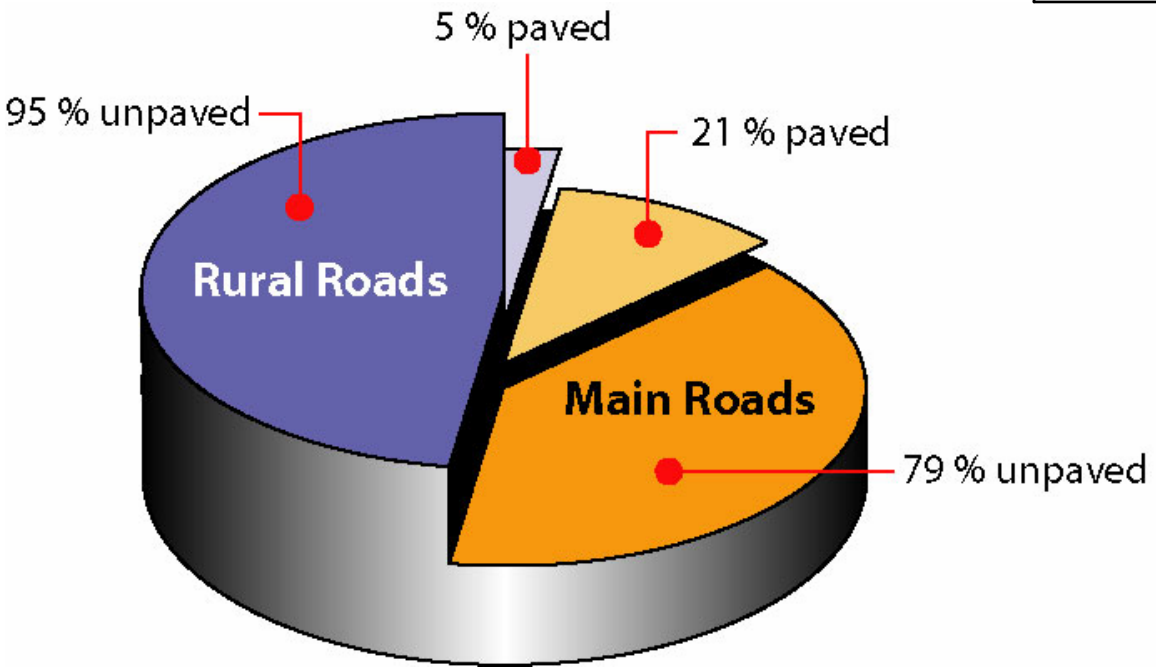
- Unfortunately, poor access for millions in rural communities limits the effectiveness of these initiatives, because of:
  - unreliable travel or impassability, especially in the rains,
  - high unit transport costs for goods, services & people.

- *Investment is discouraged by poor access.*

Introduction

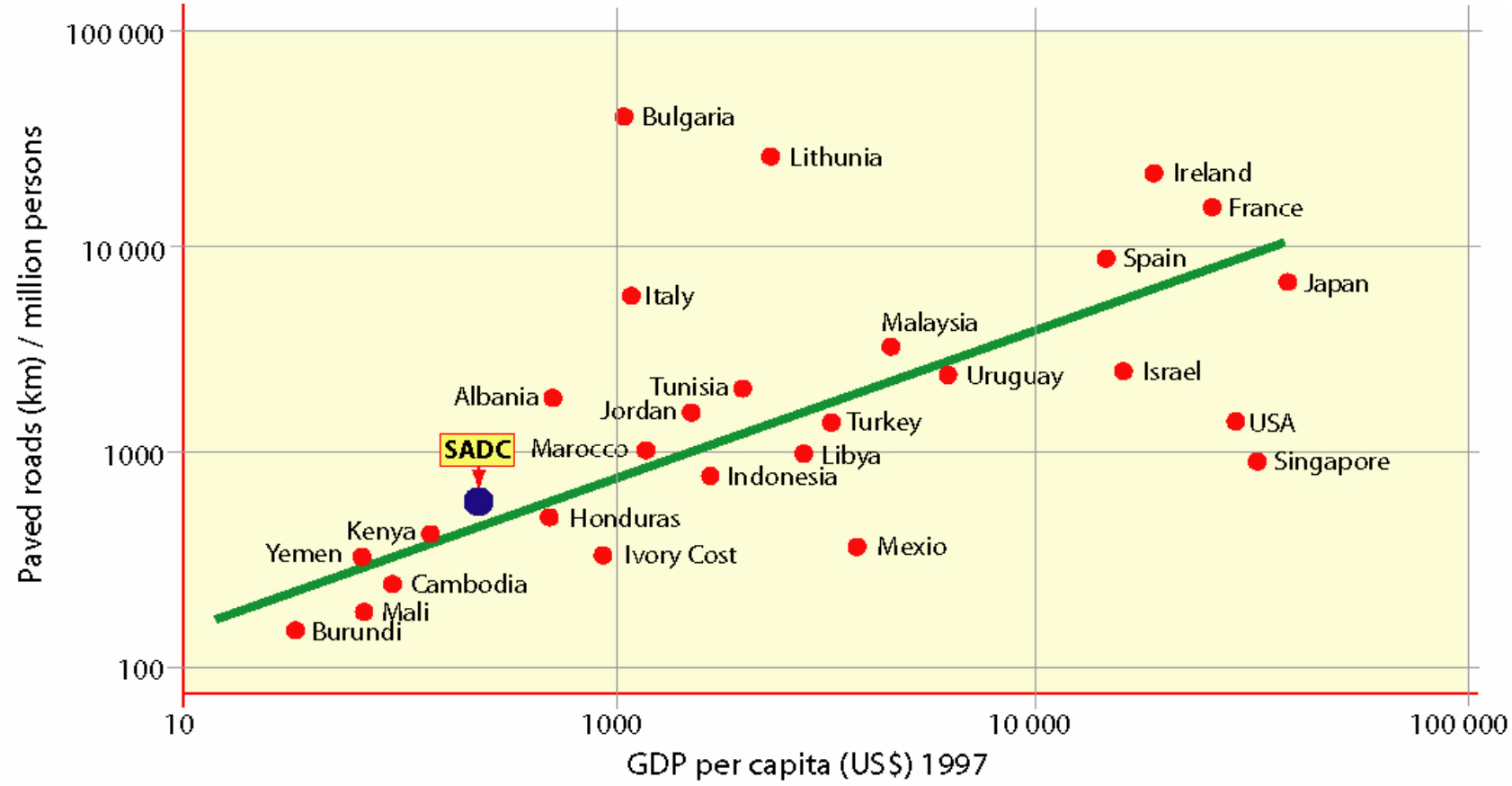
Gravel Road Network

SADC Road Network		
Paved(km)	Unpaved (km)	Total (km)
126,681	805,526	932,207
13.6%	86.4%	100.0%



Introduction

Roads and Economic Development



"You can always tell the state of a country's economy by looking at the state of its roads"

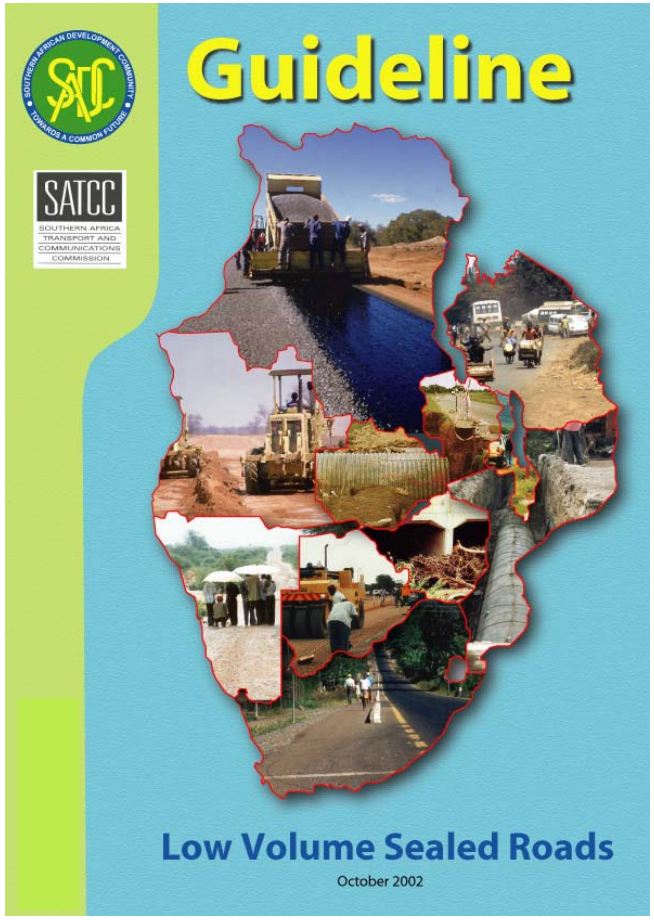
Introduction

Gravel Road Challenge

- Not possible to upgrade all unsealed roads
- However, many thousands of km of rural access roads carrying light traffic that could be justifiably upgraded using “low-cost” seals
- Guideline provides guidance on achieving this objective

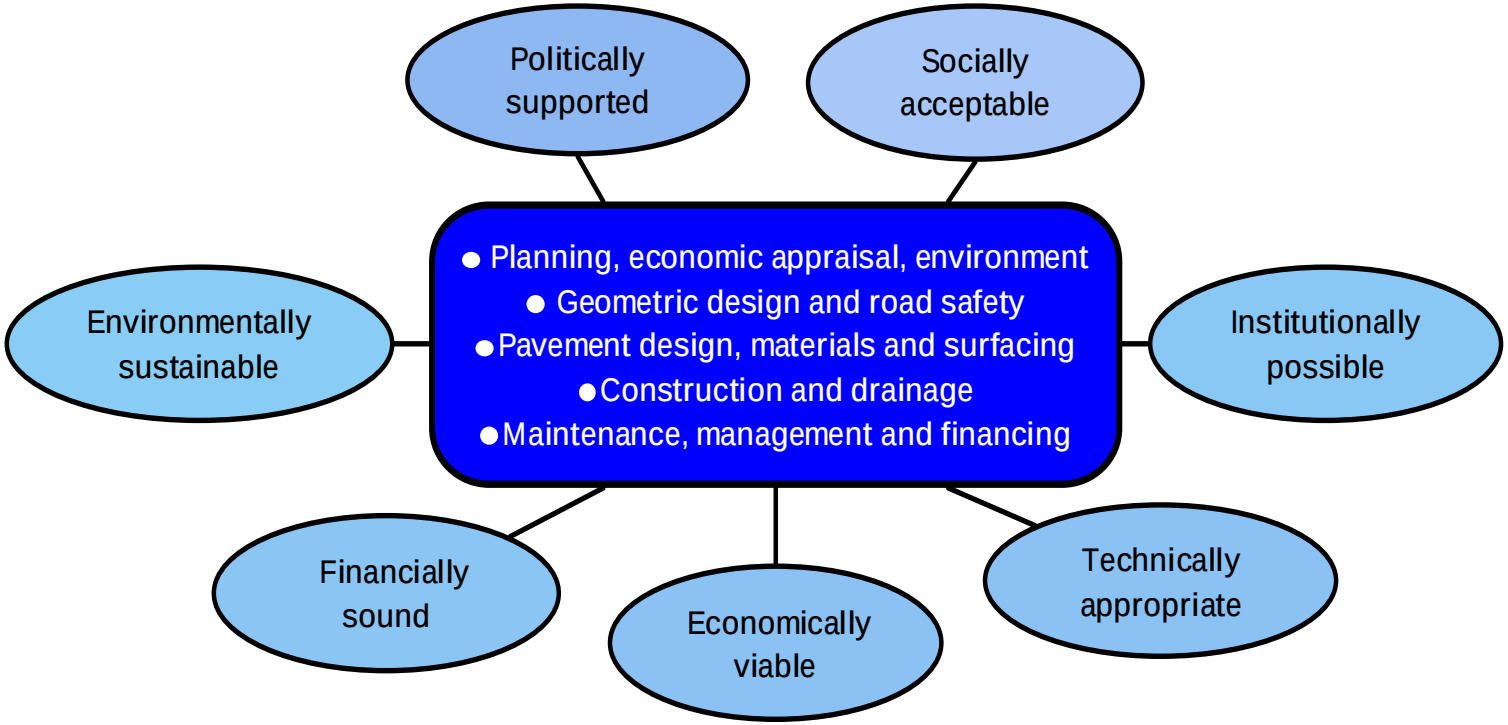
Introduction
Meeting New Challenges–the SADC LVSR Guideline

- Captures best regional and international practice
- Not prescriptive or country specific
- Departure from traditional practice w.r.t:
  - *planning, appraisal and environment*
  - *geometric design and road safety*
  - *pavement design and materials*
  - *construction and drainage*
  - *maintenance and management*
- Holistic approach satisfying *seven dimensions of sustainability* (*political, social, institutional, technical, economic, financial, environmental*)



Introduction

What's New?



Meeting the seven dimensions of sustainability

Introduction

Multi-dimensional Challenge

POLITICAL

- Sensitisation to technical standards
- Political and Public perception
- Stage construction
- Axle-load control
- Acceptance to Risk
- Public pressure

SOCIAL

- Labour-based methods
- Connectivity
- Social benefits
- Community expectations
- Safety
- Small contractor enhancement (Skills)

FINANCIAL

- Limited funds
- Funding sources
- Potential for savings
- Sustainability of funding: maintenance
- Type of contracts (out-sourced)
- Timing

PAVEMENT DESIGN FOR LOW VOLUME SEALED ROADS

TECHNICAL

- Dearth of Pavement Design methods for LVSR's
- Philosophy unchanged for 40 years
- Imposition of standards
- Innovation

ENVIRONMENTAL

- Environmental induced distress
- Resource management
- Impacts and Mitigating needs/options
- Recycling of materials
- Changing or unpredictability of climates

INSTITUTIONAL

- Operational Standards
- Variety of Procedures (imported)
- Flexibility in approach
- Training and Awareness
- Access to Choice
- Maintenance capacity
- Capacity of local industry (Client-Consultant-Contractor)

Introduction

What's new?

- Adoption of a holistic approach to rural road provision for the urban and rural poor (dimensions of sustainability)
- Application of appropriate planning tools (e.g. IRAP)
- A whole-life approach to investment appraisal
- Recognition of the environmental impacts of road provision
- The use of appraisal techniques that include social and non-motorised user benefits (e.g. RED)
- Application of geometric and structural designs based on local users, local knowledge and technology exchange

Introduction

What's new?

- Recognition of the disproportionate impact of road accidents on the poor and the need for safe designs that protect vulnerable road users
- Application of locally-derived standards and specifications
- Application of construction methods that increase the use of local materials and human resources thus reducing costs and increasing employment opportunities (compaction, LBM)
- Promotion of funding sources and maintenance planning and management techniques that ensure sustainable access

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Examples

General – Example from Mozambique

- SIDA-funded Litunde to Ruasse road in Mozambique. Traffic level as 100 vpd with 30% heavies.
  - The original project design was based on the SADC trunk road design guide to construct 28km sealed and 217km gravel at a total cost of US$21m.
  - Using the Guideline recommendations, all 245km were sealed at a cost of US$25m. Made possible by:
    - increased use of local materials (particularly by discarding cement stabilsation),
    - sealing shoulders
    - increasing compaction
    - changes in materials specifications as recommended in the Guideline
    - Adopting more appropriate cross-section width
  - Plans are now in hand for the remaining 75km to be sealed using the same approach

Examples

General – *Gundu Lashu Programme (RSA)*

- The Gundo Lashu programme in South Africa has provided very good opportunities to implement recent research and developments in the low volume sealed roads arena:
  - Project in progress and 24 contractors have been trained
  - Sealing local materials is a more viable economic option than locating suitable unsealed road materials
  - Significant environmental and social advantages
- For a successful implementation of the SADC Guidelines in project design it is vital to have informed clients as well as designers.

Examples

General – *Gundu Lashu Programme (RSA)*

Example of labour-based sealing of roads

The Gundo Lashu programme has provided very good opportunities to implement recent research and developments in the low volume sealed roads arena:

- For a successful implementation of the SADC Guidelines in project design it is vital to have informed clients as well as designers.

- These projects have shown that a modest increase in money spent on the design may give significant returns in terms of savings in construction costs.
- The implementation of the guidelines, however, probably requires more engineering judgement and understanding than required using a conventional catalogue-type pavement design.

Examples

Challenge of Using Natural Gravels

- Materials typically make up 70% of total cost of LVSR
- 90% of problems occurring on LVSRs are materials related
- Overwhelming need to be knowledgeable about use of local materials
  - Tend to be variable and moisture sensitive – require use of appropriate designs, construction techniques and drainage measures
  - Standard methods of test (e.g. CBR) often do not provide true assessment of performance
  - Conventional specs apply to “ideal” materials and preclude use of many natural gravels (grading, plasticity, strength)
- Regional research work has allowed revised specs to be derived for major groups of natural gravel materials found in region.

Examples

Materials Options


Crushed limestone

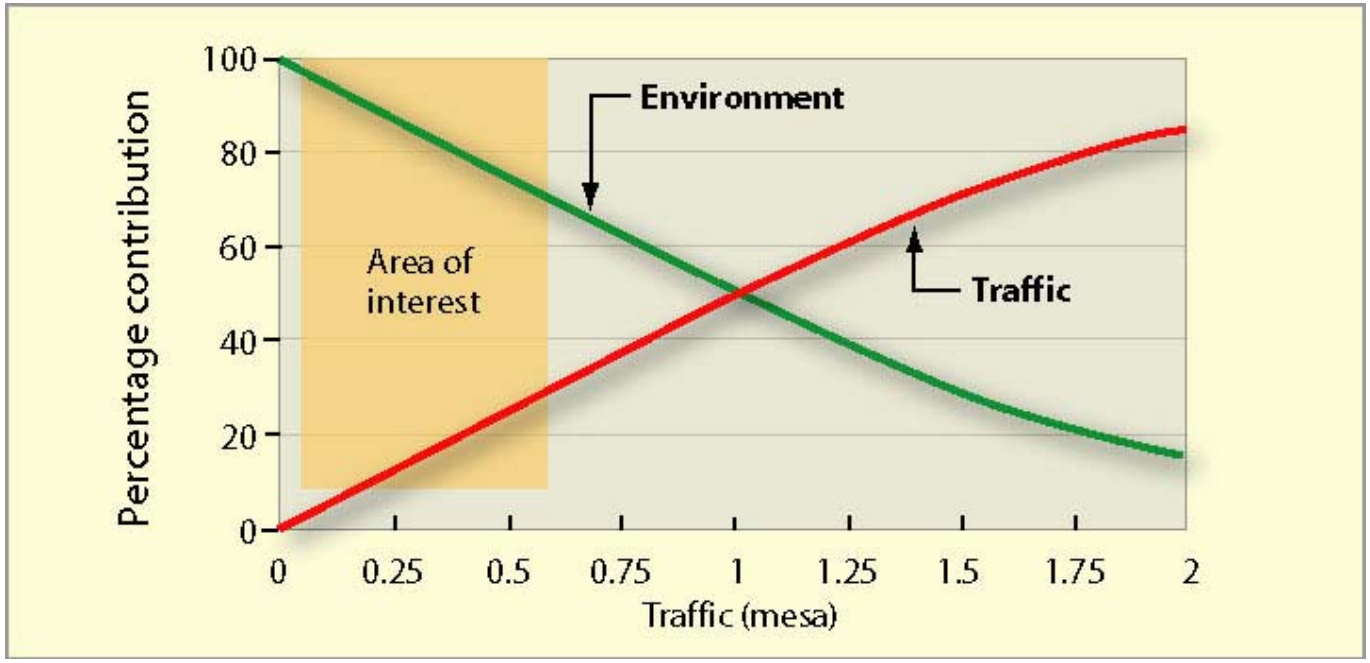

As-dug, nodular laterite


Laterite


Calcrete

Pavement design and materials

Traffic characteristics

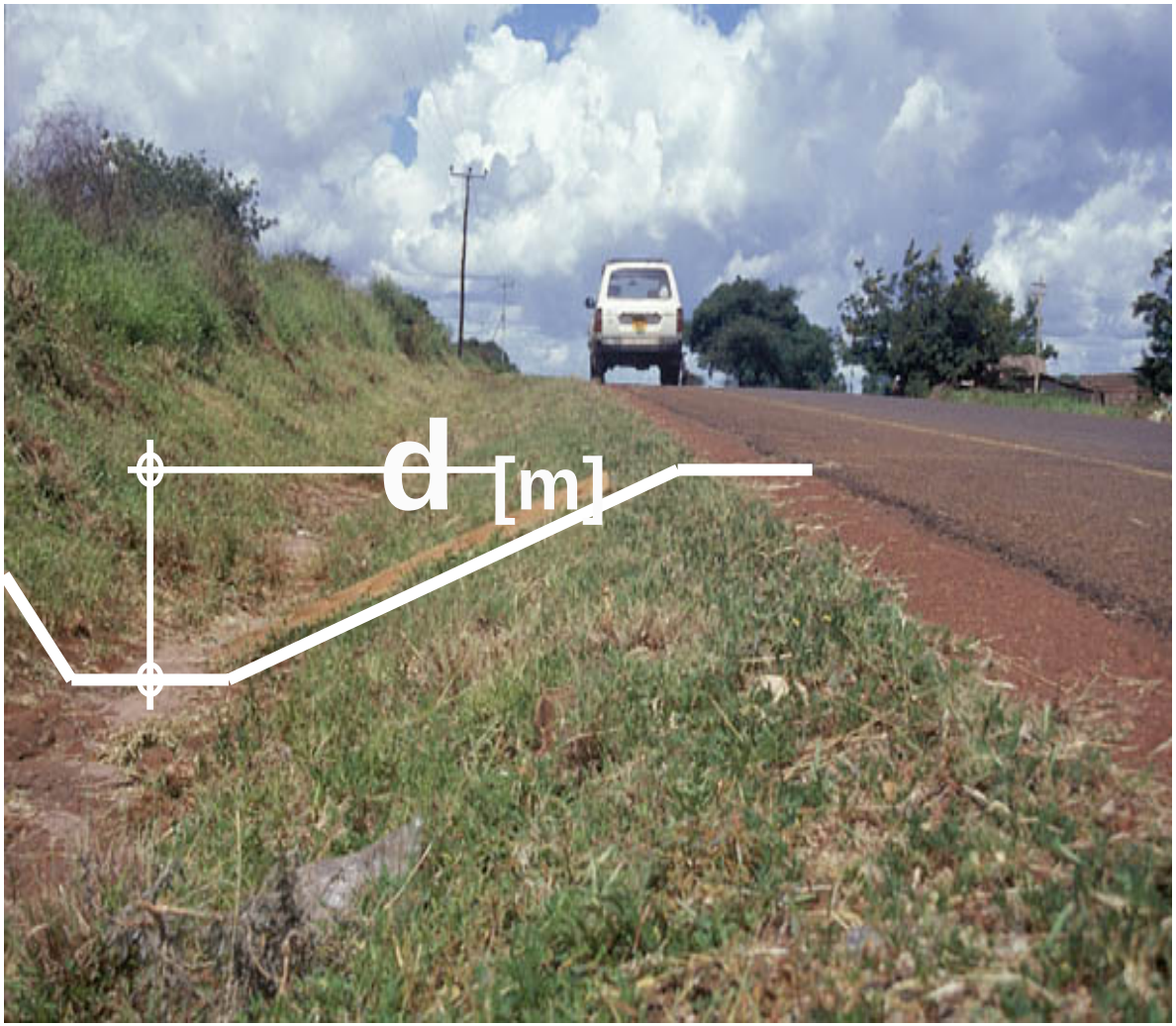


- Most design methods used in SADC region cater for relatively high volumes of traffic, typically in excess of 0.5 million ESAs over a 10–15 year design life with attention focused on load-associated distress.

- For large proportion of LVRs in the region, carrying < 0.30 million ESAs over their design life, priority attention should be focused on ameliorating effects of the environment, particularly rainfall and temperature, on their performance

Examples

LVSR Pavements



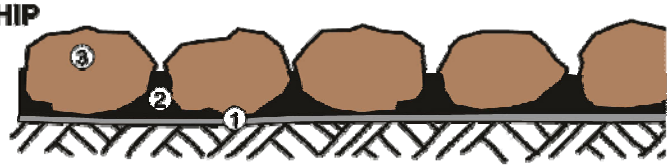
- Crown height is a critical parameter that correlates well with the actual service life of pavements constructed from natural gravels (≥ 0.75 m)
- Sealed shoulders reduce/ eliminate lateral moisture penetration under carriageway
- Avoiding permeability inversion facilittes good internal drainage

Examples

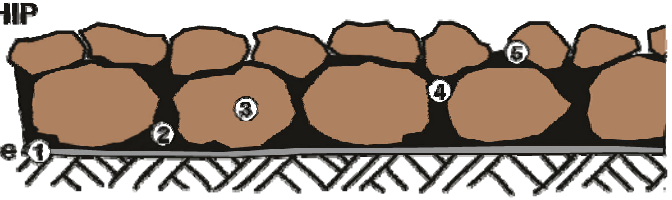
Surfacing Types

SAND SEAL
1 Prime
2 Binder
3 Sand

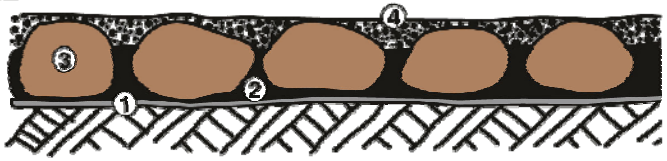
SINGLE CHIP SEAL
1 Prime
2 Binder
3 Stone



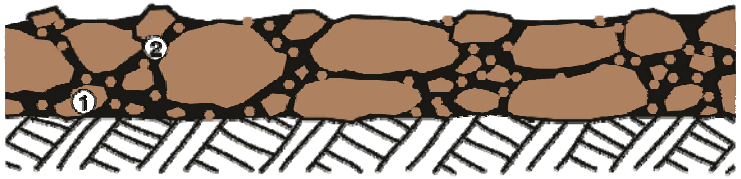
DOUBLE CHIP SEAL
1 Prime
2 Binder
3 Large stone
4 Binder



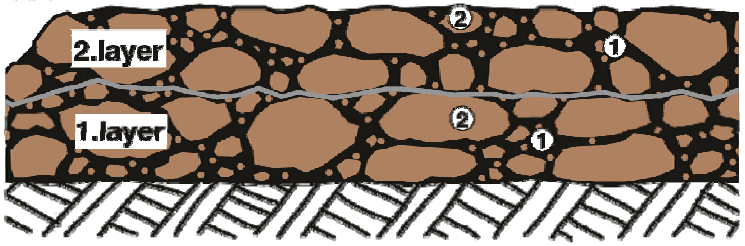
CAPE SEAL
1 Prime
2 Binder
3 Stone
4 Slurry



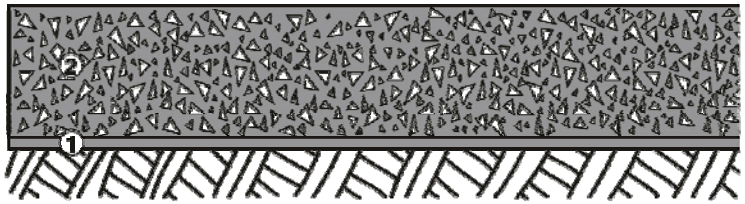
SINGLE OTTA SEAL
No Prime
1 Binder
2 Graded aggregate



DOUBLE OTTA SEAL
No Prime
1 Binder
2 Graded aggregate



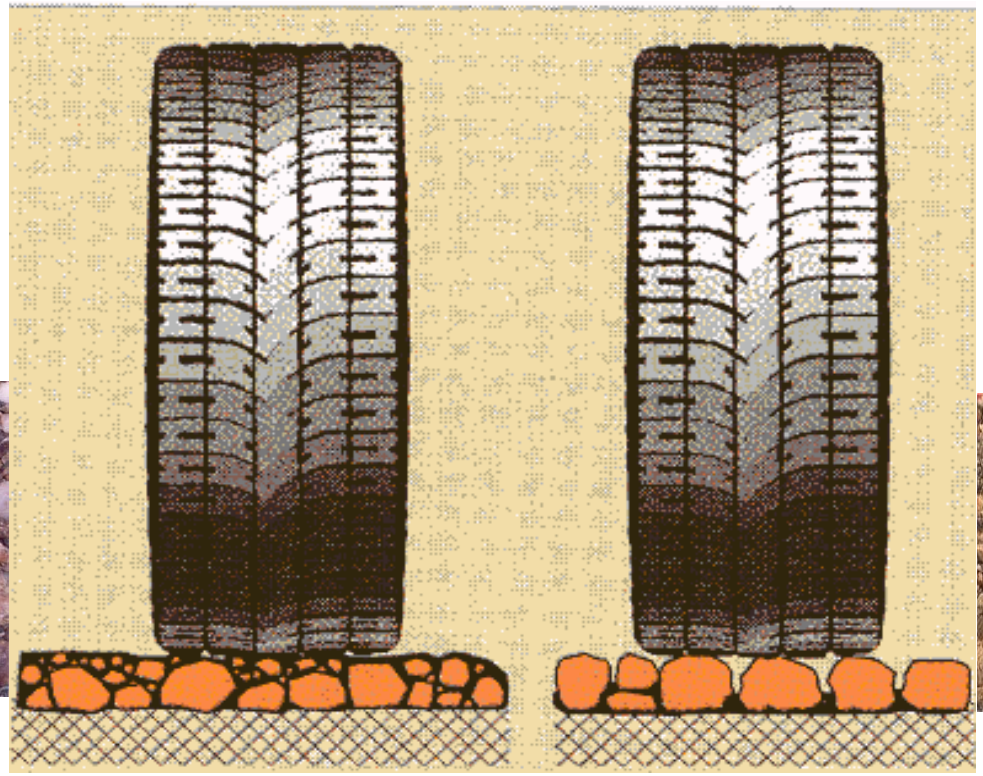
ASPHALT CONCRETE
1 Prime
2 Asphalt Premix



Examples

Surfacing types

Otta Seal



Chip Seal

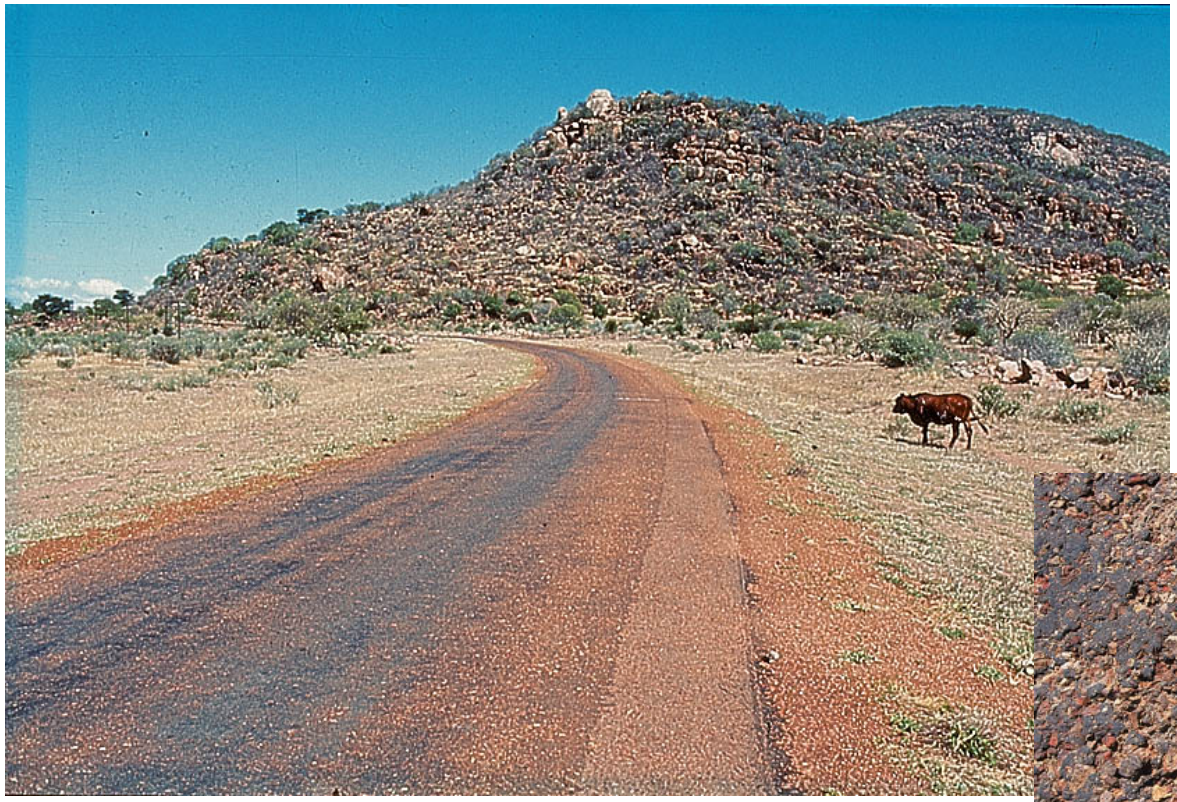
Examples

Surfacing types – Otta Seal

Use of screened lateritic gravel for surfacing

Examples

Surfacing types – Otta Seal



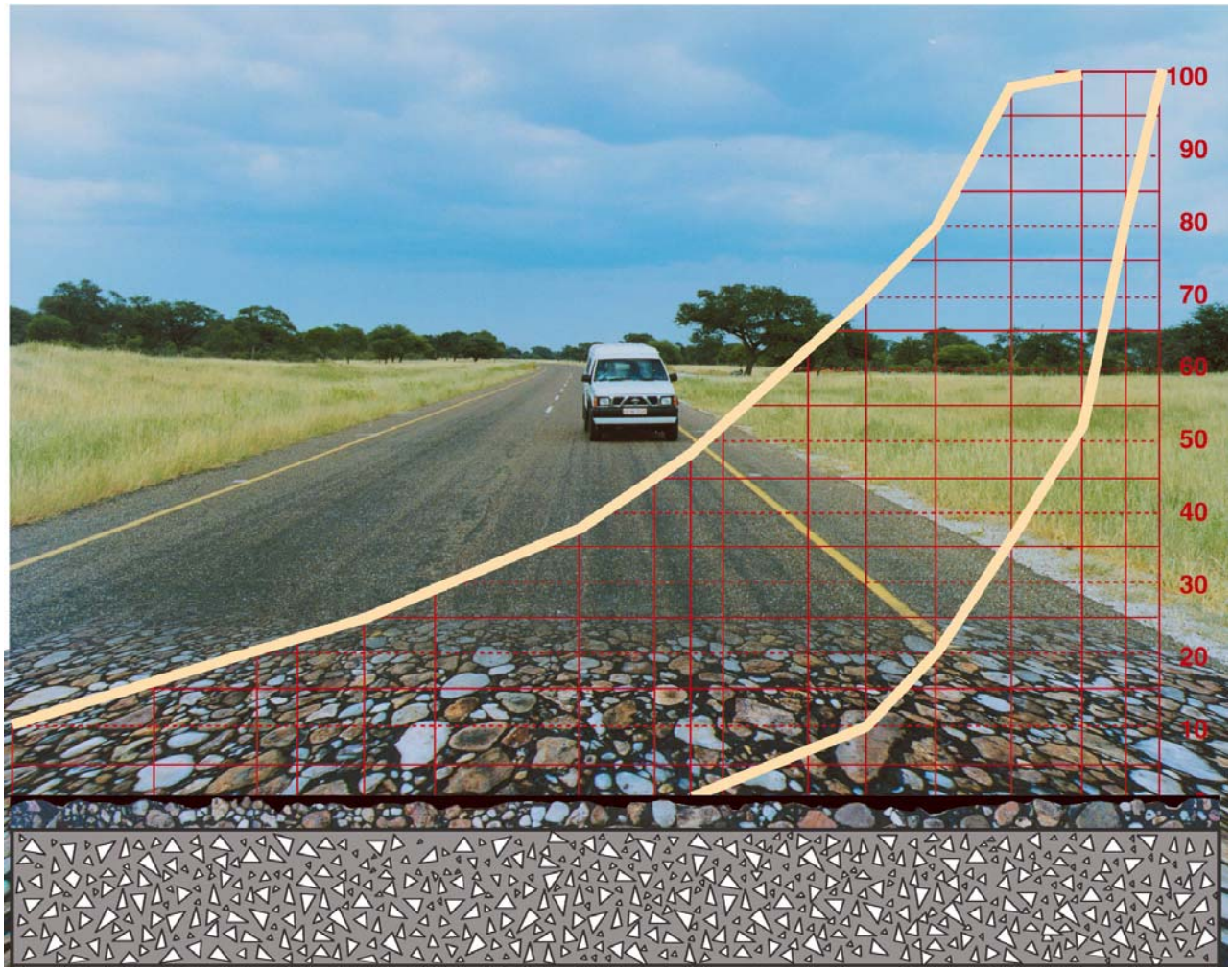
Surfacing after 8 years service with NO maintenance!

Examples

Surfacing types - Otta Seal

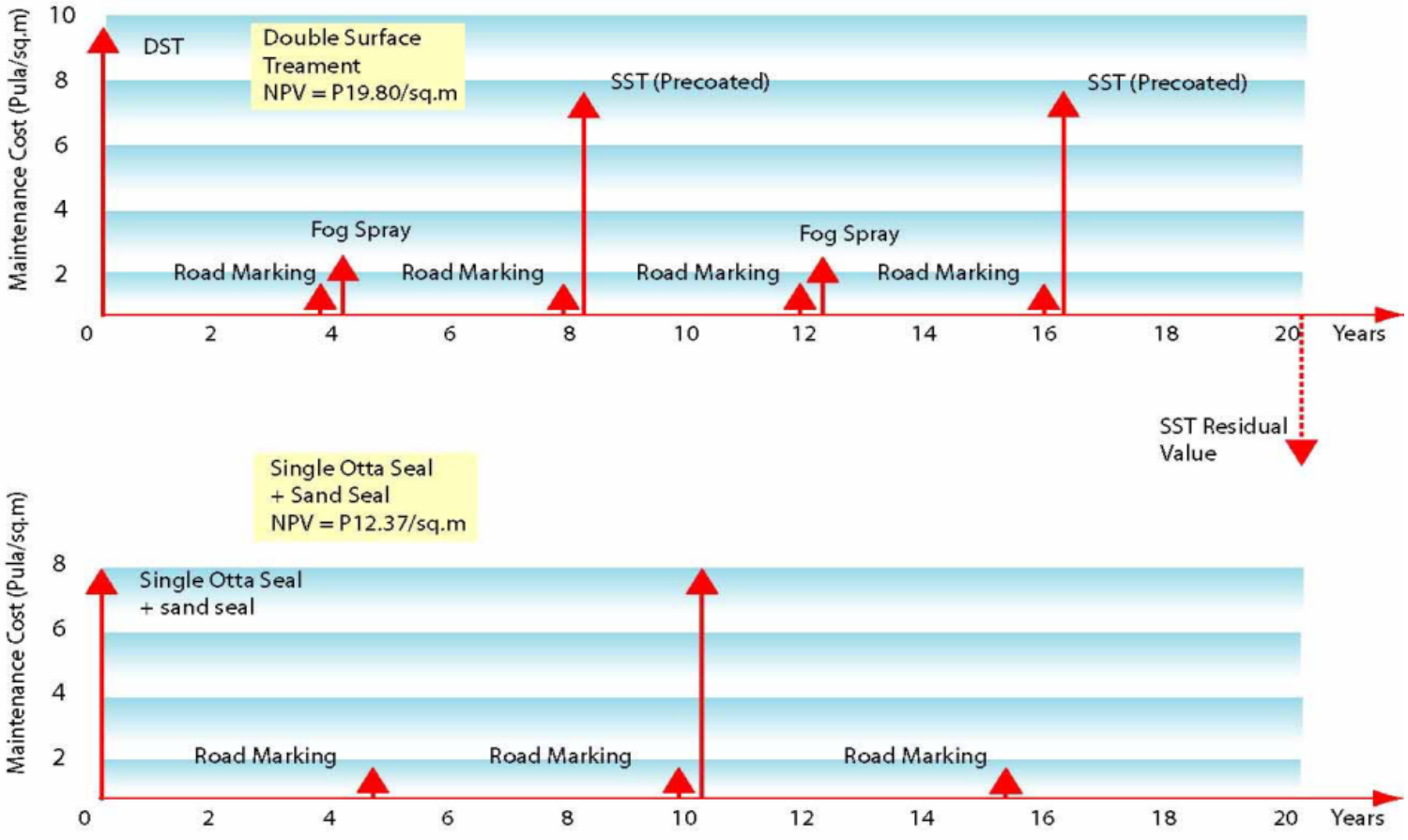
Examples

Surfacing types - Otta Seal



Examples

Surfacing types – Costs Comparisons

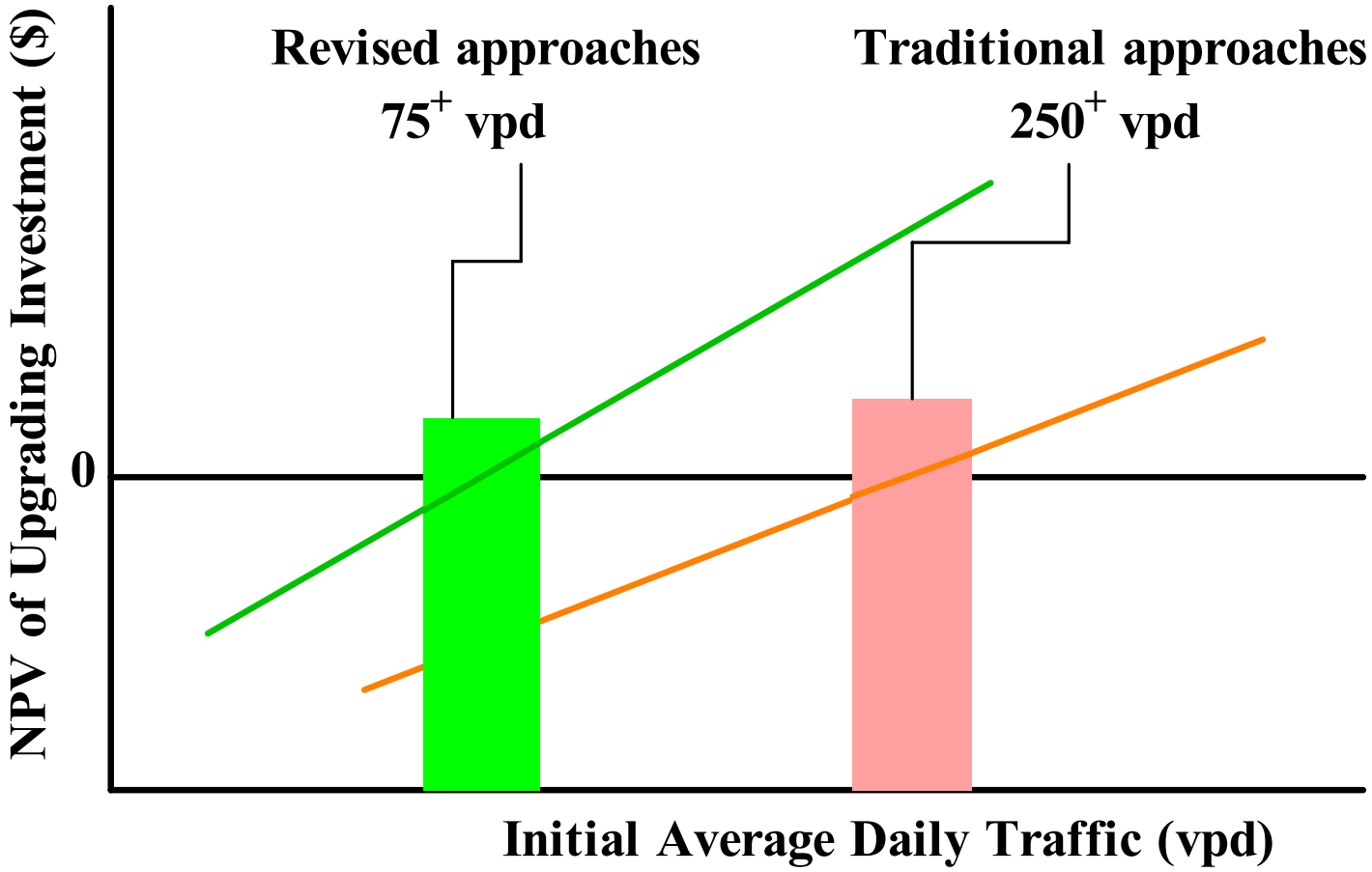


Benefits of Adopting Recommendations

Option	Potential Benefits
● Replacing a conventional geometric design process by a "design by eye" approach, where appropriate	● Reduced earth works and environmental damage.
● Use of more appropriate pavement designs and natural gravel rather than crushed stone.	● Reduced pavement costs due to lesser haulage distances and reduced materials processing costs.
● Utilising an existing gravel wearing course e.g. as base or sub-base .	● Reduced haulage distances and materials costs.
● Compacting pavement layers to refusal, where feasible, rather than to arbitrary prescribed levels.	● Increased density, reduced road deterioration and increased maintenance intervals.
● Adopting appropriate surfacing technologies such as sand seals and Otta seals.	● Reduced haulage distances, reduced processing costs.
● Increasing the use of labour and local resources where appropriate.	● Lower economic/financial costs for specific tasks.
● Using seals as a spot improvement measure.	● Reduced surfacing costs whilst maintaining year round access.

Benefits

Life cycle cost analysis



Break-even traffic: Traditional vs revised approaches

Examples

Overloading

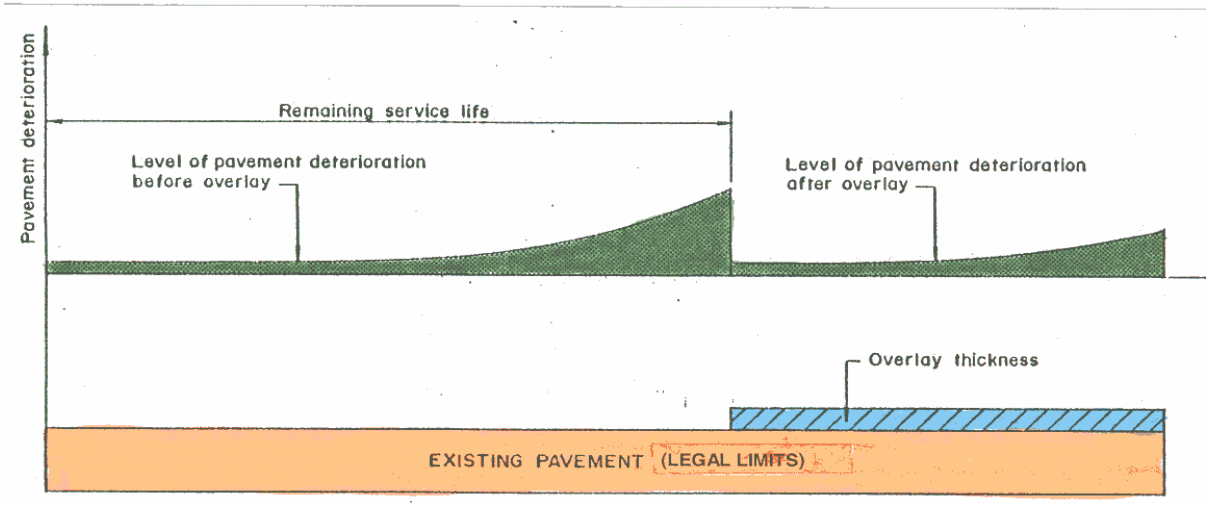
Examples

Impact of Overloading on Pavements

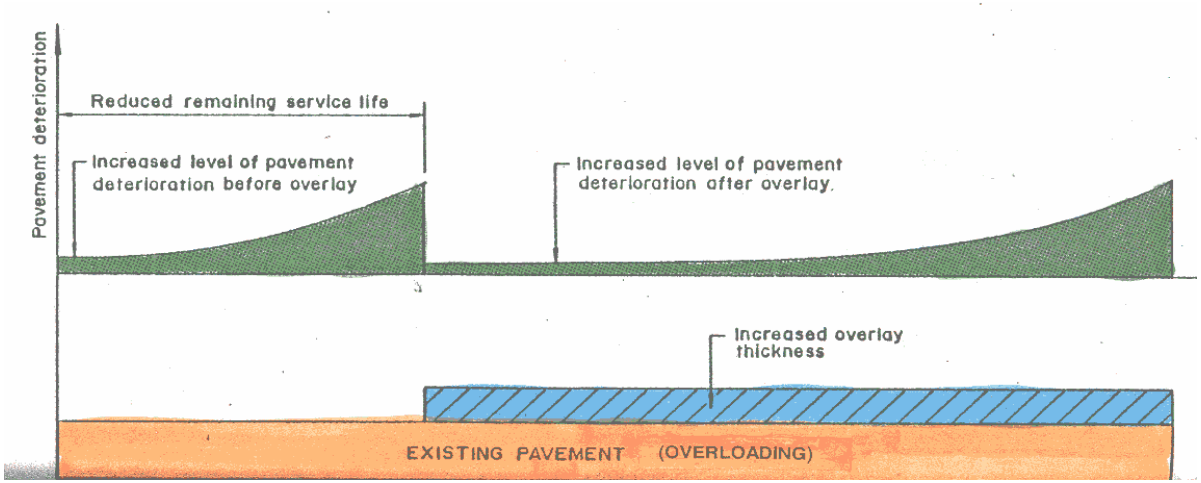
Examples

Impact on Pavements

Pavement performance under legal load limits



Pavement performance under overloading



Examples

Cost of Overloading

- **Botswana – 2004 US $2.6 million**
- **South Africa – 2002: US $100 million**
- **Sub-Saharan Africa – 2004: US $500 million**

Examples

Developments in Overload Control

- Mandatory off-loading of over-loaded vehicles
- Decriminalisation of offenses for overloading by handling them administratively and imposing a requirement on the overloader to pay an overloading fee
- Linking level of imposed fees for overloading with actual cost of road damage, i.e. by imposing economic fees
- Outsourcing weighbridge operations to the private sector on a concession basis, i.e. embarking on a commercialised public/private sector approach to overload control

Examples

Modern Weighbridge Equipment

Examples

Competing for road space

Examples

Road Safety – examples of a forgiving road side

The problem

Vulnerable road users

The Solution

Relatively low cost engineering measures

Examples

Road Safety – examples of a forgiving road side

Examples

Environmental issues – borrow pits

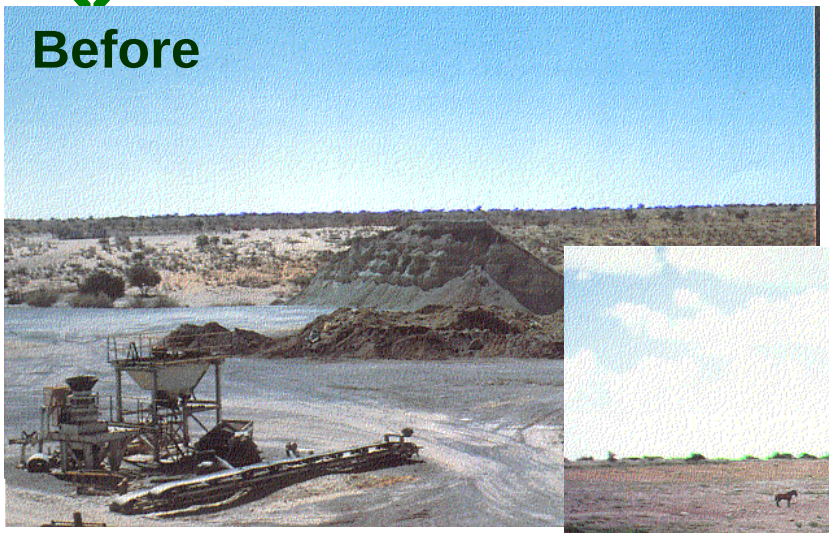
Typical, un-renovated borrow-pit in the SADC region

- **Children exposed to risk of drowning and poor quality water**
- **Ponding increases level of mosquito-borne disease**

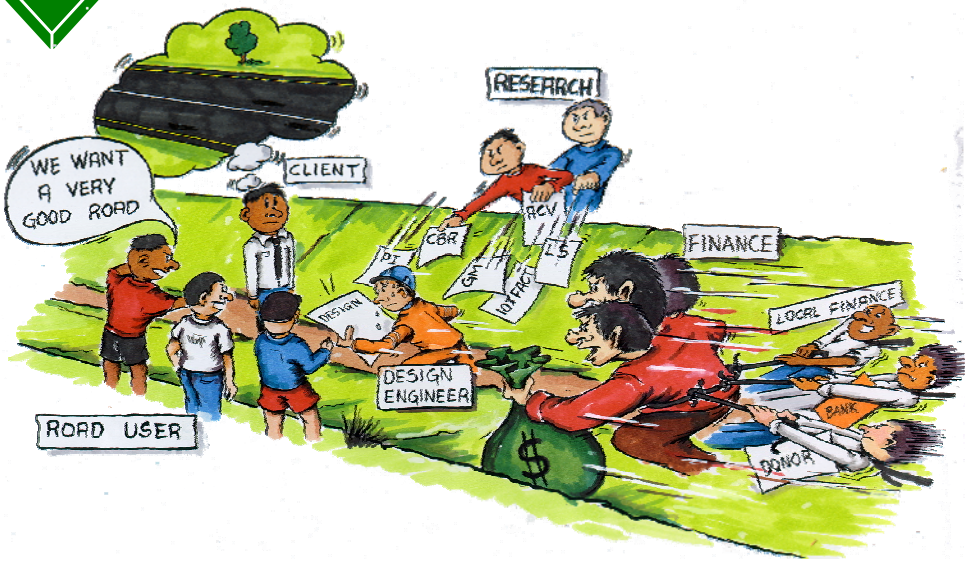
Introduction of Technical Audits at Feasibility Stage

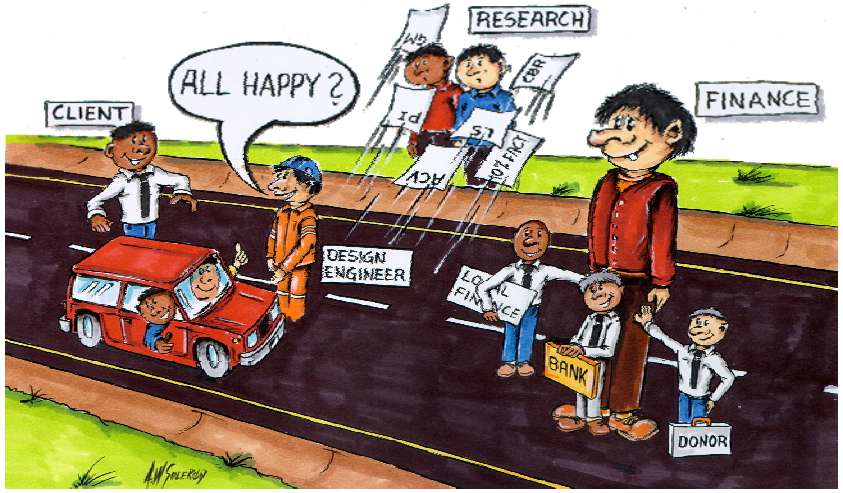
Examples

Environmental issues – borrow pit restoration



The Final Result – A Meeting of Minds





The Final Result

The successful engineering of a low volume sealed road requires ingenuity, imagination and innovation. It entails "working with nature" and using locally available, non-standard materials and other resources in an optimal and environmentally sustainable manner.

It will rely on planning, design, construction and maintenance techniques that maximize the involvement of local communities and contractors.

When properly engineered to an appropriate standard, a LVSR will reduce transport costs and facilitate socio-economic growth and development and reduce poverty in the SADC region.

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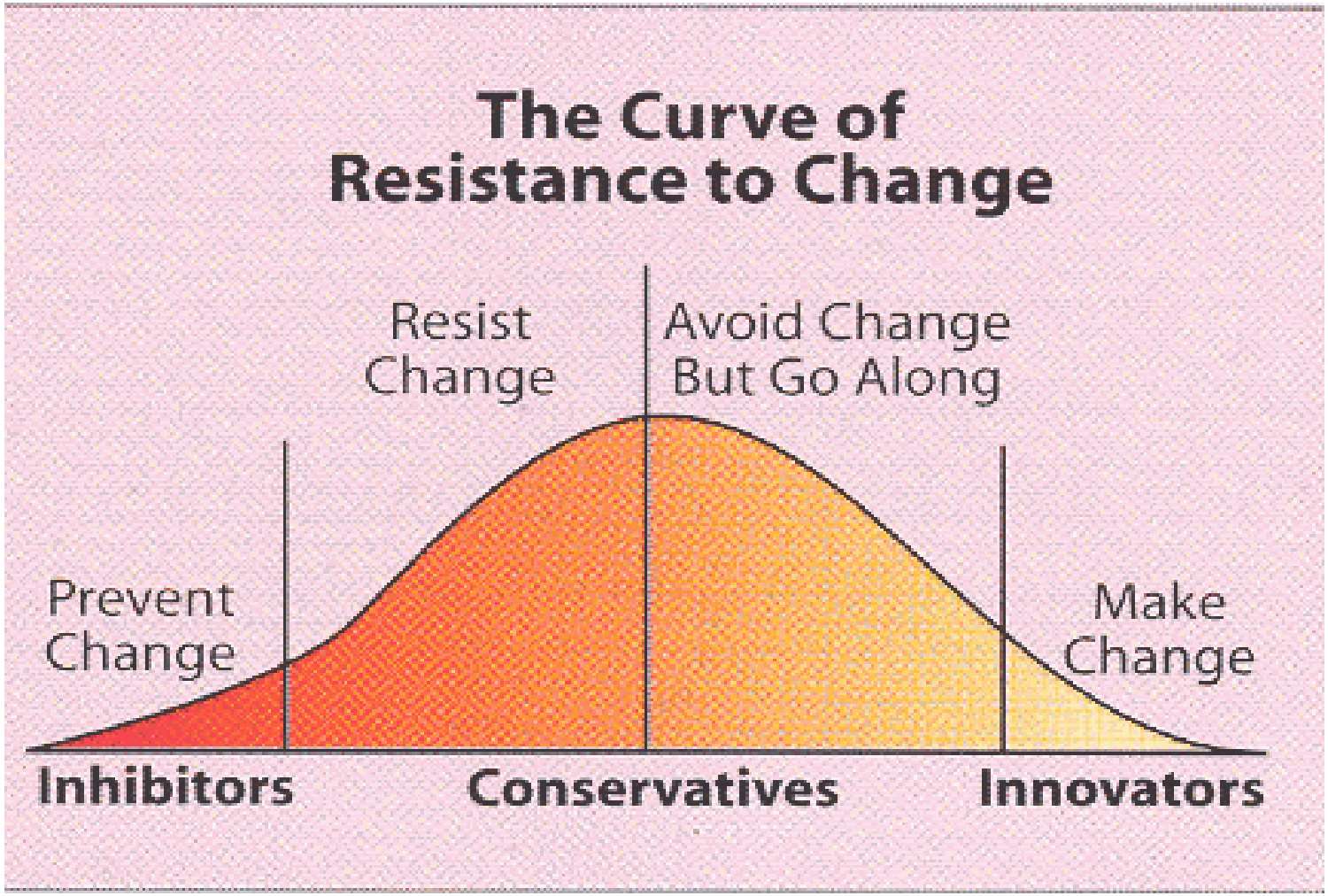
- Examples of Guideline in Practice
- Way Forward

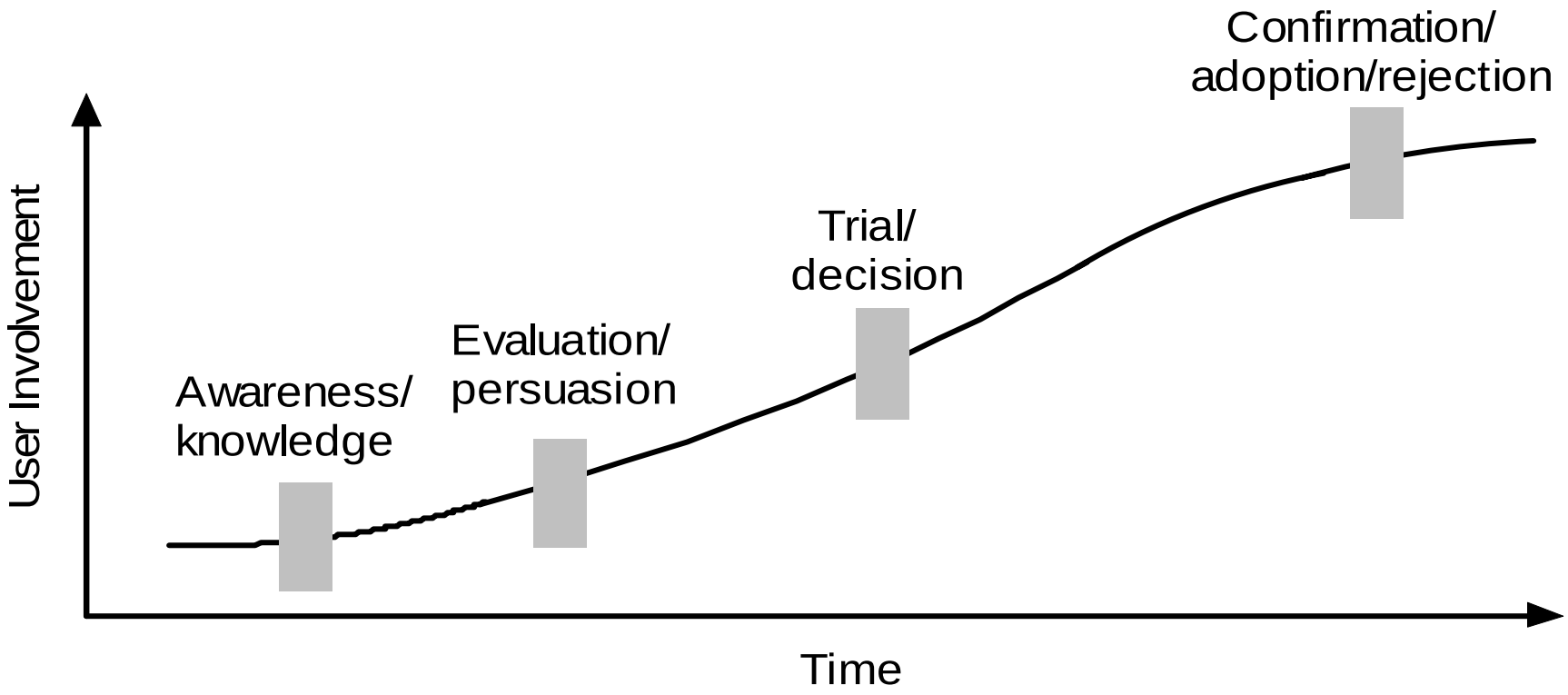
Way Forward

Resistance to Change



Way Forward

Phases in Uptake of New Technology



Way Forward

Impact

- Great demand for guideline – new printing envisaged
- Guideline used as teaching aid in USA and S. Africa – could be extended to technical colleges, etc.
- De-regionalisation of guideline planned to widen application outside of SADC region
- Request for companion document of “best practice”
- Furthering application of guideline recommendations thro’ demonstration projects in Tanzania
- Revision of Botswana Road Design Manual and Standard Specification

Way Forward

Summary

- Production of guideline has been a collaborative effort by donors (DFID, NORAD, SIDA)
- Manner of development has been participatory amongst stakeholders in SADC region
- Main purpose has been to present more holistic, innovative and sustainable approaches to provision of LVSRs
- Where guideline has been applied, significant benefits have accrued
- Still some institutional resistance to changing conventional practice
- Much potential for widening application outside SADC region
- Country support required for changing outdated standards and specs

Way Forward

Summary (Cont'd)

- Need to promote application of guideline and, in so doing, demonstrate benefits.
- Ultimate goal of poverty reduction is achievable through provision of more sustainable access to majority of rural populations in developing countries

Finally – Our Vision

"It is not wealth which makes good roads possible – but, rather, good roads which make wealth possible – Adam Smith

Thank you