



RURAL ROAD ASSET MANAGEMENT: A FOUNDATION FOR SERVICE DELIVERY IMPROVEMENT

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ABSTRACT

Effective management of Municipal infrastructure is key to an acceptable standard of service which have a direct impact on standard of living. National DoT, as part of the S'Hamba Sonke Programme, made grant funding available for the implementation of Road Asset Management Systems (RAMS). Improved data on rural roads will guide infrastructure investment, improve accessibility to and mobility of rural communities and the prospect of future development. It has been structured to respond to the prevailing statutory accounting compliance requirements, and recognised good practice pertaining to infrastructure asset management, substantiating decisions that will have a direct impact on service delivery.

It is a cost effective approach with a practical slant to road asset management and bridge management. Road Asset Management may be defined as a systematic method of information collection, evaluation and decision-making, which is necessary to permit the optimisation of resources for the maintenance, rehabilitation and the construction of pavements. Where one can see the whole picture within the current dispersed environment where inadequate or incompatible systems for managing information and communication can be amalgamated, enhancing hotspot analyses and visual reporting. RRAMS is a data-driven DSS that supports decision making through allowing users to extract and analyse useful information that was previously buried in large datasets collected in silos. This initiative is aimed at addressing the on-going deterioration of South Africa's road network and has provided opportunities for small and emerging contractors aligned with the outputs as stipulated by the S'hamba Sonke program. Deteriorating infrastructure leads to poor service delivery and reduced payment by consumers, exacerbating lack of cost recovery in many cases, this may lead to strikes and protests which can become violent. Working together, we can establish a Balanced Service Delivery Centre to the benefit of all in the country.

INTRODUCTION

Being well aware that effective management of municipal infrastructure is key to municipalities providing an acceptable standard of services to communities; National Department of Transport embarked on a drive to assist those municipalities with skills shortage in the management of their respective road infrastructure. Infrastructure has a direct impact on the quality of our living environment and opportunities for communities to prosper. Municipalities must demonstrate good governance and the processes adopted must be efficient and sustainable.

BACKGROUND

National DoT, as part of the S'Hamba Sonke Programme, made grant funding available for the implementation of Road Asset Management Systems (RAMS), as set out in the framework for the Rural Road Asset Management Grant (RRAM), Division of Revenue Act (DoRA). The strategic goal of the RRAM Grant is to ensure efficient and effective investment in rural roads through the development of Road Asset Management Systems (RAMS) and the collection of associated road and bridge inventory data, condition assessments, road-related assets such as road signage, pipes, storm-water etc. and traffic information. DoRA highlights and illustrates the interdependency in obtaining the ultimate goal of sustainable service delivery within all departments.

OBJECTIVES

Improved data on rural roads will guide infrastructure investment, improve accessibility to and mobility of rural communities and the prospect

of future development. As this information is fully transparent, Government will have a handle on it at all times, guiding proper planning on spending of infrastructure funds (from the MIG and elsewhere). This can be achieved by transparent monitoring of performance and monthly expenditure through a fully web-based system which implies that management information on all projects is accessible 24/7 disjointed from infrastructure constrictions. Information is available per department, on portfolio or per province or even at a lower level, should such information be required. Providing essential information for network level projects such as principal inspections, partial inspections, completion inspections and visual assessments. Information can be drilled down for project level inspections and maintenance program implementation.

It has been structured to respond to the prevailing statutory accounting compliance requirements, and recognised good practice pertaining to infrastructure asset management. In addition, good engineering best practice is encapsulated into the offering which provides a professional and sustainable solution to national government. Obtaining adequate warning before serious structural failures occur, disrupting service delivery, due to extensive knowledge of the current state of infrastructure and historic records of spending, repairs and strengthening. Enabling future budget forecasting through detailed and summarised reports.

This supports "whole of life" asset costs ensuring that funds are to be allocated for the complete life cycle of assets, including the operation, maintenance and replacement cost associated with assets. Benefits include knowing the location, condition and usage of the available infrastructure whilst building human capacity, economic empowerment and community upliftment. Optimum efficiency enhancement of Service Delivery require the implementation of an interrelated, transparent infrastructure monitoring and management system. This should harbor best practices, coaching, knowledge management, and human resource skills development. The primary aim of RRAMS is to integrate all relevant road asset information and improve maintenance planning, communication between Municipalities, Province and National DoT, thereby substantiating decisions that will have an impact on one another. It is a cost effective approach with a practical slant to road asset management and bridge management.

APPROACH / METHODOLOGY

This paper highlights how a Holistic approach to the establishment of skills and support for Provincial Departments, Districts and Local Municipalities proves to be effective as a solution to eradicating service delivery challenges encountered in the past through:

- Establishing institutional knowledge
- Ensuring Legislative Compliance, based on DoRA
- Expanding and developing Technical Capacity through skills transfer programs
- Solving Technical and Maintenance problems
- Creating Employment Opportunities
- Improving Level Of Service (LOS)

In essence the methodology is based on the visual assessment of roads, which originates with road location inventory, together with TMH-9 and TMH-12 condition assessments incorporating the new TRH-26 (South African Road Classification and Access management manual), TMH-14 (South African Standard Automatic Traffic Data Collection), TMH-22 (Road asset management manual), TMH-19 (Manual for the visual assessment of road structure) and TMH-18 (Road Asset Data Electronic Exchange Formats). Developing a deep business intelligence and data modeling solution, encompassing a unique institutional knowledge base of the Governmental environments. With a primary goal of creating and establishing a transparent and accessible Asset Data Warehouse at the national programme management office, where all data pertaining to infrastructure and service delivery in the country for all departments are hosted. Guiding Grant allocation and funding programs based on



justifiable fact voided of intimidation and influence. RAMS comprises of an Interactive Road Asset Management System for Paved and Unsurfaced roads, incorporating RISFSA (Road Infrastructure Strategic Framework for South Africa), now redefined as the Road Classification and Assessment Module (RCAM) and a Bridge Management module incorporating the DER-rating system as stipulated by TMH-19.

KEY FUNCTIONS

Interactive Road Location Reference System (IRLRS)

The RISFSA/RCAM road dataset is geospatially referenced with a base reference system for all measurements of data.

Road segments are uniquely identified by a unique road_id and this id can be used to reference all related road furniture data along with the kilometre position (TMH-18, 2013) for example the blue marker boards on the SANRAL toll routes.

This IRLRS usually have the following minimum attributes and soon to be a national standard enforced by TMH-18:

- **road_id** – Unique identifier across the entire authorities' network.
- **road_num** – A road number allocated to provincial and national roads only.
- **start_km** – Indicating the start km position of this particular segment e.g. N1-22/37.8N
- **end_km** – Indicating the end km position of this particular segment e.g. N1-22/38N
- **surface** – Road surface types are Flex (Bituminous); Gravel; Concrete; Block (Concrete blocks); Joint concrete; Ultra-thin concrete reinforced pavement; Earth and Undefined.
- **class** – The present RISFSA classification from 1 to 5a or 5b.
- **district** – District number
- **length_km** – The length of the road segment.

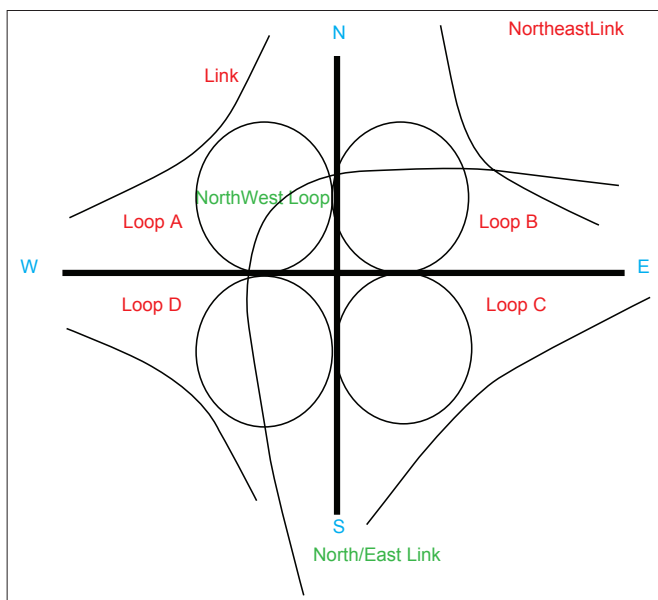


FIGURE 1 Referencing of bridge loops

The minimum requirements for road network data is presently being finalised by the Committee of Road Authorities (COTO) through the publication of the new TMH 18. Referencing of loops may seem more complex:

- On Pavement Management Systems (PMS) begin loop ABC & Slip ABC A: Top left with Northeast referring to the position of the loop.
- Specify under which highway section each reference exists. This will be imports for the use in query tools with a bridge as a possible reference point.

Road Asset Management System for Paved and Unsurfaced roads (RAMS) – RISFSA and RCAM

Road Asset Management may be defined as a systematic method of information collection, evaluation and decision-making, which is necessary to permit the optimisation of resources for the maintenance, rehabilitation and the construction of pavements. The RRAMS prepares budgets and work programs, which will provide the optimum maintenance solutions for the limited funds available through identification, quantification, prioritization and budgeting for rural road networks.

Traffic Control System (TCS)

In the specific purpose grant allocation provided through DoRA, rural District municipalities should be assisted to collect traffic data in line with the Road Infrastructure Strategic Framework for South Africa through manual counts of key road links. All the whilst uplifting the community by using local unskilled labour, obtaining traffic volume data not older than three years for RISFSA Class R1, R2 and R3 roads, and not older than five years for RISFSA Class R4 and R5 roads.

Traffic information lays the foundation for (KZN-DOT, 2014):

- Road network planning for network improvements, alignment, surfacing and paved width changes.
- Traffic planning for the allocation of funds, modal splits and land usage.
- Traffic trends in terms of growth and mode changes
- Pavement management systems; and
- Accident and energy usage analysis
- Bridge Management System (BMS)

All Road Authorities requires some type of Bridge or Structural Management System for keeping an inventory of bridge structures, culverts and other structural assets. In addition, such system should facilitate condition assessments in order to address any safety risks and required maintenance programs. Applying specialised functionality and generating useful maintenance management reports including a GIS module from where all structures are geographically available and coupled to the official Road Location Referencing System (RLRS). A number of GIS themes are available to identify structures with different thematic properties.

A BMS system provides the functionality to serve as a master database, in which all relevant bridge and culvert data can be recorded, assessed and managed. In the past, not much attention was given by District Municipalities to the condition of their bridges and culverts with many bridge rehabilitation and maintenance projects being carried out on an ad-hoc basis. A successful BMS is a valuable tool that can be used by District Municipalities to manage all their structures, allowing for the prioritisation of all structures in terms of maintenance and rehabilitation requirements which would lead to the optimization of funding spent on structure maintenance and rehabilitation works.

It is thus important to rate defects as opposed to giving the respective inspection items an overall condition rating. The rating system used for visual assessments of the structures is called the DER-U rating system, the system helps the inspector to focus on the defects on a bridge or culvert (Struman 2012). The degree (D) of the defect looks at how bad or severe the defect is. The extent (E) refers to how common the defect is on the structure being inspected, with relevancy (R) considering the consequences of this defect with regard to safety of the user and the structural integrity of the asset. The urgency (U) with which the remedial work should be carried out provides a way of applying time limits on the repair work. These time limits usually range from immediate for "Make safe" incidents, within the next five years, within the next ten years or during routine maintenance.

Integrated Management Reports and Graphs

Management reports and graphs are a direct result of integrated information management. Where one can see the whole picture within the

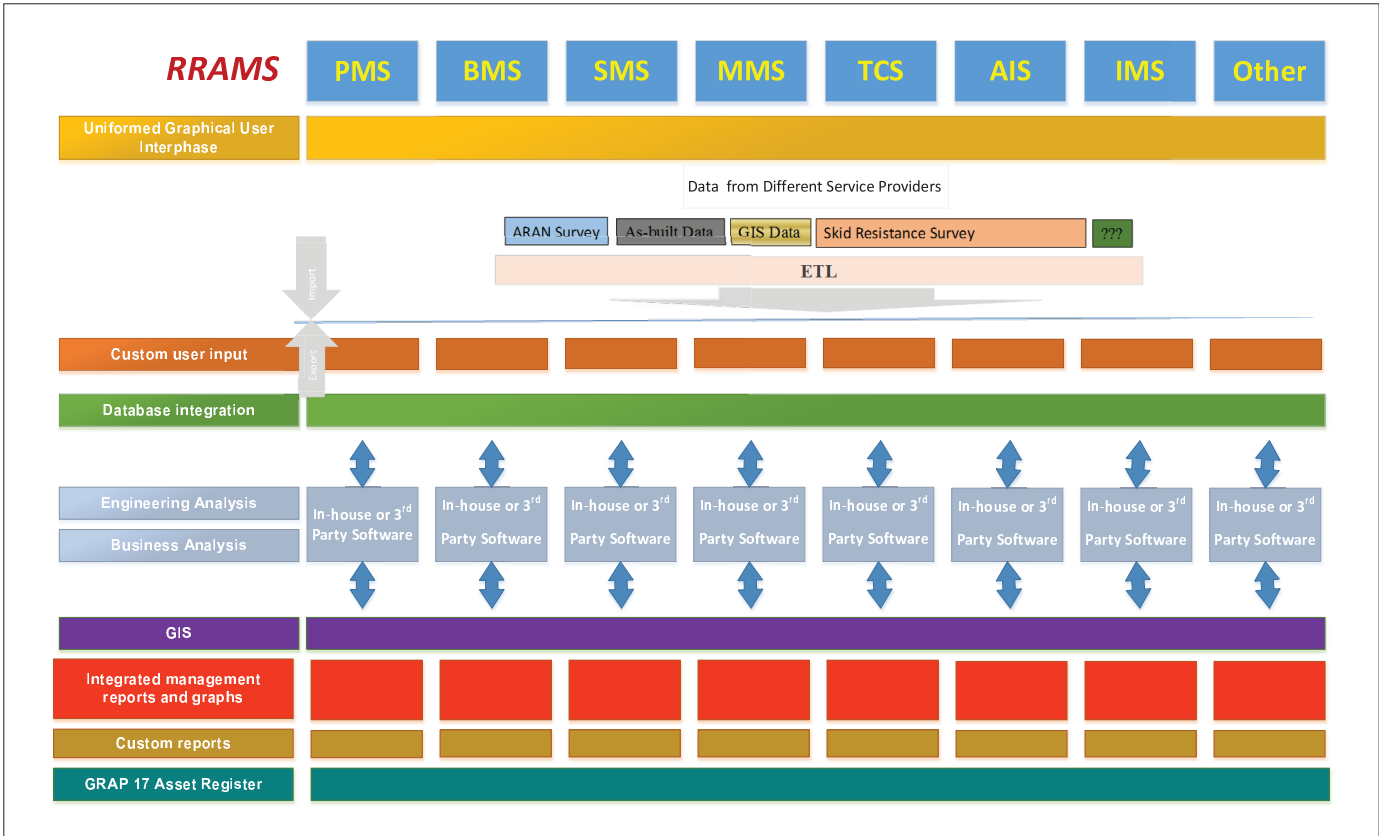


FIGURE 2 Integrated information management

current dispersed system where inadequate or incompatible systems for managing information and communication can be amalgamated.

Integrated Thematic Map Themes

A thematic map is a map that focuses on a specific theme or subject area, especially designed to show a particular theme connected with a specific geographic area. These maps can portray any aspects of the geographical area which is available within the data, examples may include among others, the VCI (visual conditioning index) of a specific road link, the structural priority index and location of infrastructure and average daily traffic per road link. This increase the capability of hot spot analyses and visual reporting.

Spatial Query Facility on Roads (Geo-processing)

Encompassing a user-friendly GIS based, but GIS independent, infrastructure and asset management solution (Hanekom et al 2008). Enabling the user to cut across functional areas in a data mining attempt, revealing information that would otherwise be hidden under layers of

Decision Support System

Decision support systems (DDS) are fundamentally different to Management Information Systems (MIS) in that it is a computer-based information system providing sets of capabilities for non-routine decisions and supports analysis and decision-making within the municipal environment or business sector. Whereby MIS primarily provide information on the business unit performance to help stakeholders in monitoring and controlling the business.

RRAMS is a data-driven DSS that supports decision making by allowing users to extract and analyse useful information that was previously buried in large datasets collected in silos. Through knowledge discovery one can identify novel and valuable patterns in large volumes of data through the

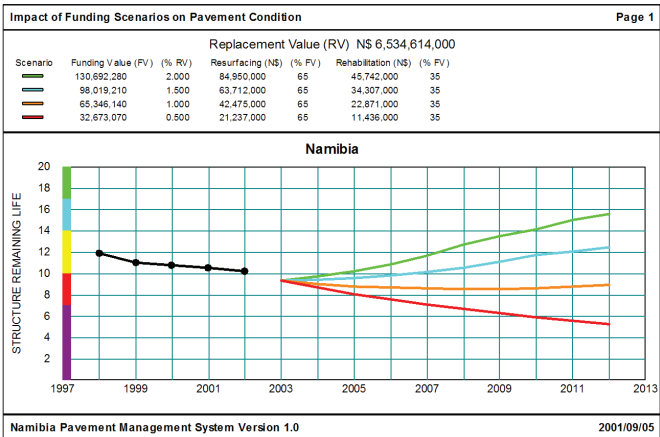
selection, preparation, and evaluation of the contents irrespective of from which sector it originates providing cross functional data analysis and pattern prediction capabilities.

Economic and human CAPACITY building

This initiative is aimed at addressing the on-going deterioration of South Africa’s road network and has provided opportunities for small and emerging contractors aligned with the outputs as stipulated by the S’hamba Sonke program.

The S’Hamba Sonke Programme seeks to empower young people and women, to develop skills and enhance dignity and human worth through constructive labour. It is supposed to target poverty stricken areas in the country and identify the special focus areas that deserves special intervention. Other objectives include building local capacity through skills development and mobilization of resources to improve community facilities

FIGURE 3 Impact Funding Scenarios on Paved Condition



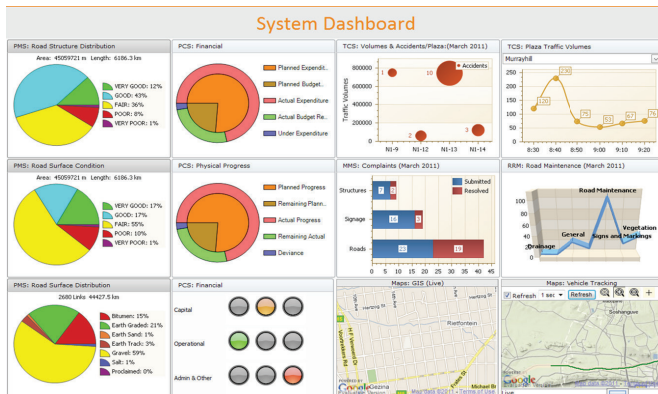


FIGURE 4 Decision Support System

like schools, clinics and other social and economic opportunities by upgrading secondary roads network, fixing and repairing potholes.

National Department of Transport has through the implementation of the RRAMS program through out seven provinces, created positions for ± 150 civil engineering graduates. Most of these graduates obtained their N.Dip. with some being in their final year of registration with ECSA as professional technicians. Assistance provided through this training program among others where (Zululand 2014), Visual Condition Assessment Training and Calibration using tablets and custom developed software. Further practical training would include small group sessions where 2 or 3 graduates do visual condition assessments with an experienced assessor provided by the appointed service providers. All assessors were continuously monitored as part of the quality control measures. The graduates were required to pass a calibration test before they were allowed to work without the supervision of a senior road assessor to incorporate a general standard for this opinion based assessments. The accuracy of the visual assessment data depends largely on the knowledge, experience and commitment of the assessors (TMH 9 1992). Driver training were provided to graduates who possessed a learners licence. This was followed by an advanced driver training course aimed specifically at travelling on gravel roads, and was undertaken in the vehicles that were used for the visual condition surveys (Zululand 2014).

All the graduates attended a Level 1 First Aid course conducted by a accredited Private Emergency Care Training Academy. General occupational health and safety induction as well as a site health and safety induction were provided to all the graduates by a professional site safety officer (Zululand 2014). Practical Training towards National Diploma's, Graduates that have not obtained their Civil Engineering Diploma's used the current employment period as their practical year – this experience would then be signed off by their Mentor at the end of the year. Graduates that have already obtained their Diploma's have been registered with ECSA as Technician's-in-Training. Their log books will be signed off by their Mentor after each phase of the project (e.g. after GIS centreline set development stage, then after the visual assessments have been completed, etc.)

Introduction to Road Building Materials and Practical Road Pavement Engineering basic theory was provided by professionally registered engineers with site visits to depict practical experience in placing of asphalt (A - E2) surface overlay with a 13 mm rolled in chippings.

- Design, Construct and Maintenance of Gravel Roads
- Design, Construct and Maintenance of Low Volume Roads

MobiCap user training sessions were conducted to aid in the use of a road inventory data capturing software. In-house GIS training and support provided by the service providers in conjunction with a formal classroom training session delivered by ESRI South Africa, in the use of Arc Map and non-accredited training in the use of QGIS open source software.

Graduates attended the following accredited training courses (Zululand 2014):

- Occupational Health and Safety (2 days)
- Introduction to Road Building Materials (3 days)
- Practical Road Pavement Engineering (3 days)
- Design, construction and maintenance of gravel roads (2 days)
- Design, construction and maintenance of low volume roads (3 days)
- Bridge and culvert inspector's visual assessment and
- Introduction to bridge management course (3 days)

CONCLUSION

South Africa has infrastructure assets with a replacement value of several Hundred Billions of Rands. Limited skills are available for effectively managing this aging infrastructure. Principles to adhere to and of importance to remember are that "Service Delivery" does not end with the commissioning of the infrastructure. Effective management of infrastructure is required to ensure each facility reaches its design lifetime and with it a balanced service delivery environment. "Money saved" on management of assets is not a saving and it becomes a vicious circle once infrastructure is allowed to deteriorate.

Expensive refurbishment becomes necessary and there is even less money for ongoing maintenance. Deteriorating infrastructure leads to poor service delivery and reduced payment by consumers, exacerbating lack of cost recovery in many cases, especially in South Africa, lead to strikes and protests which can become violent. Working together, we can establish a Balanced Service Delivery Centre to the benefit of all in the country. RRAMS is a combination of a condition based system and a defects based system to find a symmetry in identifying and repairing defects which have a direct consequence on the integrity of services and where safety of users or the community are at risk. RRAMS aims to optimise and prioritise all remedial work activities required to repair or maintain specified services given a limited budget.

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