

Taking the Namibian Road Management System to the next level

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Abstract

The Road Management System of Namibia Roads Authority has been in operation since 1998, with continuous updating and maintenance throughout this period. The System, utilising both international acceptable methodologies and local experience, is considered one of the most successful systems in Africa. RMS of Namibia has been in a leading role because of adhering to international standards but in a localized context. It can assist many developing countries to take this system as a prototype for their own development.

The current system consists of several sub-systems, all integrated and accessible from one front end to assist the organisation with strategic planning, tactical planning, design and project management.

The continuous operation of the RMS, feedback from different levels of management and the international drive towards total asset management has highlighted specific needs to take the system to the next level.

This paper summarises the structure and functions of the existing system, highlights the benefits of continuous operation and system maintenance and then focuses on four main identified improvements namely, converting priorities to practical work programs, relevant key performance indicators and rationale for selected targets, balancing funding between new roads and maintaining existing ones and keeping track of ideal funding requirements, approved budgets, annual expenditure and impact thereof. It is called Network Integration Module version III.

1. INTRODUCTION

Namibia, officially known as the Republic of Namibia, is a country in southern Africa on the Atlantic Coast. The country has an area of 825,418 km² with a population of only two million people. The GDP is estimated at US\$ 12,58 billion (2013), with an inflation rate of about 5% per annum. Namibia has a good road infrastructure and good services, and is attractive to investors due to its stability and investment incentives. The currency is N\$ which is equal to the South African Rand. At the time of writing, 11N\$ equals to approximately 1US\$.

The aim of this paper is to share the background of the Road Sector Reform, the history of the development of the Road Management System (RMS) of Namibia, and above all the improvement on the RMS and its challenges and opportunities. The system has been in existence since 2001 with the first output, but has gone through a huge evolution and has a vision to take the existing system to a higher level, whether it is with its data collection, ease of analysis, and to make the output accessible to the users, by utilizing various technologies including hand held devices.

This paper will focus on what ingredients are needed to take the RMS of Namibia to the next level. The RMS is a cross cutting concept between Budget, Performance, Corporate Governance, Transparency, Systematisation and Standardization within a Road's Organisation. It also gives "information", assists with "planning", and assists with "control or monitoring" through its various systems on strategic, tactical and operational levels.

The paper will demonstrate how the output of the RMS was utilized for sound decision making in the RA, and how it was an instrument for motivating more funding, to the extent that it has become one of the "trigger conditions" for funding by the donor community to release funding for the Roads Authority (RA).

It is a good model that can be used as an example for a developing country and competitive with any international standard as it adheres to good Road Management principles. The RMS of Namibia is a success story and needs to be shared with the international community, especially for Africa, as this system was developed by Africans. The only two countries in Africa with integrated and matured RMS are Namibia and South Africa according to a study that was made by the Association of Southern African Road Agencies (ASANRA) in 2009.

The "System" connotation has confused many road sector related people, as it is always equated with computers, and hence few years back a definition was agreed on in the RA.

There are many definitions of a RMS, and Namibia's comprehensive definition as stated in the Procedures agreement of the RA and Road Fund Administration (RFA) states, "A Road Management System (RMS) is an all encompassing framework, including both information processing and human resources, for the integrated management of the road network, including the determination and optimization of economically warranted projects, programmes, strategies and budgets, for both development and maintenance".

The next stage for the Namibian RMS is to be recognized as a fully integrated Asset Management System and not just a "tool" that is left at the central laboratory; where numbers are

crunched and outputs provided. It has developed to such an extent that it gives recommendations, advice, and audit mechanisms at all levels.

This will be achieved especially when the Network Integration Module version III is finalised as it will give the high level strategic output for the performance of the whole organisation, which will assist any stake holder to measure the RA. It will also assist the RA to be ready at any time to provide the output with a click of a button. The pressure on CEO's to provide information to the public, to the mother ministry, to government, and donors is increasing with time, and this paper will show how that information is available and with the next generation of the RMS how it is envisaged to be accessible by all interested parties for the development not only of the Road Network but as a main contributor for the Vision 2030 and the National Development Plan iv of the government. "Infrastructure" is placed as one of the enablers.

2. BACKGROUND TO THE ROAD SECTOR REFORM AND DEVELOPMENT OF THE ROAD MANAGEMENT SYSTEM

Following Namibia's independence in March 1990, the government adopted a "White Paper on Transport Policy", which called for the improvement in the performance of the transport sector, encouraging competition as the main instrument to achieve increased efficiency. It also called for the implementation of a road user charging system for the full recovery of costs to provide and maintain the road infrastructure according to the principle of minimising transport costs, with co-financing from general revenue sources for that part which does not directly benefit road users.

The institutional Government reform resulted in the establishment of the Roads Contractor Company, Roads Authority and the Road Fund Administration. The Roads Authority (RA) manages Namibia's rural (national) road network and functions under the auspices of the Minister of Works, Transport and Communication,. The Road Fund Administration manages the Road User Charging System and reports to the Minister of Finance.

During the restructuring process, and as a result of the new Act 17 of 1999, requiring the development and implementation of a formal Road Management System, the Department of Transport at the time embarked upon the development of a Master Plan for the RMS. This Master Plan mapped out how the RMS of Namibia should be developed, funded, and implemented (Reference 1). This was followed by an Architectural System Design (ASD) (Reference 2) that defined the exact interfaces, integration requirements, links of the various data entities, etc. taking into account local conditions and constraints.

Following the guidelines contained in the Master Plan, and ASD, the development of the sub systems started in 1999 in the order as shown below:

- Road Referencing System (RRS) and network definition*
- Geographical Information System (GIS)*
- Information Management and Control System (IMCS)*

- Traffic Surveillance System (TSS)*
- Pavement Management System (PMS)*
- Unsealed Road Management System (URMS)*
- Bridge Management System (BMS) *
- Network Integration Module (NIM) *
- Maintenance Management System (MMS) ^
- Material Information System (MIS)^ ^

Note: * Already implemented and operational;
 ^ Installed and in the process of being made operational.
 ^^ New development in progress

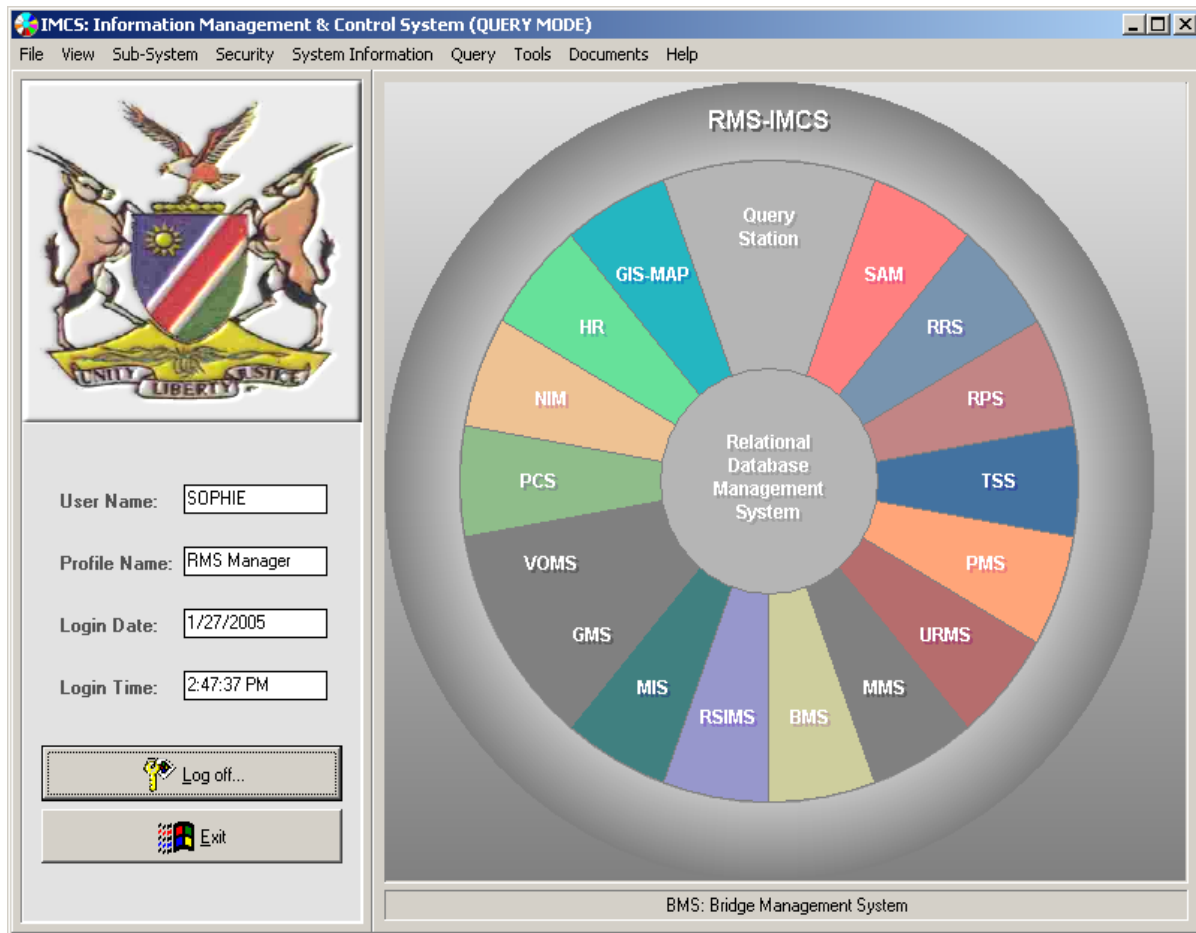


Figure 1. RMS Interface

Each of the sub-systems was developed using a development life cycle concept with the following steps:

- User Requirement Specification (URS)
- Functional Design Specification (FDS)

- Technical Design Specification (TDS)
- System Modelling
- System Implementation
- Training
- Audit
- Process redesign

This cycle keeps going on and on like a spiral, perfecting each sub-system with time.

Figure 2 shows the activity flow within the RMS starting with location referencing and inventory through to construction (remedial action). The emphasis with the development and improvement of the RMS changed with time. Initially the focus was to “Do the right thing” i.e. to identify and to prioritise the most appropriate remedial actions and timing thereof.

With more information becoming available each year the focus shifted to “Learn from performance and improve” e.g. improving or calibrating performance models.

Historically, Road Management Systems were seen only as “Planning tools”, covering only the blue-shaded area in Figure 2. Based on needs expressed by the RA Maintenance Division during development of the Maintenance Management System, the decision was made to incorporate the activities in the green-shaded area of Figure 2. The Project Planning and Control module focusses on “Doing things right”.

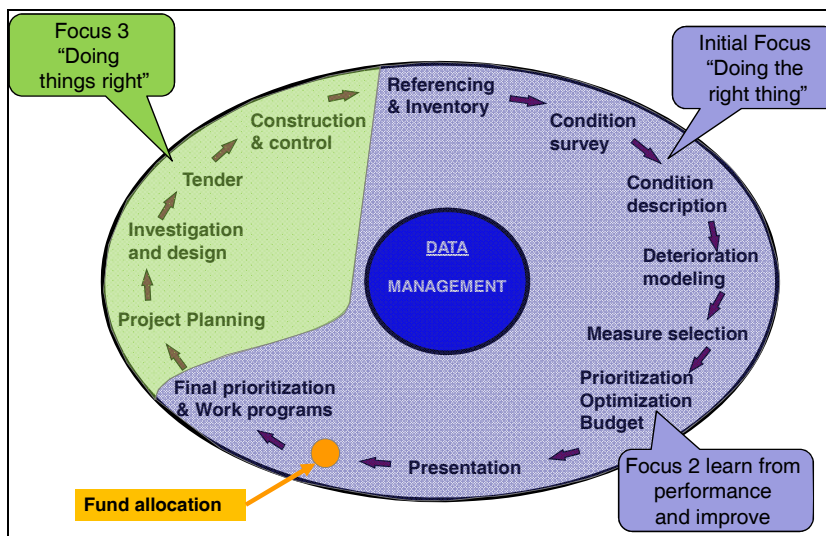


Figure 2: Activities in Road Management Life Cycle

3. DATA COLLECTION, ANALYSIS AND EXAMPLES OF OUTPUT

3.1 Data collection

Data are collected on a regular basis and include:

- Traffic counting
- Visual assessments on the sealed and unsealed road networks

- High speed profile measurements providing riding quality, rut depth and macro texture data
- Deflection measurements
- Bridge condition assessment
- There is a rigorous process followed to ensure that the data collected are accurate before uploading into the database e.g. for visual condition assessment:
- Assessors are trained and certified (Three-day course)
- A sample of the network is collected by highly experienced and the data compared

3.2 Analyses

Several processes are used within the RMS to analyse the data and include:

- Condition description
- Performance modelling using both mechanistic and empirical models
- Measure selection
- Optimisation routines
- Impact analyses

Parallel to these processes, HDM4 is utilized for strategic and tactical planning purposes with the objective function set as “minimization of total transportation costs”.

3.3 Examples of Output

Road network

The existing road network is defined in the Road Referencing System (RRS) and continuously updated. The network consists of 7165.2 km surfaced roads and 37766.5 km unsealed roads, making a total of 44 931.7 km. Several roads as classified as “Proclaimed only” (1445.9 km), which means are not yet built.

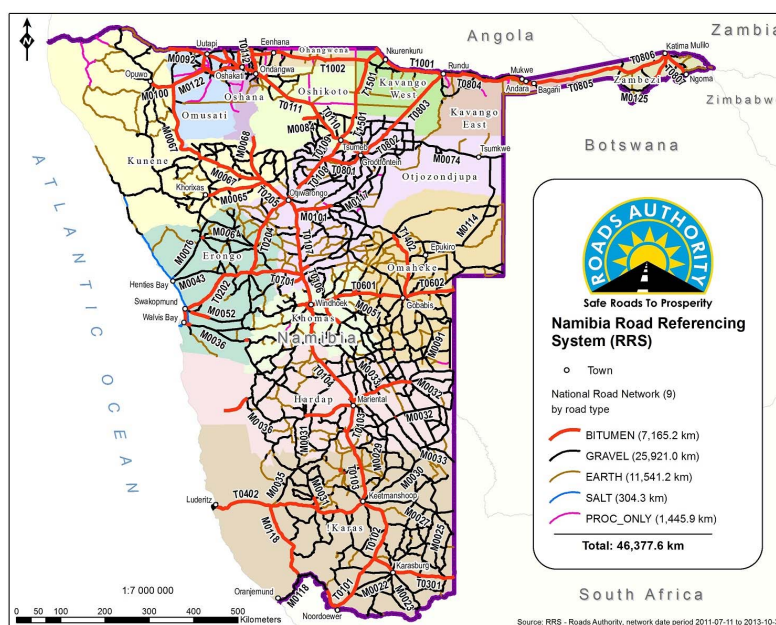


Figure 3. Namibian Road Network

The main arterials or “trunk roads” (shown in red) connect the major cities or towns with border countries, South Africa, Botswana, Angola and Zimbabwe. Bituminous roads carry over 67% of the traffic of the country.

Note: Namibia has thirteen political regions. The system allows for providing summaries of all data sets per magisterial districts, maintenance areas and political regions.

Pavement condition

Figure 4 shows the change in pavement condition the paved road network from 1990 to 2014.

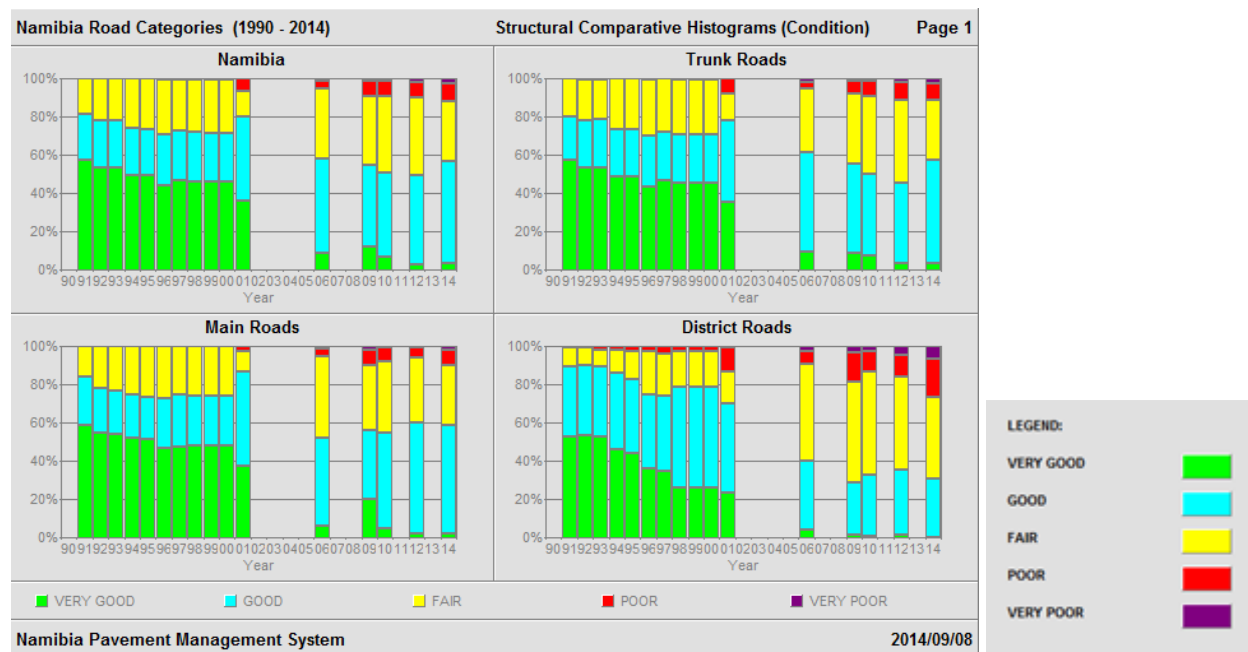


Figure 4. Trend of Deterioration on Paved Roads (Structural)

Continuously showing the deterioration of the road network and impacts on the road user and economy eventually resulted in a huge effort (2013 and 2014) by the RA in terms of periodic maintenance (Repair and reseal) on the most important roads. The improvement of the network condition is already visible (refer Figure 4 for 2014)

Replacement value

A conservative calculation indicates a value of approximately **N\$ 38 504** million to replace only the top layers and bituminous surfacing of our paved roads - Therefore, the typical cost to rehabilitate the entire surfaced road network. This does not include the value of the land, earth works, bridge structures, road furniture or the value of unsealed roads.

4. NETWORK INTEGRATION MODULE (NIM)

The RMS Master Plan, referred to earlier, recommended a sub-system (Network Integration Module – Reference 4) within the RMS which could:

- Provided easy access to summarized data of each sub-system
- Run integrated queries
- Automatically calculate performance indicators
- Assist with compilation of budgets, work programs and annual reports
- Do asset valuation
- Integrate the needs identified through all sub-systems. In this regard implementation and integration of the HDM4 software into the RMS was recommended.

Several international and local experts were appointed to assist the RA with implementation and calibration of HDM4. In addition to this, processes were developed within the NIM to:

- Prepare RMS data for direct import into HDM4
- Prepare matrices for strategy analysis application according to
 - Functional Classification
 - Pavement Surface
 - Pavement Type
 - Traffic Volume
 - Pavement Strength
 - Pavement Condition
 - Environment/Climate
- Run HDM4
- Import reports and data from HDM4 for further processing



Figure 5 NIM interface

5. TAKING THE NAMIBIAN RMS TO THE NEXT LEVEL

Development and operation of the integrated RMS of Namibia over the past sixteen years highlighted the value of good data and consistent provision of information to decision makers. However, during this period, several lessons have been learnt and shortcomings identified.

The following section highlights some of the most important aspects to maintain the momentum and to improve the RMS to a higher level.

1. Managing skill shortages

Road management requires experience and skills in various fields, some of which are difficult to find within the organisation.

Although the RMS is operated by permanent staff, the RMS Division through the approval of the CEO and its board opted to engage a team of experts to assist with the maintenance and continuous improvement of the RMS. Experts appointed on a three-year contract include:

- Location/ Road referencing specialist
- Road Management System (RMS) Specialist Technical Advisor
- Road Infrastructure Planning and Design Specialist
- Information Technology System Integration Specialist
- HDM-4 Specialist
- Road Sector Funding Specialist
- Legal Advisor (Transport Legislation)
- Road Construction Materials Specialist
- Engineering Structural Design Specialist
- Environmental Specialist
- GIS Specialist
- Contract Management Specialist
- Hydrology Specialist (Drainage)
- Transportation Economics Advisor
- Asset Management Specialist
- Traffic Management and Overload Control Advisor
- Pavement Engineering Specialist
- Adjudicator

2. Top management support

In any successful RMS implementation a champion and a driving force is required. Support of the Board and top executives is a pre-requisite for any successful RMS. (This has been the principle of good practice for implementing a sustainable RMS in Namibia).

3. Continuous training required

RMS is a specialised area of Civil Engineering, and training and appreciation of the skilled staff is essential.

4. Models should be continuously improved to pass the test of reasonableness

A computer system only calculates - the important part is what goes into the systems (good quality data) and appropriate processes (models) to ensure correct results. Experiences and knowledge of experts in the local environment (engineering judgement) must be incorporated in these models to produce results that are meaningful.

5. Keep it simple at network level

Systems should not be too complicated; they should be simple, straight forward and provide conservative results. The results will never to be 100% perfect. It should further be noted that “optimised” priorities, based on network level data only provide input into the final work programs. Several other factors are taken into account e.g.:

- Time required for investigation, environmental approvals etc.
- Visibility of the RA in different regions and communities
- Economy of scale – combining projects
- Higher level transportation planning
- Funding sources and political influence

6. Managing Institutional Challenges

All aspects highlighted by R Smith paper on Institutional Issues in Pavement Management Implementation and Use in 1994 (Reference 5) is still relevant, with particular emphasis on “resistance to change”. The selling of RMS is a continuous process and required with new Boards, new Ministers and new staff coming on board all the time.

7. Organisational Structure

The Road Management System in the RA has grown from loose-standing small systems such as a simple Pavement management System (PMS) to an integrated asset management system assisting all divisions within the organisation. Therefore, it is considered essential that the RMS Division features high in the organisational structure with own autonomy and versatile to freely support all the RA Divisions and all stakeholders; internal and external.

Particular activities identified to improve the Namibia RA RMS in the short – to medium term are as follows:

1. Easy access to all stakeholders

New technologies are available and should be implemented to provide access to information within the RMS e.g. a wireless environment, using hand held devices, to be able to access the RMS through the cloud technology from anywhere. Web enabling is progressing well, but band width in Namibia is still a constraint.

2. Performance indicators

The RA is in the process of finalising performance indicators that must be reported on an annual basis. Several of these could be directly calculated using information already in the RMS. It is envisioned that a small model will be added in the NIMIII.

3. Improved tactical level planning

Currently two strategies are applied in identifying and prioritising road projects i.e.:

- Pavement preservation strategy to optimise the condition of the road network with the least amount of money
- Economic strategy utilising HDM4 at the tactical level with the objective function of minimising total transportation costs

It should be noted that a high proportion of the road network carries very low traffic volumes, but fulfil the important function of providing access. The economic benefits of providing access to communities are not properly quantified at this stage. Hence, only the road user costs and benefits are utilised in the identifying of economic projects.

Due to only “Economic projects” being funded by the Road Fund Administration, a manual process is currently applied to extract the economic projects from the “Preservation Projects”. This process will be automated.

Regarding the preservation strategy, some work is still required to define minimum standards for different functional classes. This is specifically relevant to the surfacing of low volume roads.

4. Incorporating “Risk” in prioritisation

Current prioritisation models do not incorporate the element of risk. This needs to be addressed.

5. Incorporating “New Roads” in the prioritisation process

The RA is responsible for the **provision** and maintenance of a safe and economic road network. Several areas are not yet well served with all-weather roads. A formal and standardised process needs to be implemented to incorporate the provision of new roads in the prioritisation process.

6. Vehicle operating cost models

Currently the Vehicle Operating Cost models are embedded within the sub-systems. This currently requires annual duplicate updates regarding vehicle fleet costs

7. Integrating other relevant systems with the RMS

Relevant systems such as an Accident Management System, Overload Control System and the Road User Charging System, developed by other organisations, need to be integrated with the RMS.

8. Import of and Quality assurance on as-built information

Effort has been made to standardise the submission of as-built information. The need exists to streamline this process, to directly link the data to the Road Referencing System (RRS) and to automatically summarise the information for incorporation into performance prediction models.

9. Utilising hand-held devices for visual assessments

Recording the degree and extent of distress is done on standard visual assessment forms, whereafter this data is captured. This is a tedious process and requires dual capturing and electronic comparison to eliminate errors. Preliminary investigation indicated that hand-held electronic devices could be utilised for direct recording of distress.

10. Asset Valuation and Registry

The RMS does not yet have a module to do this function as Namibia does not yet have a national policy on asset valuation and registry from the Ministry of Finance. In the meantime, the RA will be investigating methods in how to calculate this aspect and include it in the NIMIII. There are various ways of calculating this aspect, and Namibia will choose one that is internationally recognised and one that is practiced in the country.

6. FUTURE DEVELOPMENTS

Future developments will focus on the deployment and population of the Maintenance Management System (MMS), the deployment and data population of the Material Information System (MIS), the development of the Project Control System and the enhancement of the NIM and HDM-4 Version III. Implementation of the Project Control System (PCS) and Geometric Management System as stipulated in the RMS Master Plan.

As mentioned before, the RMS is also moving towards a web environment with Microsoft Postgres database and dot net environment.

7. CONCLUSION

The formal RMS of Namibia has been developed and implemented since 2001.

The key to the success of the RMS could be summarised as follows:

- Sound Master Plan
- Support of Top Management
- Continuous system improvement and maintenance
- Utilisation of experts in different fields
- Continuous selling of the system to new stakeholders
- Continuous training of staff
- Keep it simple at network level
- Regular data collection
- Ensuring that results are in line with Engineering judgement and used
- Incorporating international acceptable models and local experience
- RMS positioned at a high level within the structure of the organisation

Continuous operation of the system and feedback from users within the RA as well as the RFA and Ministry of Transport highlighted certain improvements, which need to be addressed.

It is believed that the processes followed and lessons learnt could be of value to other developing countries.

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