PRACTICAL ASSET MANAGEMENT SYSTEM WITH SEAMLESS HDM-4 INTEGRATION IN THE CONTEXT OF THE ROAD SECTOR REFORM AND CORPORATE GOVERNANCE (Namibian Experience)

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ABSTRACT

A Road Management System or Asset Management System can be defined as : 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.

A Road Management System (RMS) is becoming more and more critical for the management of the road network all over the world. All over the world, including Africa and especially Namibia is challenged by the loss of experienced field personnel, and without a scientific and an objective system to assist the Engineers to manage the road network, the management of the road network is becoming a nightmare.

Namibia went through a major road sector reform from 1995 - 2000 funded by (Swedish International Development Agency) Sida and the government of Namibia. This restructuring process of the Ministry of Works, Transport and Communications (MWTC) especially the Department of Transport (DOT), brought about three new entities, the Roads Authority (RA), the Road Fund Administration (RFA) and the Roads Contractor Company (RCC).

The task of the RA is to manage the road network, the RFA is to fund the Roads Authority and local authorities from a dedicated fund from the Road User Charges (RUC), and the RCC is to do the physical work of the road maintenance, upgrading, rehabilitation and construction. The RMS was included in the Roads Authority Act (Act 17 of 1999) it therefore, plays a very important role. This helped the RA to look at the RMS seriously.

This paper will look at how exactly the RMS of Namibia was developed and is being used in contributing to the management of the road network especially using the HDM-4 tool, in the context of the Road Sector reform. It will look at the necessary ingredients to make an Asset Management System sustainable and practical not only in the road sector reform context but also in the whole corporate governance framework as Asset Management is no longer a small tool to be used in the Material Laboratories but a whole high level management concept.

INTRODUCTION TO NAMIBIA AND THE NAMIBIAN ROAD MANAGEMENT SYSTEM (RMS)

Namibia officially known as the Republic of Namibia, is a country in southern Africa on the Atlantic coast. It shares borders with Angola, and Zambia to the north, Botswana to the east, and South Africa to the south. It gained independence from South Africa in 1990 and its capital city is Windhoek. Namibia is a member state of the Southern African Development Community (SADC), the African Union (AU), and the Commonwealth of Nations.

Figure 1 - Namibian Map

Namibia has an area of 825,418 km², it is the world's thirty-fourth largest country (after Venezuela). It is comparable in size to Pakistan, and is about half the size of the US state of Alaska. After Mongolia, Namibia is the least densely populated country in the world (2.5 persons per km²). Average annual rain fall is 500mm, it has a population of about 2 million. The GDP is estimated at US$ 5 billion (20006), with inflation rate of 5% per annum. Namibia got its independence from South Africa in 1990.

Namibia has good road infrastructure and good service and conducive for investors because of its stability and investment incentives. The Road Network is composed of 5,822km of bitumen roads and 37,000km of unsealed roads bringing the total road network to 42,261 as of 2006 data.

The aim of this paper is to look at how exactly the RMS of Namibia was developed and is being used in contributing to the management of the road network especially using the Highway Development and Management (HDM-4) tool, in the context of the Road Sector reform. It will look at the necessary ingredients to make an Asset Management System sustainable and practical not only in the road sector reform context but also in the whole corporate governance framework as Asset Management is no longer a small tool to be used in the Material Laboratories but a whole high level management concept.
A well developed RMS can assist Road Fund Administrations and Roads Authorities to make the right decisions when it comes to determining the level of funding and the various projects that needs to be attended to by flagging potential projects.

Transportation Authorities are challenged by increasing demands for better services under constrained budgets. Better management systems are needed to support more effective decision making. An Integrated Road Management System is such a system for properly coordinating, evaluating and maintaining infrastructure systems. The development of Road Management Systems (RMS) have started in the early 1960's as a concept, but since it has been implemented in many Countries and Authority's, it has become a process which are a modern day necessity in organizations.

The preferred definition of the RMS is: 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. As an essential component of any company or organization dealing with roads, an RMS is inevitable for proper optimized planning.
Its purpose is:

- to identify needs,
- to quantify those needs
- to Prioritise needs and
- assist in planning and management.

This goal can only be achieved if the decision makers in the organization are convinced, hence the RMS Engineer, or Managers have a big role to play in having a sustainable system running with the correct output.

Namibian Experience

The former Department of Transport (DoT) under the Ministry of Works, Transport and Communications had many systems that were stand alone running on different platforms including the old HP 1000 main frame. The development of Information Technology (IT) from main frames to Personal Computers, the whole movement of the road sector reform internationally and also in Namibia necessitated the need for a Master Plan. In addition Namibia like many other African countries and international community was losing expertise in the roads sector and hence the need to develop an RMS that was sustainable in line with the roads sector reform.
The objectives of the Plan were;

- Evaluate the existing systems and situation
- Provide recommendations and guideline regarding;
- System approach to flow of activities,
- Computer requirements for Integration,
- Requirements for Integration,
- System dependencies and
- Development Plan

1 BACKGROUND ON THE NAMIBIAN ROAD REFORM OF THE MWTC 2000 PROJECT

New government came into power with Namibia's Independence on 21 March 1990, some of its main policy objectives were to:

- revive and sustain economic growth,
- promote an efficient use of scarce resources, which would create employment opportunities, and
- help to alleviate poverty.
- Government found that the availability of safe, effective and efficient transport services would be instrumental in achieving these policy objectives.

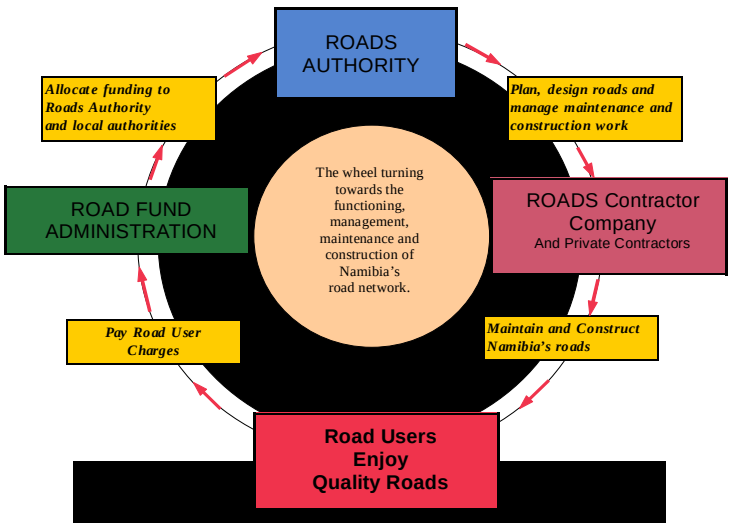

Figure 2 - Road Sector Reform Diagram

On 4 October 1994 Government adopted the “White Paper on Transport Policy” which called for the improvement in the performance of the transport sector and for encouraging increased competition as the main instrument to achieve increased efficiency.

It also called for the introduction of a system of road user charging for full recovery from road users of the costs of providing and maintaining road infrastructure according to the principle of minimizing transport costs, with co-financing form general revenue sources for that part which does not directly benefit road users.
This is inextricably linked to sustainable availability of funding at the required optimal level, as well as the institutional capacity to utilise such funds efficiently for the benefit or road users.

To give effect to Government’s policies and objectives, the Ministry of Works, Transport and Communication launched the MWTC2000 Project during 1995 to reform the road transportation sector as well as the Ministry.
The institutional arrangements for planning, designing, constructing and maintaining Namibia’s national roads network has been restructured and the arrangements for the funding via the national budget will be replaced by funding via a Road Fund and a Road User Charging System.

The institutional reform has resulted in the establishment of the Roads Contractor Company, Roads Authority and the Road Fund Administration. The entities were launched on 12 July 2000 in Windhoek. In short, all the three entities will function by a governing board of directors. The Roads Authority (RA) under the auspices of the Minister of Works Transport and Communications, manages Namibia’s rural roads network. The Road Fund Administration, under the auspices of the Minister of Finance, manages the Road User Charging System to secure and allocate funding to achieve a safe and economically efficient road sector not only for the Roads Authority but also for Local Authorities.

The Act is solid however its applications or implementation according to the intention in the Act needs time. This paper does not look into this area. Various reviews have been given on the road sector reform which will positively add to the already successful model of the roads sector reform. There is always a learning curve that one needs to take in to account especially for those countries who have not yet established these entities. The model established in Namibia is following the New Zealand model and is one of the best examples.

2 INTRODUCTION TO THE MASTER PLAN OF THE RMS

Namibia had a lot of stand alone systems which did not interface with other systems, like many of the past Pavement Management Systems throughout the world. On top of that there has been duplication of efforts and data which was very costly. Vendors would demonstrate their proprietary systems, DOT would buy them, and then there would be no support, the suppliers would vanish or would only be interested in selling their commodity without the support. Many of them looked impressive and promised to do anything, but when bought and implemented, they could not deliver the services and products as required. This initiated a need for a proper Master Plan.
Based on technologies of road management in the world and experience in southern Africa, the Road Management System Master Plan identifies the required Sub-systems and priority thereof for a sustainable RMS in Namibia.

The sub-systems which will be incorporated in the RMS are as follows:

- Road Referencing System (RRS) or network definition
- Information Management and Control System (IMCS)
- Traffic Surveillance System (TSS)
- Pavement Management System (PMS)
- Unsealed Road Management System (URMS)
- Bridge Management System (BMS)
- Project Control System (PCS)
- Maintenance Management System (MMS)
- Geographical Information System (GIS)

Summarized Recommended Systems for Namibia RMS

The main requirements for an RMS in Namibia can be summarised as follows:

- To determine a stable funding requirement for the provision and maintenance of the road network infrastructure. This information will be used by the Road Fund Administration to determine appropriate road user charges.
- To assist the RA in being effective (doing the right things) and efficient (doing things right) in the provision of a safe and cost-effective road network.

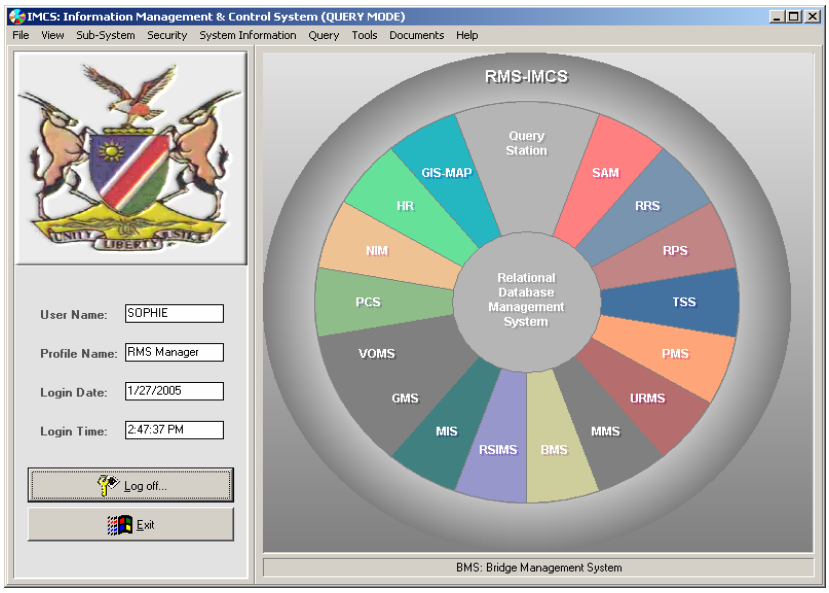

Figure 3 RMS Wheel

The primary tool to ensure accountability towards the Namibian public.
Based on experience with Road Management Systems in Namibia and Southern Africa, developments in computer technology, the staff shortages in the RA and requirements specified for the RMS in the TOR, the following further requirements and essential features are listed:

- The RMS must be sustainable, affordable and appropriate to the decision making needs and scarce financial and manpower resources
- Be able to conform and integrate with the day-to-day activities of the RA
- Flexible for stage development and implementation in a changing environment
- In line with the RA Information Technology Policy

- Make use of a central database for all sub-systems
- Facilities to monitor the present network condition over time
- Facilities for developing probabilistic models for predicting maintenance and rehabilitation costs
- Facilities for preparing medium- to long-term plans and well motivated estimates of funding needs
- A mapping facility for the graphical representation of the road network and related information
- A uniform user-interface for all systems

The current situation of the systems is as follows:

Architectural System Design (ASD) - completed
Road Referencing System (RRS) – completed and populated
Traffic Surveillance System (TSS) – completed and populated
Information Management and Control System – completed and populated
Pavement Management System (PMS) - completed and populated
Geographical Information System (GIS) - completed and populated (upgrading needed)
Material Information System (MIS) – enhancement needed
Unsealed Road Management System (URMS) by end Dec 2002 – completed and populated
Bridge Management System (BMS) by March 2002 – completed not yet populated
Network Integration Module of IMCS by end March 2008 – will be completed and populated
Project Control System (PCS) by end March 2008 – re-implement and enhancement
Maintenance Management System (MMS) by end July 2009 – as there was no funding

3 SOME EXAMPLES OF OUTPUT AND USE OF RMS

Namibia has in total of 5822km of paved roads and total of Km 42,260 (as of 2006)

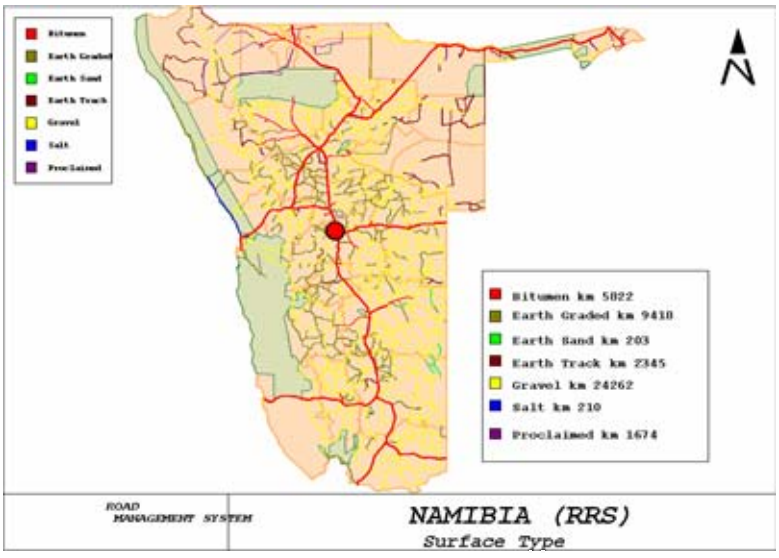

Figure 4 - Namibia Road Network

3.1 Replacement Value

Roads are assets and they should be regarded as such. A conservative calculation indicates a value of approximately N$ 7,7 billion to replace only the top layers (base and sub-base) and bituminous surfacing (black top bitumen layer) of the paved roads. This does not include the asset of the land, value of earth works, bridge structures, road furniture or unsealed roads.

76 % of the total paved road network is more than 20 years old. Due to our dry conditions, good road building materials and relative light traffic loads, the expected life can be extended with timeous routine maintenance (crack sealing, patching etc.) and periodic maintenance (reseal). However 206 km can be described as “Poor” and “Very Poor”, requiring immediate structural rehabilitation and a further 497km is considered to be in a warning state, requiring attention within the next 5 years.

The purpose of a bituminous surfacing is to prevent moisture ingress into the pavement, to provide skid resistance and to protect the pavement structure from traffic wear. The average effective life of this surfacing layer in southern Africa is 10 - 15 years – mainly due to oxidation and hardening caused by ultra violet rays, making this layer water permeable.

3.2 Funding Requirement

Table 1 - Pavement Management System identified needs (2001)

FUNDING REQUIRED FOR	1st Year need	Ave/annum (5 year)
REHABILITATION	N$ 252 million	N$ 121 million
RESEAL	N$ 175 million	N$ 108 million
ROUTINE MAINTENANCE	N$ 57 million	N$ 57 million
TOTAL NEED (Surfaced Roads)	N$ 484 million	N$ 286 million

The following graphical displays show the impact on the network condition and remaining life for different funding allocations.

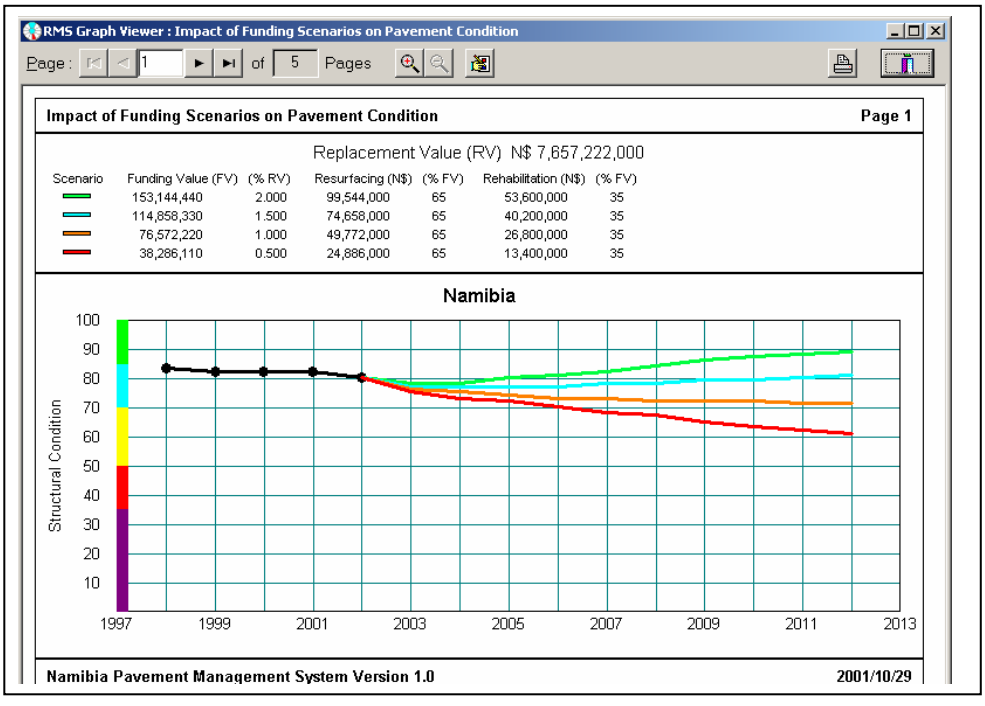

Figure 5 - Impact on the Pavement Structural Condition

A minimum of N$ 115 million/annum is required for reseal and rehabilitation to maintain the current condition. Adding an average routine maintenance requirement of N$ 57 million/annum, the minimum annual requirement for surfaced roads is calculated at N172 million.

However, from Figure 6 it is evident that a higher funding level is required to increase the average remaining life to more than 10 years. A funding level of N$153 million/annum will ensure an average remaining life of 11 years.

An amount of N$ 153 million/annum spent on reseal and rehabilitation, would eliminate the backlog within ten years. Adding an average routine maintenance requirement of N$ 57 million/annum, a total amount of N$ 210 million is required per annum for maintenance of surfaced road pavements

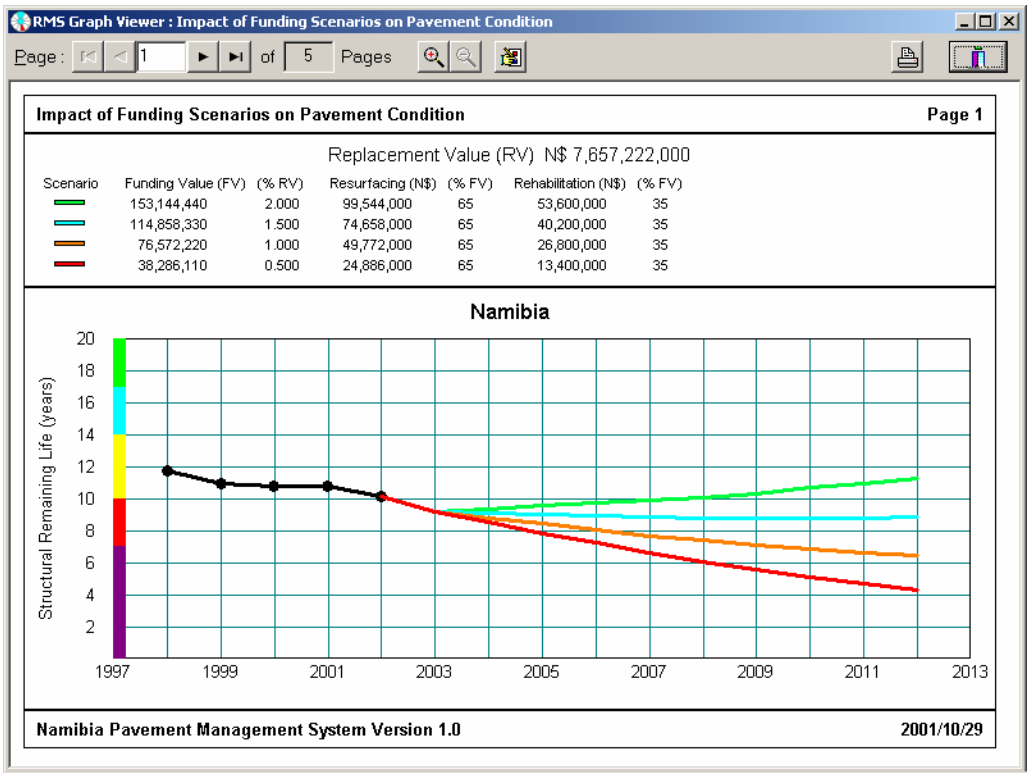

Figure 6 - Impact on the Average Remaining Structural Life

Although the current network condition of the road pavement structures can still be described as “Good”, the surfacing condition is “Warning”, indicating that a huge backlog has developed in terms of reseal.

Currently 313 km require immediate rehabilitation and 1461 km require urgent reseal or seal maintenance in the form of rejuvenation. The total immediate funding requirement is calculated at N$ 484 million.

The estimated stable funding requirement for the maintenance and rehabilitation of the surfaced road network has been determined using various approaches. The

average annual requirement for the maintenance and rehabilitation of road pavements is calculated at N$ 250 million. This funding level will ensure that:
The current backlog is eliminated within 5 to 10 years;
The average structural life increase to more than ten years;
The current condition can be improved to a stable and sustainable condition.

3.3 Unsealed Road Management System Output

Table 2 - URMS Budget

UNSEALED ROAD MANAGEMENT SYSTEM
UNSEALED ROAD ASSESSMENT (PHASE 1)
NAMIBIA ROADS AUTHORITY

Unsealed Road Budget Summary — **Assessment Date :** 2002/09/30

Maintenance Region	Unsealed Road Length (km)	Routine Maintenance Budget (N$)	Scheduled Maintenance Budget Year 1 (N$)	Year 2 (N$)	Year 3 (N$)	Average Annual Budget (N$)	Potential Upgrading Projects (N$)
Keetmanshoop	7,946.44	18 313 000	10 236 000	10 879 000	26 747 000	34 267 000	112 026 000
Oshakati	4,467.39	5 668 000	2 527 000	5 236 000	2 346 000	9 037 000	130 473 000
Otjiwarongo	10,554.29	22 674 000	21 762 000	42 229 000	39 734 000	57 249 000	235 517 000
Windhoek	13,278.46	30 750 000	44 323 000	55 784 000	52 593 000	81 650 000	243 071 000
Total Road Network	36,246.59	77 405 000	78 848 000	114 128 000	121 420 000	182 203 000	721 087 000

The N$ 182 million requirement per annum, as calculated in 2003, provides only for scheduled maintenance as indicated and for routine maintenance in the form of blading. The funding requirement for ancillary maintenance for the unsealed road network is estimated at N$ 35 million per annum and should be added to obtain a total estimate for unsealed road maintenance. In addition, provision should be made for sealing (or special treatment) of existing gravel roads. A recommended amount of N$ 71 million per annum for this purpose is based on addressing the current needs (potential projects with Internal Rate of Return in excess of 10%) over a period of ten years.

3.4 Integration of HDM-4 and the RMS

The optimum budget or the condition of the road network should not be "thumb sucking" but should be based on sound engineering judgment. The paved roads can already give the results as discussed in the above sections. The data for the entire unsealed road network was available at the end of December 2002 and the system is functional and output available.

Network Integration Module (NIM) the most important tool of the RMS sub-system was launched and has succeeded in its objective. The NIM will collate the important summarised information from the various sub-systems of the RMS as well as manually entered information obtained from other needs not yet identified through a formal system. The HDM-4 was incorporated into the NIM, as the best international tool already developed. The RMS of Namibia and HDM-4 will complement each other – HDM-4 component is funded by a donor. The project was completed March 2003. The first strategic output was delivered in 2005, comparison with the RMS of Namibia and the Medium to Long Term Master Plan developed by the Planning Division showed that the HDM-4 results were not compatible. A re-calibration and re-analysis of the HDM-4 brought about the results to be acceptable. What took months to segment road networks into homogenous sections now takes seconds through the

NIM. Economical parameters are now available by using the NIM and the HDM-4. The HDM-4 calibration factors are available as a standard after this study.

The Five Year Programme or as it is called the Tactical analysis was prepared using the HDM-4 NIM combination. The results showed that the HDM-4 programme favoured more rehabilitation and resurfacing projects instead of re-gravelling projects as was the case of the RMS modules of Namibia. Hence a further re-run had to be made by adjusting the HDM-4 model to give results that are realistic. After the re-run some re-gravelling projects were on the programme.

The second re-run of the HDM-4 model with the new data collected is scheduled to be finalized by March 2008. At this stage there is new riding quality and visual assessment data which must still be loaded on the NIM so that another run can be made with the HDM-4. The first runs will be used as a proof that the system is working and the HDM-4 analysis can be utilized provided proper calibration is done.

Some functionalities of the NIM

The HDM-4 data preparation button allows the user to create homogenous sections throughout the network.

A major lesson learnt from this exercise is that HDM-4 is a very complex programme and it is not only crunching numbers and getting results as is done by many organizations, it is a matter of understanding how the model analyses the data and gives the output. One run is not enough to get the HDM-4 output acceptable, several runs have to be made by experts to get a meaningful result. In Namibia, the Birmingham University team who developed the system initially were engaged to assist the Namibian HDM-4 implementation.

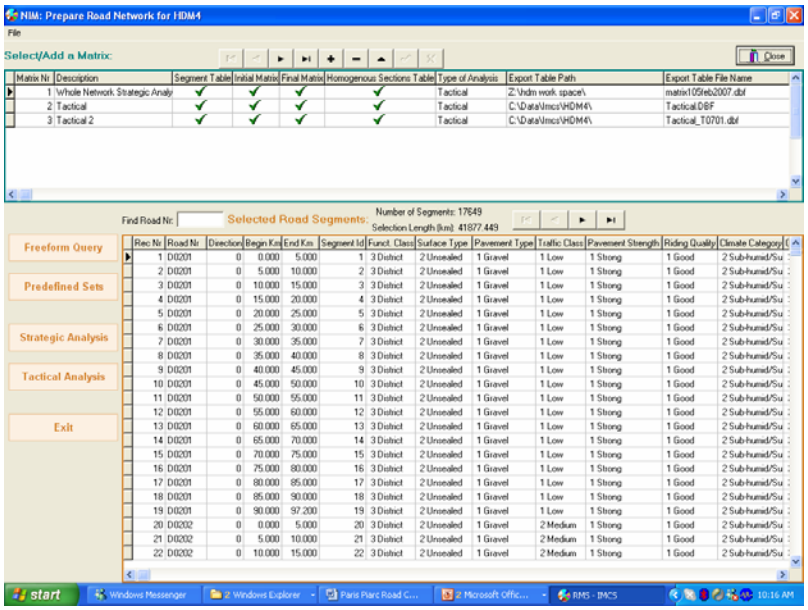

Figure 7 - HDM-4 data preparation

The HDM-4 programme has been a buzz word in the roads industry for a while and it is useful but needs caution in the utilization as the output could completely be off track from reality.

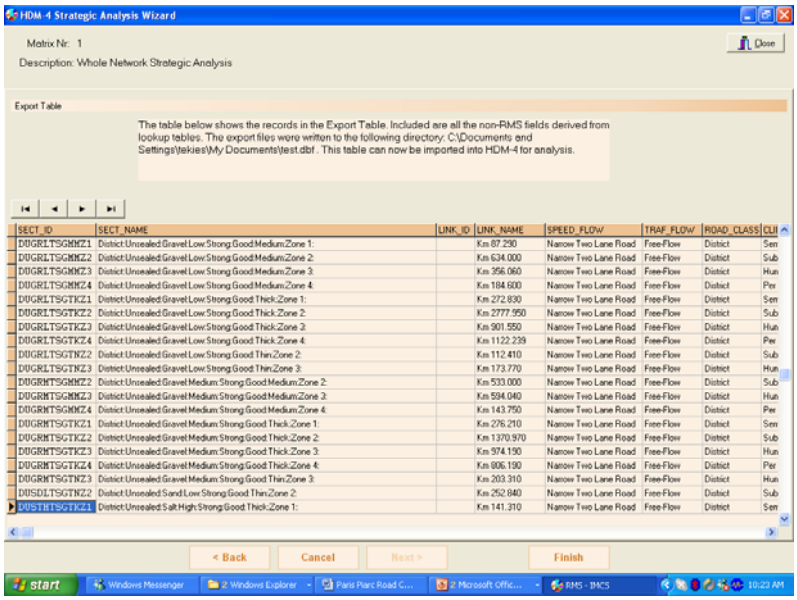

Figure 8 - Export table to be imported in HDM-4

The team of experts was composed of the Namibian experienced Roads Authority technicians and Engineers (grey haired invaluable staff members), RMS Sections staff members, IT Expert team in Roads and highly experienced engineers in construction, maintenance and in modelling (these experts are rare in the world). Nowadays it is becoming extremely difficult to find engineers good in everything. In the olden days engineers and technicians used to go through all the modules of engineering, now engineers seem to concentrate on one specialized field like only maintenance, planning or construction. That is the reason that the RMS Section through the approval of the CEO and its board opted to engage team of experts who have the knowledge and experience of the Namibian RMS Master Plan.

Figure 9 - HDM-4 Programme can be accessed from the NIM

4 LESSONS GAINED FROM THE NAMIBIAN RMS

It needs to be understood that the systems developed by developed countries may or many not work in an African environment, care needs to be taken in selecting suitable systems. Taking off the shelf systems and implementing it in Africa without following the methodology/life cycle has proven to be a failure in most of the countries. Firstly, the African pavements are different from northern hemisphere countries and hence need special attention and different consideration. Secondly, some of the sophisticated systems developed might be too complicated and African countries cannot sustain these systems because of the luck of resources such as funds and qualified personnel.

Even if the funds for developing these systems are coming from donors it needs to be used to the benefit of the organization and the country by providing information for good decision making that will save Road Authorities in millions. That is why Master Plans and ASDs are necessary. It is not what the donor wants that has to be implemented in African Road Authorities or organisations but what the organization itself wants, which is sometimes difficult to define because of luck of vision and expertise. The methodology applied in Namibia in implementing systems has been successful and hence the reason for this paper to share it with other organisations and not to repeat the same mistakes that others have done.

Number of times consultants have been appointed for various studies where documents and reports have been produced one after the other, but because they are not accessible these reports are shelved and are full of dust, the knowledge remains with few people only, and hence when they die or retire everything else around them collapses. With a proper implementation of RMS these documents will be accessible easily for future generations making the management of organisations sustainable, effective and efficient.

In any successful RMS a champion and a driving force is required to take the flag and run with it - without that the RMS will not be successful. The support of the top management and Boards is essential in making any RMS successful. In Namibia, the support has not been much, but there are dedicated champions that make the system successful through team work. Support of the Board and top executives is a pre-requisite for any successful RMS.

It needs to be noted that RMS is a specialised area of Civil Engineering, and training and appreciation of the skilled staff is essential. It is not only computer systems giving output, the essential aspect is what goes to the systems to make it give the correct results by modeling the experiences and skills of experts into the required environment to produce results by almost simulation, predictions and at the end brining engineering judgment to the out put. Systems should not be complicated; they should be simple, straightforward giving results. The results do not have to be 100% perfect initially, with time they will be perfected.

The contradictory needs and approaches of Network Analysis and Project Analysis has been also the core cause of many failures of RMS's in many organisations. RMS is a strategic, network based system, in some cases programme or tactical based system. Project Engineers have been bogged down with details trying to

make the RMS systems project oriented instead of network oriented, and once they start developing the systems they never finish it because the number of details required has no ending. This is experience in the Namibian RMS, where the GIS system was to be made a geometric system and each and every curve was supposed to be placed in the system making the system never ending. Once the basic correct information is in, it needs to be remembered that results are needed on the table and need not be perfect but needs to be workable and reliable.

Another crucial issue is Africa is exporting all the educated experts to developed countries such as Australia, Europe and the USA. Putting such a system in place where all the information is accessible for everyone will ensure the proper management of the road network, through transparency, efficiency and effectiveness. Some processes and rule sets will be followed that are defined explicitly which will assist the new personnel to somehow know what is happening in the Road Network. Countries such as Namibia are also affected by loss of expertise.

Consideration that needs to be given attention to when developing systems is that systems should not be black boxes, changes should be flexible. Systems should work for the people and not the people for the system - unfortunately this is not the case in many authorities, it is hoped that this paper will change that attitude.

5 FUTURE DEVELOPMENTS

Future developments will focus on the maintenance management system. The commercialization process has brought about the outsourcing of all works to the RCC and other private contractors hence there needs to be a system for the Regions and the Districts to control the works and to have a mechanism of reporting their progress. Because of the luck of funding this process could not be implemented. With the new financial year sufficient funding is allocated.

The other important new development is to have the NIM version II to perhaps integrate it with the Road User Charging System to get the income and the expenditure at one source. This will be a major challenge. This integration will also assist the RFA to allocate funding for the local authorities and the RA based on needs.

6 CONCLUSION

The Namibian RMS is on the right track despite some institutional challenges. The role of the RMS in new roads authorities is something that one cannot turn a blind eye to, as Africa is losing expertise. Systems like these are vital for sound decision making which was one of the reasons why the commercialization process was initiated for the sake of making the RA more effective and efficient to serve the road users based on business principles.

The vision of the Namibian RMS is to have a working RMS to assist decision makers to make sound and better decisions based on facts, and in addition, to make the Namibian RMS an internet based system. Although the availability of bandwidth is a major problem in Southern Africa, the possibility of adding Arial photography will be regarded as the ultimate cherry on the already successful RMS cake.

The Namibian RMS can be taken as a model for a good RMS implementation where without spending too much money, by having proper plans and consistency of the RMS team, it became successful. Systems need to be simple, accessible and usable hence the reason for this paper to share with other professionals. Lack of sufficient funding is becoming a stumbling block especially in the collection of data and full system implementation and enhancement. It is hoped that if people of capacity such as Board members, CEOs and Managing Directors are in this conference, they can take RMS seriously to the benefit of their organizations and allocate sufficient funding to RMS operations. By doing so millions can be saved when implementing projects if the right decisions are made using the recommendations of the RMS. In Namibia the budget of RMS is less than 4% of the budget of Maintenance and Rehabilitation/ Construction combined.

It needs to be noted that RMS is not only about crunching numbers it is about putting good engineering judgment with the latest IT technology to get realistic results by modelling the thinking process of good road professionals which are getting scarce every day. Younger generation do not want to go to university and study engineering these days there are better pastures for them in IT, Accounting or Social Studies such as law. The Engineering fraternity can be preserved and information left for the next generation by managing a good RMS.

Using both worlds of the Namibian RMS and the International Economic Model of the HDM-4 good output is obtained but needs to be interpreted and used with caution and by understanding why some results can differ or why they could be similar. For Strategic output the HDM-4 is very useful when it comes to the programme output the RMS of Namibia gives a better indication when the result is compared to reality. It is also encouraged to use the HDM-4 more on project level because of the fact that it needs too detailed and extensive data sets which can be easily be obtained from a project level analysis instead of a network level analysis.

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