

ROLE OF THE ROAD MANAGEMENT SYSTEM IN A COMMERCIALIZED ENVIRONMENT (Namibian Experience)

S. B. TEKIE

Roads Authority Namibia, Private bag 12030
Windhoek, Namibia

INTRODUCTION

This paper provides as background the recent institutional changes within the Namibia Department of Transport, the responsibilities of each new entity and the goals of a road management system within the new Roads Authority (RA). It further describes the process of the Road Management System (RMS) development and the progress up to now.

BACKGROUND

Road Reform of the MWTC 2000 Project

When 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.

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 minimising transport costs, with co-financing from general revenue sources for that part which does not directly benefit road users.

This led the way to the reform of the road sector with the fundamental and overall long term objective to minimise the total costs of road transportation to society, consisting mainly of the sum of infrastructure costs and vehicle operating costs.

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 of 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. A Steering Committee, consisting of the top management of the Ministry of Works, Transport and Communication, representatives of the Office of the Prime Minister, the Ministries of Finance and Trade and Industry as well as the Namibia Public Workers' Union, with the assistance of a project team and consultants successfully guided the MWTC 2000 Project towards its objectives.

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 road reform will have many advantages, of which the most important ones are:

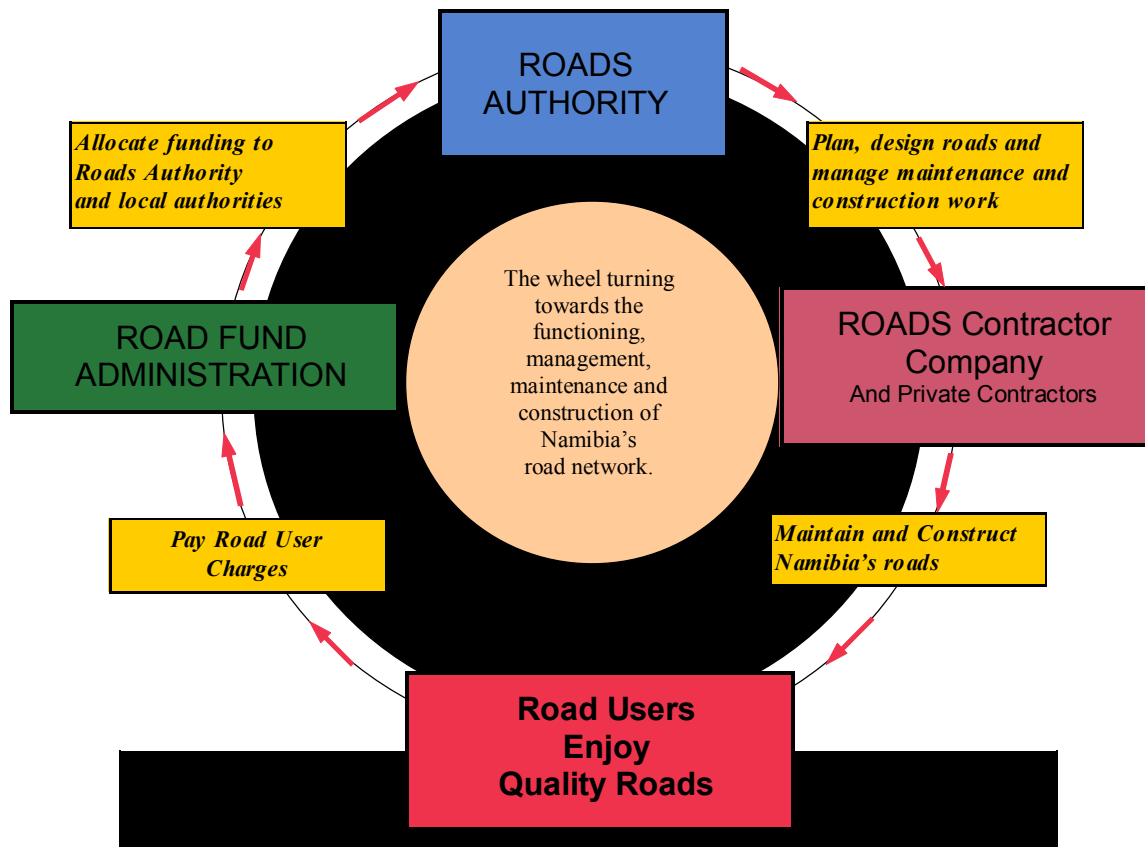
- It will bring about a more cost-effective and more competitive road sector
- It will promote a more equitable and equal means of recovering costs from the beneficiaries, the road users, including the heavy vehicle operators.
- The country will be thus be able to maintain one of its most important assets, the roads network of more than 45 000 km, of which 5 500 km are bitumen and the rest are all unsealed roads, on a sustainable and a efficient basis.
- It will reduce the direct role of Government in the road sector and increase the role of the private sector to participate in the maintenance and construction of Namibia's roads.
- Namibia will align itself with international standards regarding roads and the SADC Protocol on Transport, Communications and Meteorology to which Namibia is a party to.

The institutional reform has resulted in the establishment of the Roads Contractor Company, Roads Authority and the Road Fund Administration.

The Right Honourable Prime Minister of the Republic of Namibia , Mr Hage Geingob, set 'the wheels rolling' when he officially launched the three entities on 12 July 2000 in Windhoek.

Roads Authority (RA)

- The Roads Authority, under the auspices of the Minister of WTC, manages Namibia's rural roads network. The Roads Authority Act (No 17 of 1995) was promulgated in the Government Gazette of 21 October 1999.
- A Board of Directors is responsible for the policy, control and management of the authority, whilst a Chief Executive Officer is responsible for the administration.
- With a staff compliment of about 250, the Roads Authority performs the planning, designing and management of the construction and maintenance of the national roads network. It performs all maintenance and construction work through contracts.
- The Roads Authority is also responsible for the Traffic Information System (NaTIS), and the management of road transportation.
- According to its Act, the Roads Authority has to have a Procedures Agreement, with the Road Fund Administration and submit a Performance Statement and an annual report to the Minister responsible for transport.



Road Fund Administration (RFA)

- 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.
- The Road Fund Administration Act (No 18 of 1999) was promulgated in the Government Gazette of 22 October 1999.
- The policy, control and management is entrusted to a Board of Directors, whilst a Chief Executive Officer is responsible for the administration.
- In consultation with the Minister of Finance the RFA determines the rates of the road user charges and collects them. It has to publish Road User Charges in the Government Gazette.
- Road User Charges accrue to the road Fund Administration and may be used to defray the following expenses:
 - Planning, design, construction and maintenance of the national road network and any major urban arterial road.
 - Cost of administrative expenditures for the Roads Authority and the Road Fund Administration.
 - Traffic related maintenance in respect of any road.
 - Contribution to the cost of operation of any traffic information system.
 - Cost of traffic law enforcement and adjudication functions.
 - Contribution towards the cost of the operation of any vehicle testing station or driving testing centre.
 - Payment of capital and interest on roads related loans.
- The RFA, though autonomous, should act as a 'trustee' on behalf of road users. Therefore it has to act transparently and consult with stakeholders and interested parties.
- To ensure its efficiency and effective control, the Act stipulates that the RFA should submit a performance statement, a business plan and an annual report to the Minister of Finance.

Roads Contractor Company Ltd (RCC)

- The Roads Contractor Company Limited, a company in terms of the Companies Act, is fully owned by the Government of the Republic of Namibia. The Roads Contractor Company Act (No 14 of 1999) was promulgated in the Government Gazette of 18 October 1999.
- His Excellency, the President of the Republic of Namibia, has designated the Minister of Works, Transport and Communication to hold all shares in the company on behalf of the State.
- A Board of Directors is responsible for the policy, control and management of the company, whilst a Chief Executive Officer is responsible for the administration.
- The object of the company is to undertake work relating to the construction or maintenance of roads in accordance with sound and generally accepted business principles.
- The Roads Contractor Company is obliged to enter into a Performance Agreement with the Shareholding Minister according to which the company will have to perform its functions and meet its obligations.
- The company is granted a period of three years, from 1 April 2000, to become fully competitive and commercialized. During that time it will receive preferential contracts from the Roads Authority.
- Thereafter the RCC will have to tender for contractual work on an open tender basis, making it the first State-Owned Operational Enterprise to compete on an equal basis with the private sector.
- The company has about 2 000 employees.

2. **Background on the RMS**

Definition

A Road Management System (RMS) provides a set of decision support tools, based on standardised data sets, that is used in the road management process to help make decisions in a structured manner. Such a system identifies and prioritises needs on the road network to sustain an appropriate condition at the least possible cost.

Act No 17 of 1999 page 8 Part III Management of the Road Network Management of the road network

16. (1) Notwithstanding anything to the contrary contained in any other law but subject to this Act and with due regard to the funds at its disposal, the Authority shall undertake the management of the national road network, including-.....

(d) the operation of road management systems;

Therefore the RMS has a very crucial role to play in the whole operation of the RA.

Purpose of the RMS is, therefore, to assist authorities in providing a safe and economical road infrastructure at the least cost.

The goals of the RMS can be summarized as;

- Identify needs on the network
- Quantify needs
- Prioritise needs
- Assist in planning and management

Situation up to 1995

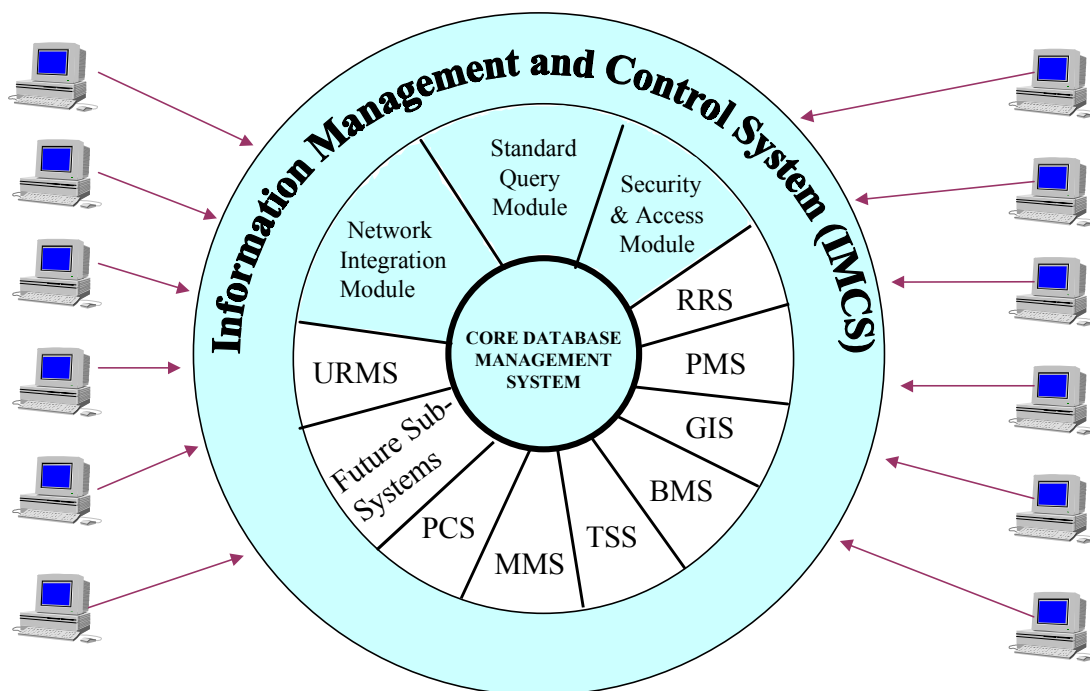
Namibia had several stand alone systems which did not interface with other, like many of the past Pavement Management Systems throughout the world. On top of that there has been duplication of efforts and data which was very costly. Vendors would demonstrate their proprietary systems, DOT would buy them, 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.

Master Plan

A Master Plan study was conducted during part of 1995 and 1996 to

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

SCHEMATIC ILLUSTRATION OF THE INTEGRATED ROAD MANAGEMENT SYSTEM



IRMSNAMS.PPT

Based on technologies of road management in the world and experience in southern Africa, the Road Management System Master Plan identified 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)

The basic principle to develop and operate a sustainable network level RMS for Namibia, is to keep each sub-system simple but to ensure that comparable parameters are produced by the various sub-systems. Simple, but sound procedures are used to identify candidate projects on the network level. Thereafter, candidate projects identified for scheduled maintenance, major rehabilitation or upgrading and the provision of new facilities, will be further investigated and analysed to ensure economic justification.

The main purpose of the **RRS** is to allow controlled updating and maintenance of the network definition according to pre-determined road network referencing methodology.

The **IMCS** has the following main functions:

- Hosts and controls the core database
- Defines the main user-interface
- Provides security control to retrieve information from the database and to access any one of the centralised sub-systems
- Hosts the network integration module, standard query module and the RMS policy and rule sets

The **TSS** provides traffic information for the other subsystems to determine needs and work programmes.

The **PMS** determines needs, priorities and budgets for scheduled maintenance and structural rehabilitation. The major input into this sub-system will be formalised visual assessments, road roughness measurements, pavement deflection measurements, traffic information and the existing pavement composition.

The purpose of the **URMS** is mainly to determine needs, priorities and budgets for optimum blading frequencies, periodic maintenance (regravelling or special maintenance) and upgrading to surfaced standards. Major inputs will consist of visual assessment data, traffic parameters and material properties.

The **BMS** will determine needs, priorities and budgets for functional and structural repairs. The initial needs identification will be based on formalised visual assessments. Structures identified for repairs will be further investigated to determine accurate priorities and budgets.

The emphasis of a **PCS** is to schedule the main activities to contract stage and keeping track of progress and expenditures during the contract. The project control system should incorporate construction projects as well as any other projects necessary to manage the road network infrastructure.

The main purpose of the **MMS** is to assist in identifying, scheduling and management of day-to-day routine maintenance activities in a region or district. Input into this system will consist of public complaints, personnel observations and formalised visual assessments.

The **GIS** will mainly be used as a mapping tool to display network information produced by the various sub-systems.

Before any system development can take place, the following aspects should be addressed, namely:

- Understanding of the RMS Master plan and acceptance thereof
- Obtain sufficient funds to implement the Master Plan
- Establishment of a Management Support Directorate and appointment of key personnel and consultants to manage the RMS development, implementation and operation
- Nominate a steering committee to guide and control the implementation phase and assign specific responsibilities to each person on the committee
- Finalise decision regarding the Information Technology (IT) policy, preferred Data Base Management System (DBMS) and the development language to be used

The fastest way to provide integrated network results and to test the IMCS, is to develop one of the major sub-systems, identifying needs, at the same time. Combining the development of the RRS, IMCS, TSS, PMS and the GIS into one phase of development will complete the data flow and operation of one major sub-system. With this in mind, and taking into account the dependencies of sub-systems, the development of the RMS is scheduled into three phases namely:

Phase 1	RRS, IMCS, TSS, PMS and GIS	(18 months)
Phase 2	URMS, BMS, and MMS	(18 months)
Phase 3	PCS	(18 months)

Phases 2 and 3 can run concurrently.

Based on experience with the development of sub-systems within an RMS and the proposed development schedule, it is recommended that an amount of N\$ 1,5 mil per annum be made available for a period of five years for development purposes.

In order to progress from the Master Plan to development and implementation of the RMS it is essential to define the specification documentation for the development of the complete RMS with a holistic approach, in order to facilitate the development of the sub-systems according to the proposed schedule. This activity, which would take approximately six months to complete, is termed the Architectural System Design and should be carried out as soon as possible.

Extracts and Discussion on the Namibian RMSMP

RECOMMENDED SYSTEMS FOR NAMIBIA RMS

5.1 GENERAL

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.
- 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 (DOT) 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

Broad specifications for the RMS are discussed that will ensure that these requirements are met.

It is essential for strategic reasons to obtain a global architectural view of the RMS before development of the system commence. The RMS Master Plan forms the basis for this function.

The traditional approach to system development as shown in Figure 2 would ensure sound applications. However, in the case of the RMS development in Namibia, there is a concern that this process could take a few years without adding significant value to the knowledge base of the information technology team or consultants. Therefore, it is considered more important to get started, address each phase as per system development life cycle in a scaled down manner which would ensure a shorter development and implementation time span.

SYSTEM DEVELOPMENT LIFE CYCLE

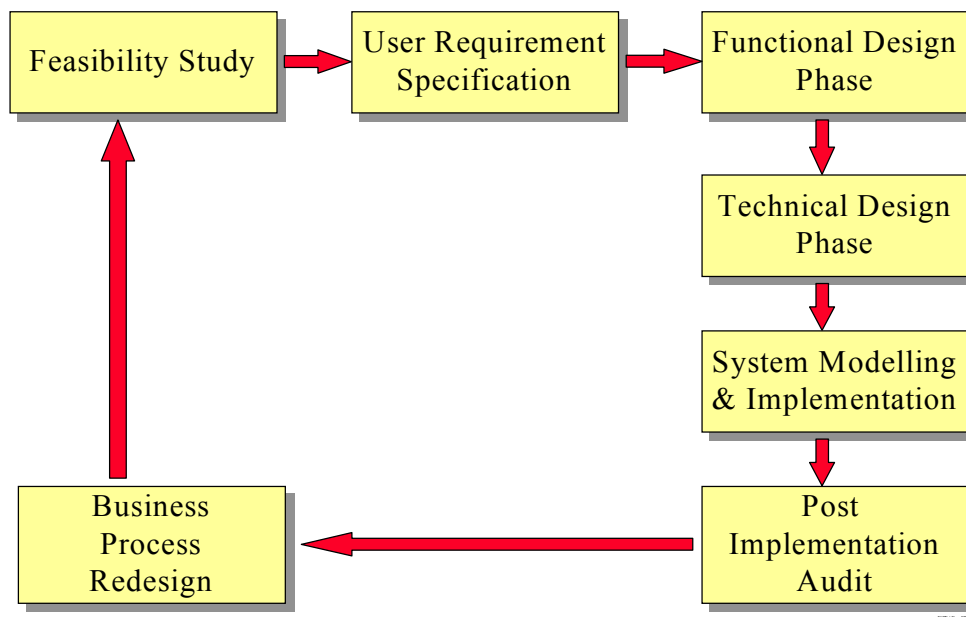


Figure 2 System development life cycle

The User Requirement Specification (URS) forms the basis for all future activities in the system development life cycle. It entails a detail layout of the outputs required and the components of the system to achieve this. A high level entity model is required. The aim of this activity is to provide decision makers with a holistic view of the entire system and to give an IT company sufficient scope to enable them to quote for the actual development and implementation of the system.

The Functional Design Phase deals with the system operational requirement, infrastructure requirement, application maintenance, data flow through the applications and detail regarding processes and data validation. (Description of engineering models, inputs and outputs form part of this phase).

The Technical Design Phase looks at the required hardware, networking requirements and database management. Detail table designs for identified entities within the system are finalised with the proposed capacity planning for data capturing and maintenance. (This phase defines the structure of the database).

System Modelling entails the physical layout and coding of applications and reports. The implementation includes user testing of data capturing, validation, processing and reporting as well as the integration with other existing sub-systems. (Users, after training, start using the system with documentation at hand).

The Post Implementation Audit is the comparison of the delivered system against the URS.

SYSTEM DEPENDANCY DIAGRAM

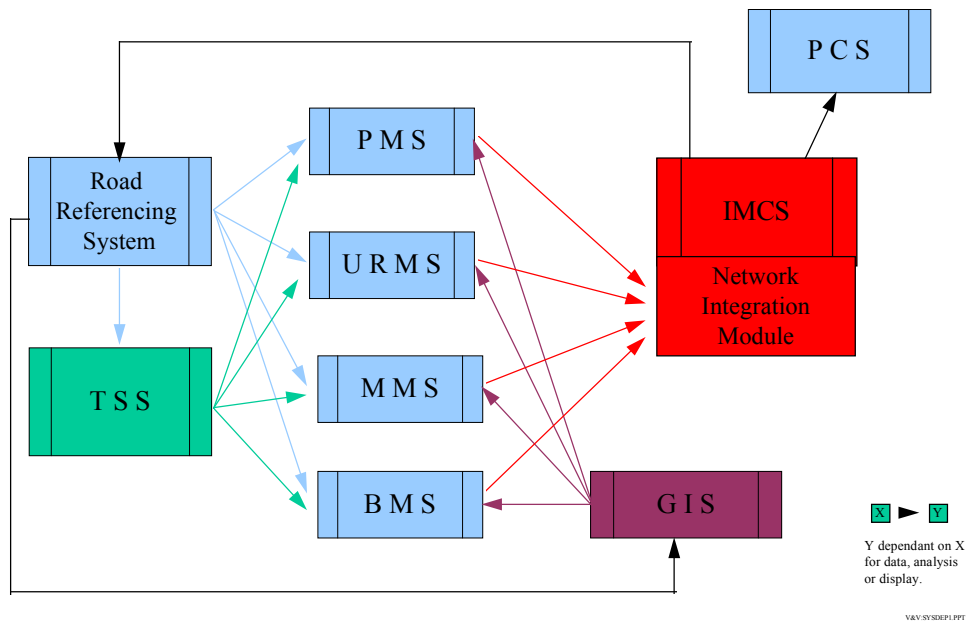


Fig 3 System Dependency Diagram

SYSTEM DEVELOPMENT PATH

The RMS is a complex collection of management systems requiring sufficient development time and funding. It must be developed systematically in a modular form, which allows simple addition and integration of modules and systems.

In order to achieve the objectives, it is necessary to conduct an RMS Architectural System Design.

The Architectural System Design provides the logical and physical application and data architecture as well as the user requirement specification for the various sub-systems.

In addition, the various sub-systems cannot be developed in isolation. They are all interdependent as shown in Figure 3. Some systems are totally dependent on other systems being complete before they can operate. This defines the criteria for the development path.

However, the most important ones to satisfy the current and future management needs were considered in structuring the initial RMS and defining the development path.

Any RMS undergoes constant upgrading. There will be an ongoing need for refinement and improvement. The RMS Manager will continually define and prioritise improvements, which will be carried out in the post implementation period.

The majority of essential sub-systems are dependent on the “Network definition” or Road Referencing System. The network definition, which will be used as the referencing system, is shown in Figure 4 as the first level to be addressed in the development path. Although there might be a need to make adjustments after the development of each sub-system, it is considered essential to develop the complete IMCS sub-system, which will also dictate the type and structure of the

outputs of each sub-system. The IMCS is shown in Figure 4 from the first level to the fourth level to indicate that adjustments will be necessary after the development of each sub-system.

Several sub-systems are dependent on traffic parameters to run prioritisation models and decision-making algorithms. Therefore, the TSS is considered to be the second most important level system to address. Although the system is already developed, it still has to be incorporated in the RMS and the necessary link developed to transfer data to the core DBMS. Furthermore, proper documentation is still required and a strategy to obtain reliable data must be finalised.

Systems shown on the third level can only be implemented fully when the TSS and components of the IMCS are operational. These sub-systems are the PMS, URMS, BMS and MMS.

PROPOSED DEVELOPMENT PATH ACCORDING TO SYSTEM DEPENDANCIES

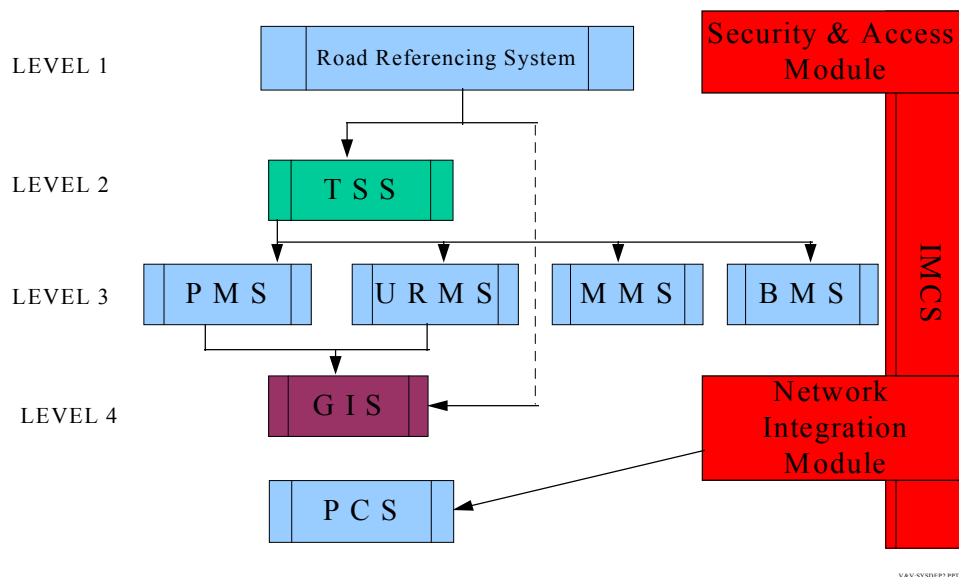


Figure 4 Proposed development path according to system dependencies

One of these sub-systems must be developed simultaneously with the IMCS sub-system to ensure proper linkage with components such as the network definition and to develop the required outputs for the network integration module which also forms part of the IMCS. The PMS is considered to be the appropriate system for this purpose.

The GIS is, for purposes of this network level RMS, primarily seen as a mapping tool to display standard queries on the summarised information contained in the core DBMS. Provision of maps is essential for communication and the development of procedures to extract and display information from the preferred DBMS should be considered a high priority. Information can only be displayed if it exists in the core DBMS. The full value of the GIS will only be seen when all the sub-systems have been developed. For this reason it is considered a fourth level of importance.

RMS ASD was completed successfully and the actual priority of system development and system dependencies was not changed as prescribed by the initial Master Plan, but implementations took longer because of institutional problems.

POSSIBLE INTERNAL INFLUENCES ON IMPLEMENTATION

Internal influences are those within RA which may affect the development of an RMS either negatively or positively.

INSTITUTIONAL ISSUES, HARDWARE, SOFTWARE MANAGEMENT RA CAPABILITIES

POSSIBLE EXTERNAL INFLUENCES ON IMPLEMENTATION

External influences are those that originate from outside the RA organisation. Generally the RA management will have little or no control over these influences.

CENTRAL GOVERNMENT ROAD FUND ADMINISTRATION POLITICS OUTSIDE SUPPORT

PROGRESS UP TO 2000

Following the development path guidelines from the RMS Master Plan, the following systems have been developed and implemented with success

1. Architectural System Design (ASD)
2. Road Referencing System (RRS)
3. Traffic Surveillance System (TSS)
4. Information Management and Control System
5. Pavement Management System (PMS)
6. Geographical Information System (GIS)

Sub-systems of the RMS scheduled for completion by the year 2003 are as follows:

- Unsealed Road Management System (URMS)
- Bridge Management System (BMS)
- Maintenance Management System (MMS)
- Project Control System (PCS)
- Network Integration Module of IMCS

During the process of developing the Integrated Road management Systems several lessons have been learnt. The following could be of value to other organisations:

- The Master Plan is considered essential to identify the priority of sub-system development
- The ASD is essential to specify the rules of integration to be followed with the development of each sub-system
- Institutional problems can be considered a reality and must be managed
- Proper User Requirement Specifications, Functional Design Specifications and Technical Design Specifications are essential activities to be completed before coding of a system can start. However, one must keep in mind that additional requirements develop continuously and that changes to these specifications must be properly managed
- Local knowledge of materials, measures and pavement performance must be incorporated in the systems

- Systems should be used as fast as possible after the required input data has been obtained and outputs are available
- A momentum of development should be maintained
- Outsourcing of certain activities can prove highly cost-effective
- The value of proper training is always underestimated

The role of the RMS in new roads authorities is something that one cannot turn a blind eye to, as Africa is losing expertise, and systems like these are vital for sound decision making, and that of course will result in efficiency and effectiveness, which was the whole aim of the commercialization process.

ROLE OF THE ROAD MANAGEMENT SYSTEM IN A COMMERCIALIZED ENVIRONMENT (Namibian Experience)

S. B. TEKIE

Roads Authority Namibia, Private bag 12030
Windhoek, Namibia
P.O.BOX 86088, WINDHOEK
Tel. 061-248273 (h) 061-2082083 (W)

HIGHLIGHTS OF QUALIFICATIONS

- Working Experience in Engineering especially in Road Management System
- Good organizational and management skills

WORK EXPERIENCE:

ROAD MANAGEMENT SYSTEM

- **Managing the Traffic Surveillance System of the Section** that is mainly supervising technicians and technical assistants in obtaining data, analysis and finally outputs.
- **Managing the Pavement Management System of the Section.** It mainly deals with the supervision of principal road superintendent, foremen, technician and hand works in obtaining data and outputs of the road network of the country.
Visual, riding quality, deflections and pavement data are collected on the paved road network are analysed to get out puts such as remaining life, reseal priority and Rehabilitation Indexes which shows the urgency of a road to be rehabilitated .
- **Managing the Unsealed Road Management System of the Section** which mainly deals with an economic analysis of the condition of gravel roads in Namibia.
- **Maintenance Management System.** Maintenance costing system of the maintenance units of all regions and districts in Namibia. Making sure data is punched in correctly outputs are produced and distributed to all relevant officials of the Department.
- **Helped specialized Consultants to develop systems for the Department of Transport. Reseal Algorithm to prioritize reseal requirements, Material Information System and a Road Referencing System. At present consultants are busy with a Pavement Management System, Traffic Surveillance System and Information and Control Management System. For these projects the RMS Chief Engineer was and still is the project leader from the Department's side.**

Presently Mrs Tekie is the RMS Manager in the Roads Authority of Namibia responsible for the whole RMS and IT of the authority.

EMPLOYMENT HIGHLIGHTS

- **LINGUAPHONE INSTITUTE FROM 1984 - 1986**
As an English teacher for beginner classes, managing the institute whenever the owner was not present
- **NAMIBIA DEPARTMENT OF TRANSPORT OCTOBER 1990 - April 2000**
Started as an Assistant Engineer and was promoted to a Chief Engineer.
- **ROADS AUTHORITY OF NAMIBIA - April 2000 till present as the RMS Manager**

EDUCATIONAL BACKGROUND

- 1978 - 1984 High School Diploma and Matric Certificate
NAZARETH SCHOOL ADDIS ABABA, ETHIOPIA
- 1984 - 1990 BSc Degree in Civil Engineering
ADDIS ABABA UNIVERSITY, ETHIOPIA
- 26 JUNE 1994 - 1 JULY 1994 , 7 - 11 June 1999 Diploma Stellenbosch University
PAVEMENT MANAGEMENT SCHOOL (PMS) SCHOOL
- **VARIOUS SEMINARS AND MEETINGS WERE ATTENDED ON VARIOUS ENGINEERING FIELDS** as well as in Management. Diploma and Certificates were obtained in each of the above courses.

REGISTRATIONS AND MEMBERSHIPS

- An Executive Council Member of the Engineering Council of Namibia and is registered as a professional engineer with the council, PE 95013
- A council member of the EPA (Engineering Professions Association of Namibia) representing the Civil Engineering field.

PERSONAL BACKGROUND

Nationality:	Namibian
Marital Status:	Married with one child
Languages:	English, Ethiopian - excellent; Arabic and Persian (fair)
Hobbies:	Reading, music, sports, travelling, community activity