A Strategic Approach to Road Asset Management – A Municipal Perspective

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***Abstract*—** eThekwini Municipality's road network represents a huge investment made at great expense by past generations. It is a vital economic resource to the metropolitan area, and the Municipality is therefore mindful of the need for judicious asset management.

As infrastructure owners, the Roads Provision Department has implemented a Pavement Management System (PMS) to support decision making, develop work programmes and evaluate the performance and cost-effectiveness of treatment options. However, eThekwini is a developing Municipality that faces several challenges affecting asset management at a strategic level. For example, there are growing calls to incorporate the network of tracks and footpaths within the ever increasing number of informal settlements around the city into the formal road network. A further challenge is establishing proper controls for the use of the road reserve for the installation of services such as water, electricity and telecommunication. The absence of proper as-built information often results in these services being damaged during rehabilitation operations at a huge cost to the city. Other issues of strategic importance affecting road asset management are inter alia developing infrastructure on land belonging to tribal authorities, reducing backlogs and investigating alternative sources of funding to supplement already constrained budgets. In addressing the aforementioned, the Roads Provision Department has adopted a multi-pronged approach to asset management.

This paper discusses a holistic approach to asset management through the integration of operational aspects driven by the PMS, with strategic components such as organisational transformation, and legislation in the form policies and by-laws.

Keywords—Pavement Management System; asset management; infrastructure

I. INTRODUCTION

The environment in which public assets are maintained and operated in South Africa is dominated by legislation, constrained resources and increased demands for service delivery. Balancing the need to deliver new infrastructure in the short term, with the need to make decisions in the long term about existing infrastructure is guided by the principles of life-cycle costing (analysing the total cost of acquisition, operation, maintenance and renewal/replacement over the life of an asset), and risk management. In the municipal sphere, municipalities are required to reflect the value, including deterioration, of fixed infrastructure assets in their books. The Public Finance Management Act (PFMA), as well as the Municipal Finance Management Act (MFMA) specifically place responsibility for effective asset management on Accounting Officers. In so doing, these Acts highlight the need not only to develop new infrastructure, but to also operate, maintain and renew existing and to-be-developed infrastructure in a way that is organisationally, technically and financially sustainable. In addition to these acts, the Committee of Transport Officials are developing technical methods on the manner in which road infrastructure should be managed, as well as the functional classification of roads to establish a uniform and integrated classification system for the country.

In the context of the legislative and technical environment described above, the Roads Provision Department of eThekwini Municipality implemented a Pavement Management System (PMS) in 2003. This initiative was designed to better equip and assist planning staff in achieving their objective of ensuring roads under their management are provided and maintained in a condition acceptable to the travelling public and at the minimum life cycle cost. The PMS is underpinned by an asset management software application that is configured for use in strategic analysis of pavement networks. The PMS is capable of the following broadly defined functions:

- Ensure accurate and reliable location referencing of road data.
- Provide easy access to accurate road network inventory information.
- Regularly quantify and report on the condition of the road network on a network, sub-network and road segment level basis (historic trends and current status quo).
- Allow for integration with Geographic Information Systems for presentation of data.
- Provide a basis for allocating funds among different sub-networks through life cycle costing and optimisation.
- Assist in selection of viable alternative maintenance strategies for each road section in the network and determining Life Cycle effects of these in terms of:
  - future network conditions, future maintenance requirements and budgetary needs,
  - future road network rehabilitation backlogs,
  - future asset values of the road network.
- Assist in selection of the best preventive maintenance and rehabilitation strategies for each road section

while taking into account imposed budgetary and resource constraints, now and in the future.

- Assist in identifying the budgetary requirements for implementing the ideal preventive maintenance and rehabilitation strategy for each road section, now and in the future.
- Ensure that decision support is available for Life Cycle Cost Analysis (LCCA), economic prioritisation, optimising investments within constraints and sensitivity analyses. Decision support at lower levels will not be sufficient to manage the maintenance of the extensive eThekwini pavement network effectively. Specifically, LCCA and optimisation of investments under constraints are the tools required for effective pavement management.

II. NETWORK MANAGEMENT

The Roads Provision Department is the designated custodian of the road network. However, management of the eThekwini Municipality road network is undertaken on two fronts. The Road and Stormwater Maintenance Department undertakes the day to day maintenance of the surfaced road network as well the full maintenance responsibility for the gravel road network including shaping and re-gravelling. Strategic interventions such as road resurfacing that will impact the long term performance of the network are the responsibility of the Roads Provision Department and are implemented through its PMS. The design and construction of these interventions also constitutes a significant element of the output of the Roads Provision Department.

The total paved road network within the eThekwini Municipality consists of approximately 8200km of formally maintained roads of which the Municipality is responsible for almost 6900 km of flexible, concrete and block roads. Other significant road authorities within the Municipal boundaries include the South African National Roads Agency and the KwaZulu-Natal Department of Transport who are responsible for their own road networks. Table 1 describes the lengths of the paved road network within eThekwini.

Since implementation of the PMS, the eThekwini road network has been categorised according to the functional hierarchy defined in Table 2. All roads in urban centres and industrial areas have been categorized as category "B" roads. The majority of the paved road network (54.4%) consists of UD roads that provide mobility and access in a local residential context. UA roads make up only 1.9% of the network while UB and UC roads constitute 28.1% and 15.6% of the road network respectively.

The preceding functional road classification was later transferred to the categories specified in the Road Classification and Access Manual (RCAM), and is described in Table 3. According to this manual, the primary function of urban mobility roads is to connect urban districts while the primary function of urban access/activity roads is to provide access to individual properties and to accommodate associated activities.

The current road network is an amalgamation of networks inherited from several former local and regional authorities. The absence of needs based funding models and a "fix-worst-first" approach to the general maintenance of existing infrastructure needs has led to an imbalance in the condition of the network by location with the major industrial areas being most affected. Another characteristic of the road network which sweeps across all former entities and locations is the extreme variability in layerwork construction. The ad hoc development of the urban network both length wise and width wise has resulted in numerous layerwork constructions occurring over very short intervals on any one road. Allied to this issue is the virtual absence of as-built information for the network. This has made rehabilitation of the network particularly challenging with the consequential difficulty in defining "uniform" sections for rehabilitation design purposes.

TABLE I. PAVED ROAD NETWORK LENGTHS (APRIL 2017)

Pavement Type	**eThekwini Length *(km)***	**KZN Length *(km)***	**SANRAL Length *(km)***	**TOTAL Length *(km)***
Block	44	1	0	45
Concrete	129	0	0	129
Flexible	6675	985	360	8020
TOTAL	6848	986	360	8193

TABLE II. FUNCTIONAL ROAD CLASSIFICATION

Functional Category	**Description**
UA	Trunk roads, primary distributors, freeways, major arterials and bypasses used for primary urban distribution and linking urban districts/sectors.
UB	District and local distributors, minor arterials and collectors, industrial and CBD roads, goods loading areas and bus routes used for district distribution and to link communities.
UC	Urban access collectors used for local distribution and to link neighbourhoods.
UD	Local access roads (residential): Loops, access ways, access courts, access strips and cul-de-sacs.

TABLE III. RCAM FUNCTIONAL ROAD CLASSIFICATION

RCAM Category		**Description**
MOBILITY	U1 (UA)	Serve traffic in metropolitan areas and large cities. Connection for general overall mobility and economic activity centres such as airports. Population > 500 000; Traffic ≥ 40 000 v.p.d[a].; Routes > 20km.
	U2 (UA)	Serve traffic in metropolitan areas, cities and medium to large towns. Connection between larger regions of the city and important economic activity not served by U1. Population > 25 000; Traffic between 20 000 and 60 000 v.p.d.; Routes > 10km.
	U3 (UB)	Serve traffic in cities and larger towns. Last leg of mobility road network. Cannot connect to U1. Traffic between 10 000 to 40 000 v.p.d.; Routes ≥ 2 km.

RCAM Category		Description
ACCESS/ACTIVITY	U4 (UC)	Collecting traffic between local streets and the arterial system. No through traffic, but an origin or destination in the street itself or near to the street. A collector street should not be quicker than a mobility road. Collectors are: Class 4a (Commercial collector street): ≤ 25 000 v.p.d.; Class 4b (Residential collector street): ≤ 10 000 v.p.d. Routes ≤ 2 km.
	U5 (UD)	Exclusively an access or activity function. Provide access to individual properties. No through traffic, only an origin or destination along the street. Collectors are: Class 5a (Commercial local street): ≤ 5 000 vehicles per day, areas with commercial, business, industrial, shopping and mixed-used residential developments. Normally high percentage heavy vehicle traffic; Class 5b (Residential local street): ≤1 000 vehicles per day, areas with residential traffic, some public transport, service vehicles and small delivery trucks. Routes between 0.5 km and 1 km.

[a] Vehicles per day

III. VISUAL CONDITION ASSESSMENTS

A fundamental aspect of the PMS is the network level visual condition inspections conducted every two years in accordance with well-defined standards that cater for flexible road pavements, jointed and continuously reinforced concrete pavements, segmented block pavements, and non-standard or unclassified pavements. Paved roads are segmented into smaller segments of 500 m which are rated in terms of the various distresses occurring on them. The degree (seriousness) and extent (occurrence) of each distress are recorded. The distresses include surfacing defects, structural defects and functional aspects.

Since its inception in 2003, the PMS has embraced the principles of capacity building and skills transfer by training in excess of one hundred visual condition assessors and assistants from the private sector. To date, the selection of survey teams has been based on an Expression of Interest, followed by a pre-tender training, calibration and testing session with specific, defined criteria for acceptance of staff offered as assessors and assistants. This happens together with continuous follow-up and recalibrations, as needed from the quality control part of the Quality Management Plan (QMP) for visual condition assessments. The quality acceptance procedure is based on re-assessment of a random ten per cent of the road network of each assessment team to confirm the quality of the production condition assessments. This forms the quality acceptance part of the QMP. The QMP ensures that only acceptable data is imported to the PMS for analysis. The road network is divided into a number of inspection areas, depending on the number of appointed teams (each team consisting of two people, i.e. an approved assessor, and a driver (the assistant). Typically 15 teams are used, and progress per team per day is approximately 10 to 15 km.

Visual condition assessments are captured on the road on tablet notebooks in pre-prepared forms using customised data capture software. At the start of the segment the form for the relevant visual assessment segment is displayed on confirmation from the assessor that his location as shown on the GIS map on the tablet, from the linked GPS, is correct, as well as the road type. This ensures data capturing against the correct segment. The forms also contain all possible validation procedures during and at the finalisation stage of data capturing of each individual segment's visual data. The purpose is to achieve complete and cross-checked data per visual segment before the assessor physically leaves the relevant segment. Capturing the visual assessment data directly on the tablets also provides an additional advantage: assessment teams are monitored weekly regarding progress as they submit the data to a central repository. Weekly and cumulative progress per team is available in tabular format and spatially on the GIS. This allows contingency plans to be made should a team default on the required progress. Since 2003, eight iterations of the biennial network level visual inspections on the city's paved roads were successfully completed by trained assessors, a feat unmatched by any other metropolitan municipality in South Africa.

An important factor in the PMS life-cycle approach however is the quality and significance of the data used in its analysis. To date the assessment of the network has been based on visual data only. Although a rigid quality control procedure is adhered to during the inspection process, a degree of subjectivity still remains. It is therefore acknowledged that some form of mechanical testing would add significant weight to the PMS output. A start has been made to conducting Falling Weight Deflectometer testing over the higher order network but the limited availability of such equipment however remains problematic. Another significant detraction with regards to visual assessment of the network is the dearth of available assessors and the length of time required to undertake an inspection. The Roads Provision Department is currently investigating the feasibility of substituting the visual assessment of the lower order PMS category UC and UD network with a range of mechanical tests.

IV. MAINTAINING A HEALTHY ROAD NETWORK

The surfacing, structural and functional distresses recorded are used to calculate a composite Visual Condition Index (VCI) for each paved road segment. As it is generally accepted that the condition of a road deteriorates with time, the VCI is a percentage index ranging between 0 and 100, where 0 represents a road segment in very poor condition and 100 represents a road segment in very good condition. The five categories adopted are:

- Very Good = 86% to 100%
- Good = 71% to 85%
- Fair = 51% to 70%
- Poor = 31% to 50%
- Very Poor = 0% to 30%

In order to ensure that the municipal road network delivers an acceptable level of service, the performance targets below have been set. The PMS is ideally suited to determine the future budget needs for achieving and maintaining the performance targets through its life cycle cost analysis (LCCA) component.

- No roads in any of the UA to UD categories may deteriorate below a VCI of 30.
- No UA and UB roads may deteriorate below a VCI of 50.
- Less than 10% of UC and UD roads may deteriorate below a VCI of 50.
- The average VCI of the entire network must remain greater than 70.

Since 2003 the average condition of eThekwini's surfaced roads fluctuated between 70% and 80%. The paved road network is probably eThekwini's most expensive asset. Maintaining it in a good condition is vitally important to the city's economic growth, quality of life and its overall sustainability.

V. THE PMS AS A STRATEGIC PLANNING TOOL

In an environment of decreasing budgets and increasing demands, the PMS has proved to be an invaluable strategic tool used to make cost-effective decisions on pavement management issues. The PMS optimizes the information from the network level surveys taking into account pavement condition, predicted deterioration and treatment costs to produce a prioritized list of rehabilitation and seal projects across the entire municipal network such that the most economically viable treatment is undertaken given the budgetary constraints for road maintenance. The optimisation process is therefore not a simple worst first scenario, but evaluates the merits of a range of possible treatments each time taking into account the predicted future deterioration of the road in accordance with the HDM-4 World Bank Road Deterioration models. This iterative process is undertaken for every road in the Municipal network to produce a multi-year Maintenance and Rehabilitation (M&R) programme.

Based on the strategic level maintenance needs analysis, the Roads Provision Department has successfully influenced Council to increase its funding allocation for pavement preservation and rehabilitation. For example, the 2007 Strategic Maintenance Needs Analysis indicated a funding level need of approximately R300 million for preventive maintenance and rehabilitation to prevent further deterioration and to improve the condition of the network. The Municipality subsequently increased the preventive maintenance and rehabilitation funding level from R80 million to more than R300 million for 2008/9. This investment resulted in a consequent increase in the overall condition of the network from 2007 to 2009 due to increased proportions of roads in the "good" to "very good" condition categories.

The Strategic Maintenance Needs Analysis of 2009 and 2015 predicted an improvement in the overall network condition if the Medium Term Expenditure Framework (MTEF) budget (R424 and R300 million respectively) was allocated for preventive maintenance and rehabilitation according to the recommendations of the LCCA. A national bitumen shortage and contractor procurement issues were some of the pitfalls resulting in the recommendations not being fulfilled, hence a slight decrease in the condition in 2011 and 2017. However, based on the Strategic Maintenance Needs Analysis of 2011 and 2015, the Roads Provision Department implemented intensive reseal programmes to prevent "fair" roads deteriorating into the "poor" condition category. Roads in a "fair" condition have the opportunity to be preserved with cost-effective preventive intervention measures, effectively increasing the life of the pavement by many years. This informed decision making process would not have been possible without the PMS and its decision support tools. The strategic analysis is used to determine the consequences of various policy and budget scenarios, and can be expressed as the expected average future condition, expected future backlog (roads in poor and very poor condition), expected condition distribution, etc.

VI. LIFE CYCLE COST ANALYSIS

Life cycle cost analysis (LCCA) is used to investigate the extent to which current preventive maintenance and rehabilitation strategies and budget levels affect the life cycle and performance of a pavement. Scheduling preventive maintenance and rehabilitation strategies through a process of optimisation improves pavement reliability, time between failures, overall service delivery, pavement useful life, and ultimately reduces the total life cycle cost of road ownership. The input into this analysis is the current condition of the pavement, appropriate pavement performance prediction models, intervention treatments and costs, current fund allocations, current maintenance policies and desired future performance. In the analysis, pre-determined preventive maintenance and rehabilitation strategies are considered for each road segment over a long-term analysis period. The outcome of the optimisation process is a multi-year maintenance and rehabilitation plan under constrained budget scenarios. The area-under-curve benefit function is used for the analysis of the paved network. This benefit function is calculated by summing the present value of the difference between the condition index resulting from the repair strategy and the condition index for the do-nothing alternative. The method of calculating this benefit is illustrated in Figure 1. The equation to calculate this benefit for an intervention strategy on a road segment is:

$$Benefit_i = \sum_{i=1}^{TotYears} AADT_i \, (IS\_Cond_i - DN\_Cond_i) \quad (1)$$

In (1) the terms have the following meaning:

$Benefit_i$	Benefit of an intervention strategy for a road segment
TotYears	Total number of years in the analysis period
i	Year in the analysis period
IS_Cond_i	Condition of the road segment for the intervention strategy in year i
DN_Cond_i	Condition of the road segment for the Do Nothing Strategy in year i
$AADT_i$	AADT on the road segment in year i

For each strategy, the benefit is calculated for each year in the analysis period, weighted by traffic and totalled for the analysis period. In theory, the "benefit" is the area between the two curves. Any repair strategy that improves the condition of the road segment would thus result in a positive area above the

'Do Nothing' curve. During the optimisation analysis, the incremental benefit of alternative intervention strategies of increasing costs, are measured in terms of the area-under-the-condition curve. This method is most suitable to use on road networks that include low trafficked roads, thus complying with the objective of preservation irrespective of economic benefits, and thus agreeing with sound asset management policies.

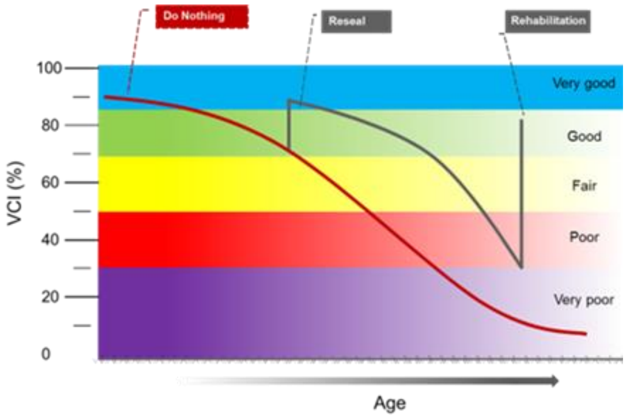

Fig. 1. Area-under-the-condition curve.

VII. Pavement Management in the Asset Management Context

The PMS is strategically positioned to satisfy National Treasury's regulatory requirements of Generally Recognised Accounting Practice (GRAP) from a road asset management perspective. The PMS provides the information needed of the Municipality's asset management system regarding the relevant characteristics of the pavement asset, and their condition and remaining useful lives. The PMS however contains substantial more detailed information without which the strategic needs analysis and preparation of multi-year preventive maintenance and rehabilitation plans would not be possible. Currently, the PMS satisfies the decision support needs of the pavement managers of eThekwini, while the information passed on to the asset management system satisfies the accounting requirements. The latter alone is not sufficient for pavement management and satisfies a different need.

VIII. PMS and GIS Integration

The implementation of the PMS has led to substantial requirements being put on Corporate GIS regarding the spatial integrity of the road centerline map. The PMS uses the dynamic segmentation (also known as linear referencing) capabilities of the GIS to display data and information from the PMS for the linear pavement infrastructure. This requires specific topology rules to be adhered to in the GIS regarding direction of lines, overshoots, undershoots, duplication, etc. To assist Corporate GIS in complying with this, an Editing Verification Tool (EVT) was developed as a plug-in to verify any changes made to the spatial network, e.g. addition of new roads, splitting of links, etc. The road network identifier information of every link (start and end descriptions, nodes, km positions) is also generated from the GIS, thus ensuring a fully synchronized GIS and PMS.

IX. Improving Sustainability with Reclaimed Asphalt

eThekwini Municipality is fully aware that preserving the road asset through sustainable development and innovation is one way of ensuring intergenerational equity. The candidate projects selected under the maintenance and rehabilitation programme provides the ideal backdrop for innovative pavement research into the use of reclaimed asphalt and bitumen stabilised materials as these projects are used to conduct trials, thus promoting research, technology transfer and training. The effective implementation of results emanating from such research would satisfy the common objective of reducing total life cycle and road user costs, while increasing road user benefits, and in so doing, promote environmental, social and economic sustainability. This relationship presents minimal risk to the city with the added benefit that the results of any research, if implemented properly, will result in cost savings in the medium to long term.

The increased number, size and axle loading of vehicles using the Municipality's road network have significantly increased pavement maintenance and rehabilitation costs. One of the reasons for this is that current construction practices and materials may not provide adequate performance in the presence of modern heavy loaded vehicles. The already scarce supply of suitable road building aggregate has been exacerbated by legislation that regards the establishment of a borrow pit as a mining activity. The lengthy application procedure in obtaining the necessary permits often results in many delays before a borrow pit can be commissioned for commercial use.

As part of the Municipality's commitment to reduce its carbon footprint and its dependency on non-renewable resources, extensive use is being made of reclaimed asphalt, especially as abitumen stabilised material, in as many rehabilitation projects as possible. Bitumen stabilised materials are usually granular materials, previously cement-treated materials or reclaimed asphalt layers that are treated with either bitumen emulsion or foamed bitumen. The benefits to the Municipality of using recycled bitumen stabilised materials include an environmentally friendly cold-mixing process and minimal traffic congestion and disruptions as the road can be trafficked soon after compaction. Recycling pavement materials not only preserves valuable landfill space which would otherwise be used to stockpile old asphalt, but the addition of rejuvenators and linking agents in mixes containing reclaimed asphalt reduces the amount of bitumen required. The trials conducted indicate that this rehabilitation option is a viable alternative to conventional methods especially in situations where an overlay is not possible due to site constraints or where there is a requirement to complete the rehabilitation quickly to prevent disruption to business or residents.

X. Forging Sustainable Partnerships with Warm Mix Asphalt

eThekwini Municipality's Integrated Development Plan emphasizes the need to develop and sustain the spatial, natural and built environment and to create a quality living environment. A key contributor in reshaping eThekwini's urban landscape is the numerous road rehabilitation projects which are undertaken annually. This major investment in the city's road infrastructure creates and stimulates positive synergy and enhances social cohesion and integration by improving access to all opportunities and facilitating poverty alleviation. However, the socio-economic benefits of road construction are often overshadowed by its negative impacts, especially on the environment. The innovative use of warm mix asphalt (WMA) has increased sustainability and yielded numerous benefits to the Municipality.

Using the candidate rehabilitation projects identified through the PMS, the first properly monitored WMA trials in South Africa were conducted in eThekwini Municipality and confirmed that asphalt mixes could be produced and paved at significantly lower temperatures than conventional asphalt, resulting in energy savings through lower fuel consumption, and a decrease in the emission of greenhouse gases. Several roads have since been constructed within the eThekwini Municipality in which WMA has been specified and successfully implemented. These projects are good examples of how partnerships can be forged between clients, contractors, consultants and suppliers to successfully introduce new technology.

XI. Improving Pavement Performance with High Modulus Asphalt

Economic growth, higher traffic volumes and axle loads have made it necessary for the Municipality to review how roads are constructed and maintained in the city. This is especially true for roads around the harbour which carry a continuous stream of heavy vehicles, many of them laden with containers and other goods destined for export. Normal asphalt mixes cannot cope with this extreme loading resulting in deformed pavement structures characterized by severe rutting. In addition to the high cost of routine maintenance, any interruption of traffic to effect repairs ultimately affects the national economy.

A major access route to the harbour which was identified for rehabilitation by the PMS was offered as a trial site for the transfer of high modulus asphalt (EME) technology to South Africa. The asphalt surfacing displayed severe rutting due to high volumes of heavy vehicles en route to the harbour. The use of EME technology was considered as an option not only to ensure a longer life road section that will be able to carry the significant traffic volumes and loads, but also to offer a solution that would result in reduced life-cycle costs and require less maintenance. It was envisaged that the implementation of EME on such a high demand road section will reduce the rapid occurrence of permanent deformation. One of the EME mix designs contained twenty percent reclaimed asphalt which satisfies the Municipality's broader recycling initiatives by decreasing the use of non-renewable materials such as aggregate and bitumen. The use of EME lends itself to eThekwini's long term plan of constructing 'perpetual roads' which are constructed to have a very high carrying capacity, using thick layers of high quality material. The high short term capital investment is superseded by the reduced life cycle costs as a result of the structural layers requiring less maintenance, which ultimately reduces road user delays over the life of the road.

XII. Community Infrastructure Programme

The Municipality's Community Infrastructure Programme (CIP) is aimed at improving the mobility of citizens in rural communities, and providing access to economic opportunities that were previously unattainable. Footpaths, access roads and sidewalks are constructed through the CIP contracts using funding provided by National Treasury. Traffic calming measures are also implemented around public areas such as schools, clinics and community halls. The CIP contracts are used to empower local businesses by ensuring that work is undertaken by previously disadvantaged contractors from the community. These projects consistently achieve the necessary community participation goals and local employment targets with a major portion of the expenditure being retained within the community. The PMS fulfils a strategic planning function as it provides the necessary information used to identify projects, select routes and provide much needed GIS support. These CIP projects are a positive indication that the PMS can operate effectively throughout all levels of the road hierarchy.

XIII. Developing a By-law for Work in the Road Reserve

A further challenge is establishing proper controls for the use of the road reserve for the installation of services such as water, electricity and telecommunication. The absence of proper as-built information often results in these services being damaged during rehabilitation operations at a huge cost to the city.

A particular challenge facing the Roads Provision Department is the competition for space in the road reserve. In addition to the road surface, the road reserve is required to accommodate various services including sewer, stormwater, electricity and electronic communication networks. Although the preferred location for these services is the road verge, it is often very difficult to achieve in practice because of unsuitable ground conditions or a lack of space in the verge. There is thus a proliferation of services under the hardened road surface. Although service providers are encouraged to use trenchless technology, there is still a significant extent of trenching required within the hardened road surface. This has a highly detrimental effect on not only the condition of the affected roads, but also on the PMS generated road rehabilitation programme.

The Electronic Communications Act (Act No. 36 of 2005) has also started to impact on the road network. Under the Act, a service provider is entitled to place its network of cables within the road reserve. However, with the competition for space and the potential occurrence of unsuitable ground conditions, location of these networks under the hardened road surface becomes an attractive alternative. The depth of the service can be agreed to but remains the prerogative of the service provider. The cost of relocation envisaged by any future road development has to be borne by the road authority. The proliferation of companies installing such networks and sub-letting "cable space" to accredited service providers has potentially dire consequences for the integrity of the road network.

The Electronic Communications Act has severe consequences for local authorities as it allows licensees to construct and maintain an electronic communications network or facility upon, under, over, along or across any land, including streets, roads, footpaths or land reserved for public purposes. One method of controlling such activity is the issue of a wayleave by the Municipality to prospective service providers to carry out work in the road reserve. A wayleave constitutes a formal approval with accompanying conditions. Notwithstanding the aforementioned, the ECA allows the licensee to begin operations after providing thirty days prior written notice. It appears therefore that a licensee must, as a matter of principle, obtain the consent from the applicable roads authority before installing the services, but, in extraordinary circumstances, may proceed without such authority. The Roads Provision Department has subsequently embarked on an initiative to streamline the city's wayleave application process with the aim of creating a single point of entry for all service providers intending to work in the road reserve. In addition, a by-law is being formulated to control the manner in which all service providers work in the public road reserve.

XIV. Developing a Roads Policy

Issues of strategic importance that affect road asset management are inter alia developing municipal infrastructure on land belonging to tribal authorities, reducing backlogs and investigating alternative sources of funding to supplement already constrained budgets. The Roads Provision Department has formulated a policy to address such issues in an effort to reach its long-term goals. The policy is designed to influence and determine all major decisions and actions, and to ensure that all activities take place within the boundaries set by it. For example, there exists a measure of uncertainty regarding the manner in which roads are to be developed on tribal land especially since approximately thirty percent of Municipal land belongs to tribal authorities. The policy addresses this contentious issue by stating that Council approval shall be sought prior to processing requests for the construction of new infrastructure on tribal land. Furthermore, all requests for the construction of new roads shall be considered in accordance with future development plans of the area.

XV. Conclusion

The success of eThekwini Municipality's PMS can be attributed to the interaction of four fundamental components, viz. *profit* (using the road network as a catalyst to grow the city's economy), *people* (using the road network to initiate social change), *planet* (ensuring that the road network does not adversely affect the environment) and *passion* (the perseverance of the city's officials in the face of adversity). eThekwini has developed a 'pavement management mindset' having implemented processes that are geared towards managing the road network at optimal levels. The professionals responsible for the PMS ensure that sufficient budgets are motivated for data collection, system upgrades, skills development and operational support. Adhering to strict quality management procedures for data collection ensures the strategic analysis of the consequences of budget and policy scenarios is based on sound data. This leads to the development of optimum multi-year preventive maintenance and rehabilitation plans, the implementation of which has had positive effects on the overall pavement conditions. In the long term, eThekwini Municipality's R100 billion road network is in good hands!

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