GENERALLY ACCEPTABLE MINIMUM STANDARDS FOR ROAD DESIGN AND MAINTENANCE PROCEDURES

ABSTRACT:
The level of knowledge and expertise regarding generally acceptable methods and procedures for the design of roads and streets (new, maintenance and rehabilitation options) is currently lacking in many municipalities, mainly due to the lack of in-house technical capacity. This leads to inability of critical evaluation of designs submitted to municipalities, resulting in low-risk run-of-the-mill designs obtained from inexperienced designers. Typically, this results in inflated project costs due to the risk for the design being absorbed into an over-conservative road and street design. Although good design guidelines and specifications exist in South Africa, these are often not used correctly. Further, the required foundation for the effective implementation of some of the design guides is absent as many municipalities do not have adequate infrastructure management systems to enable objective decisions to be made regarding infrastructure (roads specifically in this case) construction and maintenance.

This paper motivates for the development and adoption of a Generally Acceptable Minimum Engineering Design Procedure for municipalities to enable their technical evaluation of submitted designs to be improved and to ensure more effective spending of funds due to the technical requirements of the project being well-defined and appropriate designs to be provided for specific project conditions. It further supports the development and maintenance of adequate infrastructure management systems to enable technical staff to take objective decisions regarding their infrastructure spending.

The paper starts with a short evaluation of the problem, highlighting some of the issues identified to hamper effective and applicable road designs in municipalities. It links and translates the principles used in the Generally Acceptable Accountancy Procedures to road design and develops a proposed structure along this procedure that should assist municipalities to invest their limited funding more effectively during road design, management and maintenance.

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INTRODUCTION

In alignment with the topic of the conference the objective of the paper is to determine how we can today influence the infrastructure we constructed yesterday to ensure optimal functionality tomorrow?

Municipalities (and clients in general) in South Africa has a major lack of technical staff with relevant training and experience in terms of the technical requirements of their responsibilities. Numerous reasons can be identified for this situation, and this is outside the scope of this paper. Evaluating references such as Lawless (2007) indicates shortages of more than 5 000 civil engineers in local government in South Africa.

This situation partly leads to the case where the lack of technical expertise in a municipality allows a lack of infrastructure management to take place, and also a lack of appropriate appreciation of the value of infrastructure assets and the importance of management and maintenance of this infrastructure. Technical designs for new and maintenance work on municipal infrastructure can easily be evaluated and accepted without detailed technical evaluations of the appropriateness of the specific design, and with the main focus on the cost of the project, as well as various non-engineering aspects. Unfortunately the same principles apply for the appointment of design (consulting) engineers which are currently based largely on the cost of the services rather than technical expertise. This situation leads to a trend where consulting engineers generally gravitate towards a least-effort (least cost) design method as the technical merit of a proposal is not necessarily the reason for a design to be accepted and implemented. Risk management by the design engineer in a scenario of insufficient funds for the services of design, indefinably results in a conservative (unnecessary expensive) design.

It can be argued that most of these designs are safe and conservative in their nature, and therefore implementation of these designs can not do harm. For most road designs this may be true, provided that the described quality control (services also provided by the consulting engineer appointed at least cost) is done to ensure that the construction is done to meet the specifications and, that a management system is in place to ensure that the required routine and periodic maintenance is done. However, any comprehensive life cycle cost analysis, taking into account the cost of spending money unnecessarily early, will be difficult to economically justify. The process of selecting conservative designs based on published solutions further limits the risk of failure to the engineer, and is therefore (in an environment where initial costs and non-technical aspects drives the selection process of the consulting engineer) a safe and relatively cheap design approach in terms of design effort where inexperienced staff can be used to develop designs that are based on previous solutions, resulting in a relatively expensive construction option. This, unfortunately, is not engineering. It does not support the use of innovative solutions to existing problems during maintenance and typically will also exclude the potential benefits of implementation of innovative materials in developing more appropriate infrastructure maintenance and construction designs. This resultant cost increases as a consequence of the criteria used for the appointments of service providers can least be afforded in a developing environment.

The lack of appropriate infrastructure management systems, incorporating inventory data, condition data, infrastructure condition modelling data and appropriate decision criteria for maintenance, further affects the situation in that decisions are made with the focus only on the immediate cost and without a holistic evaluation of life-cycle aspects of the infrastructure.

This paper evaluates this issue and motivates for a system where technical staff can be empowered to expand into more innovative use of their engineering skills and training through appropriate infrastructure supply and maintenance, whilst keeping with minimum standards for the benefit of the client (ratepayers of the municipality). The paper do not suggest a change in the standard contractual requirements for civil engineering work, but rather attempt to provide general principals that should guide even non-technical staff into a direction where more effective management of existing and new infrastructure will lead to a higher level of service to the client (in the end the ratepayer is the reason we have a job). The paper focuses on roads as one specific example of municipal infrastructure, although the same principles can be applied to most of the other infrastructure in a municipality.

PRINCIPLES OF ROAD MANAGEMENT SYSTEMS

The main objective of a comprehensive approach to road maintenance is to minimize the total effect of the provision of the road infrastructure on the economy. In order to minimize the cost the cost stream as a whole should be minimized including, agency costs such as planning, design, construction, management, maintenance and, rehabilitation as well as road user costs. The minimizing of individual items in the cost stream (as is currently the case) could lead to an ineffective transportation system and a dramatic increase in the total cost to the economy. For example, cheap planning will usually result in poor transportation systems and a resultant increase in road user costs; cheap design usually leads to increased construction costs and, cheap management systems (or no management systems) usually result in poor or inappropriate or no maintenance practices, resulting in premature distress, unnecessary deterioration of

infrastructure, an increase in road user costs and ultimately an dramatic increase in rehabilitation costs (up to 16 times the cost of timely periodic maintenance).

Transportation costs play a major part in the competiveness of a country in the world market to attract foreign investment and ensure growth in the economy. Similarly, an effective and well run road and transportation network plays an important role in a municipality's ability to attract new businesses and investment which will ensure economic growth and job creation. The establishment of a guide of acceptable minimum standards could go a long way towards achieving the objective of establishing and maintaining road infrastructure at a minimum cost to the economy as a whole.

GAAP PRINCIPLES

The Generally Acceptable Accountancy Principles (GAAP) refers to the standard framework of guidelines for financial accounting (also known as Accounting Standards). GAAP includes the standards, conventions, and rules accountants follow in recording and summarizing, and in the preparation of financial statements. The GAAP has been developed in an evolutionary approach over a period of more than 60 years. Although various versions exists internationally, and moves are afoot to change some of the details, the general principles guide the accountancy profession into ensuring delivery of a fair, objective and transparent product to its clients. It generally requires financial reporting to provide information that is supporting rational investment, credit, and other financial decisions in the short-and long-term and ensure the improved performance of the business while maintaining appropriate records.

EVALUATION OF GAAP PRINCIPLES FOR APPLICATION IN ROAD DESIGN AND MAINTENANCE PROCEDURES

The GAAP is focused on eleven concepts which provide the guidance required to adhere to the stated principles. It is important to appreciate that these concepts do not prescribe technical methods or procedures. Application of the concepts to the civil engineering area is thus not constrained by a different mindset or even by internal or professional specifications and guidelines used to ensure a good quality product. The proposed application of the concepts thus does not exclude the appropriate and correct application of documents such as the Technical Recommendations for Highways (TRH) series, Committee of Transport Officials (COTO), South African National Standards (SANS) specifications or any in-house specifications of a municipality. It rather supports the effective and efficient application of these approaches for municipal infrastructure supply and management.

Each of the eleven concepts are stated with the original (accountancy focused) application and the proposed application for municipal road design and maintenance in South Africa.

Business Entity Concept

The business entity concept provides that the accounting for a business be kept separate from the personal affairs of its owner or any other business. This concept may support the development of a focused multi-year budget for road construction and maintenance where these entities receive appropriate funding planned for multi-year implementation to ensure that funding is not moved between departments as and when required during a financial year, or when political or social demands requires different spending priorities. Technical staff can only make long-term plans for long-term infrastructure if an indication of long-term funding is available. The application of the Medium Term Economic Framework (MTEF) concept instituted by National Government a number of years ago supports this frame of mind.

Continuing Concern Concept

The continuing concern concept assumes that a business will continue to operate, unless it is known that such is not the case and therefore the values of the assets belonging to a business would be valued at their cost. This concept can be applied to the fact that the roads in a municipality do not change their performance based on who are responsible for their maintenance and management. Often, uncertainty exists regarding longer term planning around ownership of infrastructure and its maintenance, leading to a lack of interest and a lack of attention regarding the deteriorating condition and maintenance needs of this infrastructure. In a municipal environment this translates into the responsibility of the current owner of the road to include the development and maintenance of a complete inventory and condition database of all roads under their jurisdiction. Whenever ownership or responsibility of a specific road changes (re-allocation of responsibilities between levels of government, change of municipal boundaries etc), these records will allow the new owner to understand the asset that they take care of and also appreciate the maintenance and performance history. A more holistic view of the current and future expected performance of the facility can thus be used to also influence the new budget requirements for the facility.

Principle of Conservatism

The principle of conservatism provides that accounting for a business should be fair and reasonable and should not overstate or understate the affairs of the business. Application of this concept to road maintenance and management procedures addresses the requirement of understanding the actual need for the facility (road) before a new or maintenance design is being conducted. For roads this specifically means that the municipality should have a detailed understanding of the function of the road (e.g. local collector, through road, etc), past and current traffic (volumes and types), expected future traffic and future developments that may affect these traffic levels. A regular traffic count on at least the major corridors in the municipality should go a long way in providing the decision makers with a clear understanding of what to provide to the rate payer to ensure that designs are not overstated (copying over conservative designs from published manuals) or understated (guessing traffic requirements based on old information).

Objectivity Principle

The objectivity principle states that accounting will be recorded on the basis of objective evidence and that different people looking at the evidence will arrive at the same values for the transaction. Decisions should thus be based on fact and not on personal opinion or feelings. For roads this simply means that no design can be performed if there does not exist a current and clear set of data originating from the field (i.e. visual condition, in situ material and drainage conditions) and the laboratory (actual current properties of materials to be used in the construction or maintenance and not historic material data). The application of standard recipes in road design, using standard off-the-shelf materials designs and structural designs do not cater for the most efficient application of limited budgets in providing minimum required service levels to the client (ratepayers).

Time Period Concept

The time period concept provides that accounting takes place over specific time periods known as fiscal periods. Any road is designed to carry a certain amount of traffic over a defined life. At the end of this life the road has reached its defined end condition (not completely failed but at a stage of end of optimal functionality where the road can still carry traffic but at a compromise in terms of safety and/or road user costs and/or routine maintenance costs) and is in need of regular planned periodic maintenance. A decision should be made regarding appropriate time periods that can be realistically accepted as standard life periods before maintenance be conducted on a road. The level of maintenance on a road affects both the cost and the life to end-of-functional-condition directly. Appropriate time periods should be assigned to different levels of roads in the municipality to ensure that the travelling public (rate payers and

therefore clients) are not unduly inconvenienced by badly planned maintenance cycles. These maintenance schedules must also be linked to the technical capacity of contractors to actually conduct the planned maintenance and rehabilitation work.

Revenue Recognition Convention

The revenue recognition convention provides that revenue be taken into the accounts (recognized) at the time the transaction is completed. The importance of this action is to ensure that the financial statements of the company will be correct. For roads this may be translated into the requirement that timeous and appropriate condition data will be collected and entered into an active infrastructure management system to ensure that an accurate status of the condition of the road network can be obtained at any given time. The need for a complete road inventory is self-evident. The concept can further be expanded to the correct update of the management system with accurate as-built information as soon as work is completed, as well as the complete annual condition assessment data (i.e. visual, structural and related data). A clear understanding of the actual condition of the road network supports the motivation for budget requests, as it can be used to show clear trends in pavement condition change as soon as they start to develop.

Matching Principle

The matching principle states that each expense item related to revenue earned must be recorded in the same accounting period as the revenue it helped to earn. For roads applications this can be translated to ensuring that the design – construction – quality control – management loop is completed. It is the responsibility of the road owner (municipality) to ensure that the design that was selected to be implemented is actually being constructed, that it is constructed according to the required quality standards, and that the work is recorded accurately in the form of as-built information in the appropriate management system. Hence the consulting engineer appointed to control these activities for the municipality must have the technical ability and the funds available to ensure that these duties are performed excellently (small expense if compared to the expense of the construction costs).

Cost Principle

The cost principle states that the accounting for purchases must be at their cost price. This is the figure that appears on the source document for the transaction in almost all cases. There is no place for guesswork or wishful thinking when accounting for purchases. This concept can be applied to accurate record keeping of all aspects of the road design, construction, quality control, condition assessment and maintenance processes. A standard method should exist and a standard approach should be adopted to specify the format in which data should be collected, stored, the number of repeats of specific tests that are required. A procedure should also exist for defining access and editing control of the infrastructure database to ensure data security and integrity.

Consistency Principle

The consistency principle requires accountants to apply the same methods and procedures from period to period. When they change a method from one period to another they must explain the change clearly on the financial statements. This concept links to the previous concept in that the procedures that are used to evaluate tenders for work, the measurement principles used during work and the assessment methods used during annual condition assessments be kept constant and applicable. Changes in frequency of measurement, accuracy of measurement and documentation procedures can easily lead to gaps in the management process as trends becomes tainted through a lack of comparable data.

Materiality Principle

The materiality principle requires accountants to use generally accepted accounting principles except when to do so would be expensive or difficult, and where it makes no real difference if the rules are changed. This concept is of importance for road works where generally acceptable design and construction methods needs to be followed, using proven methods, materials and processes to ensure that the product delivered adheres to reasonable expectations and are in line with industry standards and norms. This does not preclude the use of alternative methods and procedures (i.e. when an approach exists to conduct certain work labour-intensively, the management processes may look different than when machine intensive construction is followed). When adverse conditions requires it (i.e. flood damage and emergency repairs to infrastructure) it may be acceptable to follow different processes, as long as the outcome is still acceptable for the specific application (i.e. erection of a temporary bridge to allow traffic to pass a stream after flooding).

Full Disclosure Principle

The full disclosure principle states that any and all information that affects the full understanding of a company's financial statements must be include with the financial statements. This concept can be applied to the requirement for transparency in all proceedings related to the assessment, tendering, construction, quality control, and recording of all aspects of the road infrastructure supply process. A transparent system allows for professional peer-evaluation of all aspects in the case of failures on the roads and ensures that correct data are being used whenever future planning is required for the road system. It further allows for objective support of all decisions taken regarding the provision and upgrading of infrastructure in the municipality, as well as motivation of requirements for increased budgets. Through such a transparent system the history of road performance in the municipality is also developed as a basis for further road infrastructure planning and implementation, as the real local conditions (traffic, development and environment) are being incorporated into an improved understanding of the requirements for roads in the specific municipality.

CONCLUSIONS

The focus of this paper is on the motivation for the development and adoption of a Generally Acceptable Minimum Engineering Design Procedure for municipalities enabling their technical evaluation of submitted designs to be accurate and ensure more effective spending of funds due to the technical requirements of the project being well-defined and appropriate designs to be provided for specific project conditions. The Generally Acceptable Accountancy Procedures (GAAP) concepts are used as the basis for the paper, as these are well entrenched and tested in the accountancy area. The paper motivates how each of these eleven concepts can be applied in the provision of roads in a municipality and proposes that agreement with these concepts should enhance the general level of technical excellence provided to the client (rate-payers) due to an open and objective process being followed by all parties concerned.

It does not detract from the correct use and application of standard engineering documents such as the conditions of contract and technical recommendations that may be applicable to the provision and management of roads.

It is envisaged that the application of these general concepts should assist the municipal engineer to ensure that the infrastructure constructed yesterday be evaluated and managed in such a responsible way today that it will continue to serve the client tomorrow in enabling efficient and effective transport in the municipal environment.

REFERENCES

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