The application of Earned Value Management to manage project costs within the South African municipal infrastructure sector

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ABSTRACT

If not managed properly, the cost of South African municipal infrastructure projects could represent a major financial burden on the country's fiscus. Cost management on these projects is, therefore, a significant parameter that needs to be managed appropriately. Earned Value Management (EVM) is a control tool that integrates a project budget and schedule in a single monitoring and control mechanism that has the potential to improve overall project performance in this sector. However, it is necessary to first investigate factors that would lead to increased acceptance of EVM within the sector. To solicit the perceptions regarding project cost management within the sector, a survey questionnaire was developed and distributed to project managers working in the municipal infrastructure sector in South Africa. Descriptive and inferential statistics were used to analyse the data received. Indications are that project managers working in the municipal infrastructure sector recognise the importance of managing project costs. However, attention should be paid to a formal cost control system that interfaces with the current reporting practices; is integrated into and accepted by the whole project team; and is supported by national norms and sector (e.g. water or energy) norms.

INTRODUCTION

In South Africa the third sphere of government, *local government*, is responsible for service provision (*inter alia* water, sanitation, transportation, electricity and social services) and hence for the associated infrastructure development. Local government is supported by national and provincial government to fulfil its development mandate (RSA. Department of Provincial and Local Government 2006:2). However, this sphere of government is plagued by institutional capacity constraints that create a major risk for the implementation of municipal infrastructure projects. One such risk relates to the management of project costs. This article focuses on the management of project costs within municipal infrastructure sector projects.

Table 1 Unspent Municipal Infrastructure Grant Amounts (Source: RSA. Department of COG, 2011)

	2007/08	2008/09	2009/10
	In ZAR '000		
Unspent Amount (MIG)	622 312	847 815	1 256 601

COST MANAGEMENT ON PROVINCIAL PROJECTS AND RESEARCH OBJECTIVE

As the national government is primarily responsible for funding of infrastructure development in municipalities, management of capital infrastructure project cost is of importance to the national economy. Municipal Infrastructure Grant (MIG) expenditure as a percentage of the allocated amount was 92%, 90% and 86% respectively for the 2008, 2009 and 2010 financial years (RSA. Department of COG 2011). Although the expenditure rates (percentages) are high, considering the capacity constraints of municipalities, the monetary value of under-expenditure is considerable.

The values shown in Table 1 show a considerable deviation from scheduled drawdowns. However, it is difficult to determine project performance based on these results. The under-expenditure can be a result of either of the following possible scenarios:

- Scenario 1: Projects were completed ahead of schedule (or on schedule) and with cost savings. Therefore, the values are either (a) due in inflated initial estimates or, (b) the project teams were consistently able to perform better than planned.
- Scenario 2: Projects are behind schedule and were unable to meet planned expenditure targets.

Overall, the deviation from planned expenditure is an indication that project performance is not proceeding as originally planned, but as the two scenarios represent opposing reflections of performance, it is difficult to gather any conclusive information with regard to the overall project performance. Therefore, although targets for reducing infrastructure backlogs may be achieved over a period, it is not possible to assess whether these targets were met in the most cost-efficient manner. This issue can be addressed by Earned Value Management (EVM).

Earned Value Management is a project management control method that is commonly used in both the public and private sectors and would clearly indicate which one of the two scenarios applied to a specific project or set of projects. However, Fleming and Koppelman (1997) state that there may be too many requirements to make it a viable tool for the private sector, and suggest that project teams should make independent assessments of the utility of earned value (EV), and in effect re-*engineer* the process to best fit its own needs. It is proposed that this principle may also apply to the municipal infrastructure sector in South Africa where the utility of EVM should be assessed to evaluate its applicability and benefit to municipal infrastructure programmes.

An investigation into these research questions provides an overview of the current project cost management focus within the municipal infrastructure sector and could contribute towards the appropriate use of EVM within the sector.

OVERVIEW OF MUNICIPAL INFRASTRUCTURE SECTOR

Municipal Infrastructure is defined as "the capital works required to provide municipal services" (RSA. Department of Provincial and Local Government 2006:1). An analysis of municipal capital budgets indicates that the Municipal Infrastructure Grant (MIG) Programme funds a significant portion of municipal capital infrastructure expenditure (Savage 2008:25). Furthermore, as outlined in the *RSA Division of Revenue Act,* 2011(92), MIG remains the largest direct infrastructure grant transfer to municipalities. This is the *first* reason to use the projects funded through the MIG programme as a basis for analysis. *Secondly*, all of the 278 municipalities in South Africa participate in the MIG programme and finally, the MIG programme has an extensive institutional and implementation framework that has been in place during the last eight years. Consequently, stakeholders have significant experience working within the programme.

The Project Management Unit (PMU) is a ring-fenced unit within the municipality that manages infrastructure projects funded by the MIG programme. All the information sought through the research survey was requested from PMUs. It should be noted that there are limited guidelines or policies which are available to assist PMUs with the management of programmes and projects. The exception hereto is the *Industry Guide to Infrastructure Service Delivery Levels and Unit Costs* (RSA. Department of COG 2010), which guides municipalities in their project cost estimation processes. However, estimation of project cost, is only one component of project cost management and control.

It is important to highlight the focus on MIG Expenditure as the key measurement for project and ultimately MIG programme performance. According to Section 21 of the Division of Revenue Act (RSA National Treasury 2011), RSA National Treasury *disburses funds to municipalities based on a quarterly schedule, irrespective of whether or not a municipality performed the work for which funds had previously been allocated.* Hence, municipalities are required to meet quarterly cash flow targets which are based solely on expenditure. As Fleming & Koppelman (1997:1) mention, this one-dimensional measure of programme or project performance does not provide any indication of what physical work was accomplished for the funds spent, or whether cost performance is getting better or worse, and at what rate.

CHALLENGES WITH PROJECT COST MANAGEMENT

The various challenges associated with the management of project costs within the MIG Programme are summarised below:

- The capacity of municipal PMU staff to manage infrastructure projects remains a major concern (Savage 2008:31). Problems exist in the infrastructure delivery process, namely: planning to budgeting and financial management. This leads to extensive delays as poorly planned projects cannot be budgeted for; budgets are often under-estimated; funds are not made available in a timely manner; and procurement activities are not properly undertaken.
- According to Savage (2008:18), individual MIG projects are effectively approved by the Department of COG before spending can commence, while municipal budgets are evaluated by National Treasury. This implies that cost management and scope management within the overall MIG programme is addressed by two different national departments, and not seen as two interrelated activities within project management.
- The typical project timeframe between Project Identification and Contractor Appointment is 26,5 months (RSA. Department of Provincial and Local Government 2007). This prolonged period is a major risk to the planning and the validity of original project estimates, as escalation factors create large differences between initial project estimates and tender cost.
- Few positive incentives are provided for performance in meeting and exceeding key priorities or for adopting innovations that could overcome constraints (Savage 2008:35). This makes it difficult for National Government to hold sub-national governments (in this case, municipalities) accountable for their infrastructure investment performance.

PROJECT COST MANANGEMENT AND COST CONTROL

According to Rad (2002:81), cost management is the process used to minimise the cost of the project while maintaining acceptable levels of quality and the scope of the deliverables for the duration of the project. Behrendt (2006:10), states that projects are cost driven and not schedule driven; cost is the deciding factor in most projects. Therefore, cost management is the linchpin to project success. Keeping track of all aspects which can affect project cost is a critical requirement. Project cost management is one of the nine PMBoK® knowledge areas (Project Management Institute 2008) and extensive literature is available on this topic.

Key Considerations of Public Sector Cost Management

Wirick (2009:107) provides a background to the challenges of managing project costs on public sector projects. These can be summarised as follows:

- The public sector is averse to the use of cost data or the type of financial tools used in the private sector as the outcomes are often difficult to measure. In South Africa, this challenge also relates to the capacity (or skills set) of project managers in the municipal sector to understand cost management as a part of project management

and isolate key cost management deliverables. Wirick (2009:108) explains that public sector projects operate in a hypercritical environment in which political opponents may seize any opportunity to criticise an agency's operations (especially if costs are out of control). The results cannot be scrutinised if they are not available, thus emphasising the need for proper date on projects.

- Most public sector agencies use analogous estimates as their initial rough order estimate, where the estimate of a similar project implemented recently in the organisation or by a neighbouring or sister agency may be modified and used as an initial estimate. However, the analogous estimate overlooks several factors including the local environment (site conditions and community), changes in technology, ability of staff and the willingness of sister agencies to share data about project completion.

- Public sector projects are often handicapped by the establishment of fixed budgets early in the project lifecycle. Legislative constraints may detail fixed project budgets and dates by which programmes must be complete (e.g. the MIG Programme). As a result, the scope of the project is the only aspect that can be adjusted; budgets and schedules remain fixed.

- Public sector projects are rarely concerned with cash flows and it is assumed that some other party will assume responsibility for meeting cash needs. In South Africa, however, cash flow performance is a critical performance area that both National Treasury and the Department of COG monitor and manage. Strict punitive measures are in place to ensure that municipalities spend their allocations since allocations are made to municipalities on an agreed payment schedule (RSA. National Treasury 2011), irrespective of physical completion.

- Public sector procurement policy or purchasing systems limit the ability of the project manager to control costs. These processes are slow and may not allow the most effective purchases to be made.

Drivers of project cost risk

For effective cost control, it is necessary to identify the factors which have a direct impact on cost risks. According to Patterson (2006:IT.05.3), the key drivers of cost risk can be categorised as the duration of tasks, the resource rate/cost, the resource burn rate and the uncertainty of scope. Therefore, a project manager requires an understanding of the risk to project cost overruns in order to properly manage project costs, so that project costs do not exceed acceptable threshold limits. In the case of the municipal infrastructure sector, project costs are locked in once approval is given from the National MIG Programme and National Treasury. Careful attention to cost management is required to ensure that the scope of the project is met.

Principles for Efficient Cost Control Systems

In an attempt to produce an efficient cost control system, Zhan (1998:31) identifies the following guidelines:

- A cost conscientious project management team which not only controls its own actions but also influences sub-contractors, vendors and workers to make cost effective decisions. Without cost conscientiousness, project teams would not possess creativity or willingness to improve.
- The capturing of data in a realistically and timely fashion will ensure that information on local market conditions, project complexity and possible contingencies help to develop a competitive and profitable bid and sets up a realistic budget which forms the baseline of project cost control.
- The setting up of a realistic budget establishes targets to be measured during project execution. A comparison between as-built costs and the original budget indicates the quality of the budget and will help with preparing future budgets for similar projects.
- The comparison of the *to be committed* against the budget before it is committed, is the first quantitative measurement criterion against the budget.
- The comparison of actual cost to the budget is the most common measure of project performance. The result of this measure will inform corrective action. However, without accurate and timely (relevant) data or a realistic budget, the comparisons described above become meaningless.
- It is important to recognise the cause instead of the symptoms when analysing variances. The differentiation between the four types of causes (common, special, structural or tampering) is critical because the appropriate management actions are quite different for each type of cause. Time, cost and energy may be wasted if a solution is applied to the incorrect cause of a problem.
- The allocation of appropriate time and budgetary provision to each project task is necessary to prevent the short term focus and sub-optimisation of local objectives at the expense of the overall project goals.
- The use of accumulated historic data to improve the cost control cycle leads to more efficient management of future projects. This is also true during the project execution, where each cost cycle data forms the latest reference material for the next cycle thereby allowing for continuous improvement.
- The overall cost effect of changes must be considered within the project budget, which must include direct costs, indirect costs and impact costs.
- Every member of the project team must strive to continuously improve the existing cost control system as there is always a better way of conducting business.
- These cost management principles are integrated into the design of the research survey.

THE EARNED VALUE METHOD

Earned Value Management (EVM) or Earned Value Analysis (EVA), is the most widely used and researched cost control model in project management (Anbari 2003; Fleming & Koppelman 1997; Morrison & Tague 2007; al-Jibouri 2003 and Rozenes *et al.* 2006). For this reason, its application within the municipal infrastructure sector was investigated to identify the value which this control method could add to municipal sector infrastructure project performance.

EVM is a management technique for project performance monitoring (Pajares & Lopez-Paredes 2010:147), which integrates scope, cost and schedule control within the same framework. It provides performance variances and indices which allow managers to detect cost overruns and project delays. Furthermore, Anbari (2003:148) states that EVM provides performance results which assist project managers and their teams to adjust the project strategy and to make trade-offs based on project objectives, actual project performance, and trends, as well as the environment within which the project is conducted. EVM requires the monitoring of, not only actual project expenditure, but also the measurement of physical work progress.

Implementation of EVM

Opponents of EVM criticise the quantity of data required and the effort to calculate EVM indices. It also produces a large number of parameters to describe the state of the project, which makes it more difficult to use and difficult to communicate to all levels of staff (al-Jibouri 2003). Below is a simplified approach proposed by Fleming & Koppelman (1997:15).

- management commitment to the Earned Value Process;
- projects must be defined with the use of a Work Breakdown Structure;
- the project scope must be planned and scheduled;
- authorise resources and assign cost account plans;
- the formation of a project measurement baseline; and
- monitoring of project performance and forecasting the final results.

Shortcomings of EVM

Whenever payments are made in periods other than when expenses are incurred or budgeted, the cost variance (CV) is skewed (Nicholas & Steyn 2008:428). Therefore individual cost sources should be scrutinised to identify the reasons for variances. Nicholas & Steyn (2008:429) also highlight the challenge with accurately estimating percentage complete, where it is easier to estimate percentage complete when work can be measured in uniform unit rates. However, it is difficult to measure work when uniform unit rates cannot be applied (e.g. the number of drawings produced). The EV method does not take the critical path into account; if many non-critical activities are ahead of schedule but one critical activity is late, it will in all likelihood indicate that the project is ahead of schedule. Kemps (1993) in Kim (2000:69) argued that since schedule variance is not related to the critical path, most companies have to use additional scheduling techniques like Gantt charts and CPM (critical path method). Little (1983) in Kim (2000:69) states that the use of deterministic rather than probabilistic approaches lowers the credibility of EVM in estimating the impact of some delay on overall projects. Users rejected EVM as they saw EVM as *bean counting* which focussed more on what had happened that on what is going to happen in the future (Meredith & Mantel 2000 in Kim 2000:69). This misunderstanding resulted in the perception that EVM is not timely. There is also a misconception of EVM being used as a financial tool instead of a project management tool, thus limiting the utility of EVM.

RESEARCH METHODOLOGY

Target Group

For the purpose of this article, *the unit of analysis is the project manager working on municipal sector MIG programmes*. Either municipal employed PMU engineers and technicians, or civil engineering professional consulting companies working on municipal MIG projects perform the role of *project manager*.

Research Instrument

A research instrument based on accessibility and ease of use was considered. For this reason, a survey questionnaire using Survey Monkey® software was used. Once the survey questionnaire was designed, a cover note containing the link to the survey was sent to each target respondent via e-mail. The cover note briefly explained the purpose of the research study and listed compelling reasons why each recipient should respond.

Developing of Survey Questions

All the aspects discussed in the literature review and conceptual method sections have been incorporated into the design of the questions for the survey. The questions were designed as follows in Figure 1.

Figure 1 Questionnaire Sections
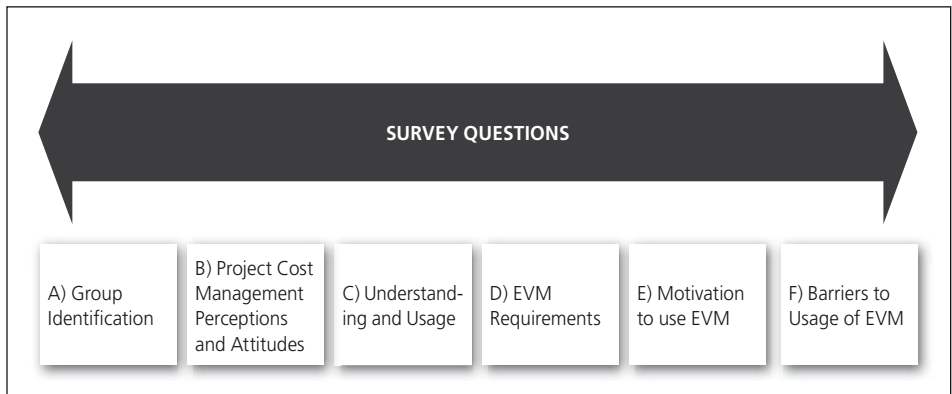
The research questions outlined in the introduction were used to develop sections of the questionnaire. Figure 1 reflects these sections. *Section A* is known as the identification or classification section where information about the respondent is solicited. *Section B* solicits current perceptions within the municipal sector and how project managers differ in their attitudes and perceptions. *Section C* evaluates the level of understanding of EVM concepts. It is assumed that understanding the concepts will indicate the level of training an individual has experienced with regard to EVM. Furthermore, it is assumed that a higher level of understanding will lead to greater usage. *Section D* identifies whether EVM requirements are

being met within the sector e.g. the compilation of a work breakdown structure. If some of the EVM requirements are being met, it may improve the usage of the EVM. *Section E* relates to motivation to use project cost control methods. These questions determine whether municipal project managers would be motivated to use EVM. *Section F* links with section C as it evaluates limiting factors to EVM Implementation. The list of barriers is taken from a similar survey undertaken by Song & Shalini (2009:12).

RESULTS

Summary of Responses

A total of *72 responses were received* including 10 incomplete surveys. It was observed that there was insufficient data to conduct the analysis for each province as some provinces were severely under-represented e.g. Free State, Limpopo and North-West. However, there was adequate data to compare the *engineering consulting* group and the *local/district/metropolitan municipality* group. The data were also compared with two experience groups: less than 10 years experience and more than 10 years experience.

Statistical Analysis of Data

The statistical methods applied to the data in this research survey were Mann-Whitney U tests, Correlation Analysis, Chi-squared tests for independence and descriptive statistics.
- Mann-Whitney U tests were undertaken to determine if EVM understanding scores differ between sub-groups.
- Correlation analysis was conducted to determine the strength of the relationship between two continuous variables. Correlations between the understanding of EVM principles and the usage of EVM were calculated.
- Summary statistics, frequency counts and percentages were conducted to describe and rank the responses to questions.

Findings

The overall objective of the research project is to

> *Investigate the application of EVM within the municipal infrastructure sector in South Africa by evaluating the criteria which will lead to greater usage of EVM.*

In order to achieve the objective, the following research questions were answered.
- *What are the current perceptions and attitudes of Project Managers within the municipal infrastructure sector with regard to project cost management?*
  In terms of the value of cost management, most respondents agreed that implementing a project cost management system would improve project success. However, in terms of the difference in utility between cost management and delivering infrastructure in the shortest possible time, the majority of respondents (60%) did not

rate cost management rank higher than rapid delivery. This can be attributed to the current political situation in South Africa which focuses on addressing the issue of infrastructure backlogs. Hence, the priority is on improving access to basic services and although cost management is of importance, it does not take priority over service delivery (delivery infrastructure in the shortest possible time).

The current perception of respondents from the municipal infrastructure sector is that there is already excessive reporting on project implementation and progress. Furthermore, the perception is that implementing a cost management and control system would require additional resources. Therefore, the cost to implement EVM and the amount of additional reporting requirements it prescribes needs to be carefully quantified and listed to give project managers within the municipal infrastructure sector the skills which they may need to implement EVM.

The majority of respondents (61,5%) agree that there are inadequate policies and guidelines available to assist them in managing project costs. This indicates that there is a gap when it comes to standards and consistency when managing project costs within the municipal infrastructure sector. Although, the research has shown that the Department of COG provides guidelines to assist in preparing preliminary projects cost, the survey shows that only 6,1% of the respondents actually use the guide. In terms of managing project costs, a large majority of respondents (87,9%) agree that project cost control is the responsibility of the project manager and the quantity surveyor (QS). Therefore, what is lacking is the integration of cost management throughout the project team, where cost management becomes every team member's priority.

Most respondents (74%) state that the preliminary project costs are generally less than the tender costs. This represents a problem, as preliminary costs are included when submitting projects for MIG approval. Therefore, MIG approval is based on preliminary costs that are, according to the respondents, generally less than the actual tender amount. It can be deduced that most projects have budgets which are inadequate to meet the requirements. Furthermore, the majority of the respondents indicated that the common method of estimating preliminary costs is by using the budgets of similar projects. Only 16,7% of the respondents list estimating the cost of each work package within the Work Breakdown Structure as a means of estimating preliminary cost, which is what literature (Kuehn 2006) state as an appropriate method of estimating project costs.

- *What are the factors which will affect the usage of EVM within the municipal infrastructure sector?*

    Thus, i*n the municipal infrastructure sector, what level of understanding of EVM do project managers possess and does understanding of EVM translate to greater usage?*

    On a 0 to 4 scale of understanding (0 being unfamiliar with EVM terms and 4 being having an excellent understanding), the mean level of understanding within the entire group of respondents is 2,37 which translates to *understanding between fair and good, of EVM principles.* In order to determine if the population means differed among sub-groups, the Mann-Whitney U test was undertaken and it was found that the level of understanding of EVM between PM's working for Engineering Consulting companies and the PM's working in municipalities does not differ significantly, and

the level of understanding of PM's with less than 10 years experience and PM's with more than 10 years experience, does not differ significantly either.

In terms of the correlation between the level of understanding of EVM terms and the usage of EVM within the municipal infrastructure sector, there is a positive correlation albeit a relatively weak correlation (coefficient of correlation = 0.4434). This implies that those who understand EVM terms may likely use the EVM cost control system. For the respondents from municipalities, the correlation between the level of understanding of EVM terms and EVM usage was lower (0,37) than for the Engineers (0,5). This implies that whether they understand EVM principles or not, the local government respondents are less likely to use EVM. Hence, there must be some other reasons why EVM is not widely used. The *Barriers to EVM implementation* in the next section lists some of these reasons.

- *What are the barriers to the usage of EVM, as perceived by municipal project managers?*

The *lack of EVM exposure and experience* ranks as the greatest barrier to the implementation of EVM, followed by the tedious data collection and reporting procedure and lack of top management support. In terms of how the sub-group rank the barriers, all groups rank the lack of exposure and experience with EVM as the greatest barrier to implement EVM. Therefore, this barrier ties in with the finding related to the preceding section where a group of respondents display only fair to good understanding of EVM principles, indicating their lack of confidence in implementing EVM on projects due to their average understanding of the concept. The *tedious data collection and reporting* associated with EVM ranks second highest as a barrier to the implementation of EVM. Since there is excessive reporting on municipal infrastructure projects, any activity that requires data collection and reporting will understandably become constrained by the amount of data collection and reporting it requires. *Lack of top management support* also ranks as one of the greatest barriers and this indicates the necessity for EVM to be accepted at the highest levels of management.

In terms of how the ranking of barriers in this survey compares to the findings of similar surveys undertaken by other researchers, the following is observed.

According to Song & Shalini (2009:11), their survey (targeting project managers from different industry sectors, regions, project sizes and contract types), shows that the primary concerns are related to the lack of EVM knowledge and experience, the lack of top management support, and the lack of interests from the project clients. Therefore, for the current study, the group of respondents displays a similar perception of the most relevant barriers to the implementation of EVM as the Song & Shalini (2009) study group. A similar survey conducted by Kim (2000:139), was undertaken to identify the main problem areas with the EVM process and found that the main problems with EVM were the optimistic view of users in planning; the inaccurate assessment of EVM and the lack of understanding of EVM. These are viewed as user related problems and are ranked higher than either culture or system of implementation related problems.

- *Are EVM requirements currently being met within the municipal infrastructure project environment?*

One of the main features of EVM is having a proper Work Breakdown Structure (WBS) in place. However, only half of the respondents generally have a WBS in place

during project implementation. This creates a challenge for the implementation of EVM within this sector. Secondly, budgeted cash flows are mostly in place which is an advantage when implementing EVM. Lastly, measuring progress is done in the majority either by milestone completion or by percentage complete, which are recommended techniques for measuring progress when using EVM. It is further observed that using a tool to manage project costs or having a cost management plan is not consistently in place for this group of respondents. This can be related to the value which is placed on cost management (discussed earlier). Identification of project requirements and scope definition are done often, which is a positive indication that planning processes are undertaken widely and that the project scope is maintained to prevent scope creep which, in turn, could increase project costs. However, from this section, for the data observed, it is deduced that some of the EVM requirements are already being met; however, there is a need for WBSs to be undertaken more often on municipal infrastructure projects. This is an important element which must be in place if EVM is to be implemented, as it assists in calculating the cost and duration of each work package.

- *If the use of EVM became mandatory for the control of project costs within the municipal infrastructure sector, will project managers be motivated to use EVM?*

   The response from this group of PMs indicates that management of project costs is included in performance plans of employees and this indicates a keen interest by management who want to hold employees accountable for management of project costs. Furthermore, the majority of respondents (66,7%) agree that management recognises improvement in project cost performance. These two items are concurrent with the value of cost management in the municipal sector as project cost over-runs place huge financial challenges for municipal organisations that depend largely on National Treasury for grant funding in order to implement projects.

   This group of respondents did not agree that any savings in project budget leads to employee reward. Employee reward is a significant motivator and could impact on the usage of EVM within this sector. Lastly, the majority of the respondents agreed that corrective action would be taken if a project control system indicates the need for corrective action. This is also a significant motivator as people are more likely to undertake activities if they perceive that it will result in something beneficial.

CONCLUSION AND RECOMMENDATIONS

Overall, the current perceptions of cost management within the sector indicate that project managers working in the municipal infrastructure sector recognise the importance of managing project costs. However, more attention should be paid to a formal cost control system that is integrated into the current reporting practices, accepted by the whole project team and supported by national and sector norms.

Limitations of the Study and possible bias

The major limitations to the survey are summarised below.

- There was insufficient data to conduct an analysis per province. Therefore the research did not report on how provinces differ from each other. Fewer than five responses were received from five of the nine provinces in South Africa. The findings are dominated by responses received from the Eastern Cape, Gauteng, KwaZulu Natal and Western Cape (incidentally, the provinces all consisted of at least one metropolitan municipality prior to the 2011 municipal elections).
- Due to the political nature of the municipal infrastructure sector, there is a possibility that the respondents tried to respond positively to the question to avoid the risk of additional scrutiny.
- The topic of project cost management is a controversial one as it deals in part with financial management in the municipal sector. Therefore, there have been various allegations about poor management and fraudulent activities related to cost management. This is a sensitive topic and this could be the reason for the poor response rate.
- The survey questionnaire aimed to improve response rate by including only multiple-choice questions. However, the inclusion of a section, which allowed respondents to comment if they so desired, could have provided additional insight into the sector.
- One question on the *Barriers to EVM Implementation* was not answered in its entirety due to the ambiguous phrasing of the question. Instead of rating all barriers, some respondents chose one barrier, which fits the high, medium and low significance option. Although, it is still possible to extract data to conduct analysis, it resulted in respondents not completing the section (15 to 20% of respondents did not complete the relevant section).
- A large portion of the e-mails sent to the target group was returned undelivered (73 e-mails). This could relate to the high staff turnover within the municipal sector.

Recommendations and Future Work

This study provides an indication of the perceptions of project managers in terms of cost management and cost control within the municipal infrastructure sector. It further highlighted the factors, which could lead to greater usage of EVM within the municipal infrastructure sector, which include understanding of EVM, barriers to EVM implementation, readiness to use EVM and motivation to use EVM.

As a recommendation for further research into the application of EVM within the municipal infrastructure sector in South Africa, the following is suggested:

- Research into the project management environment within the municipal infrastructure sector, which will evaluate the state of readiness for a cost control system, such as EVM.
- Research into the development of an EVM implementation model which considers EVM methodology; EVM users; EVM implementation process and the project environment (similar to Kim 2000). This will allow a cost control tool (EVM) to be formulated for the specific sector (municipal infrastructure), thereby improving its acceptance and usage, and ultimately contributing to project success.

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