This item was submitted to [Loughborough's Research Repository](#) by the author.
Items in Figshare are protected by copyright, with all rights reserved, unless otherwise indicated.

Developing monitoring indicators for urban micro contracts in South Asia

PLEASE CITE THE PUBLISHED VERSION

PUBLISHER

© Elsevier

LICENCE

CC BY-NC-ND 4.0

REPOSITORY RECORD

Sohail, M., D.W.J. Miles, and Andrew P. Cotton. 2019. "Developing Monitoring Indicators for Urban Micro Contracts in South Asia". figshare. <https://hdl.handle.net/2134/3844>.

This item was submitted to Loughborough's Institutional Repository (<https://dspace.lboro.ac.uk/>) by the author and is made available under the following Creative Commons Licence conditions.

For the full text of this licence, please go to:
<http://creativecommons.org/licenses/by-nc-nd/2.5/>

Date written	<p>16 January 2000</p> <p>Revised and submitted on 29/4/01</p> <p>Referee's comments incorporated and submitted on 29/10/01</p>
Title	<p>DEVELOPING MONITORING INDICATORS FOR URBAN MICRO CONTRACTS IN SOUTH ASIA</p>
Authors	<p>M.Sohail¹, Member, ASCE</p> <p>D W J Miles², FICE</p> <p>A.P.Cotton³, Member, MIWEM</p>
Positions/ affiliations	<p>1. Research Manager</p> <p>2. Director</p> <p>3. Senior Programme Manager</p> <p>Institute of Development Engineering, Department of Civil and Building Engineering, Loughborough University, Loughborough, LE11 3TU, UK.</p>
Contact	<p>Institute of Development Engineering, Department of Civil and Building Engineering, Loughborough University, Loughborough, LE11 3TU, UK.</p>
Number of words	<p>5, 414</p>
Number of tables and figures	<p>6</p> <p>1</p>
Key words	<p>Implementing Strategy</p> <p>Quality</p> <p>Cost</p> <p>Time</p> <p>International Projects</p> <p>Partnerships, Alliances</p> <p>Stakeholders</p>

ABSTRACT

The growing emphasis in many low-income countries on community-based infrastructure means that more programmes are being implemented through micro contracts. The advantages of this approach are that it encourages:

- participative negotiation of activities and speedier implementation;
- the use of local resources, skills and appropriate technology; and
- entrepreneurship in communities.

For client organisations, however, large numbers of very small contracts are much harder to monitor, supervise and evaluate. This paper draws upon recent research in India, Pakistan and Sri Lanka to develop a ‘benchmarking framework’ to study the time and cost performance of 162 small-scale contracts for urban infrastructure. The study found that costs were normally very close to target, but project duration generally far exceeded the target. There is only a weak association between the cost and time growth.

INTRODUCTION

In many developing countries the inability of national and city governments to satisfy the demand for infrastructure and services has led to the proliferation of informal, unimproved slum and squatter settlements that lack adequate water and sanitation, access/pavements, solid waste related construction or small community buildings. Surveys suggest that between 40% to 50% of the population in many cities live in such settlements [1]. The provision of urban services to city dwellers is usually best achieved through a very large number of small-scale contracts or *micro-contracts*, which usually have an individual value of less than £10,000 and duration less than one year. In engineering terms, the works involved in small-scale contracts are minor, but they are difficult to implement due to their multiplicity and the complex physical and social fabric of low-income urban communities.

This paper provides a brief overview of the procurement process used in three South Asian countries: India, Pakistan and Sri Lanka, based on a study undertaken during 1995-1998. The three countries have a common legal framework which was developed during the colonial period and is based on British law. The framework was flexible and procedures were frequently amended in response to new situations, often at the behest of the then Superintending Engineers in the Public Works Department (PWD). This capacity for regular modification to meet changing needs has unfortunately decayed. In Pakistan, for example, there have been few changes in almost fifty years of independence. This has led to an increasing gap between what is theoretically meant to happen and what actually happens, which in turn results in inflexibility and lack of transparency.

The three roles in the procurement process are, as elsewhere, the *Promoter*, the *Engineer* and the *Contractor*. The *Promoter* plans, prepares briefs, commissions design work, hires an *Engineer*, who is usually responsible for design, monitoring and quality assurance of the contracts and hires a *Contractor* to undertake the construction work. In many government organizations, the engineer is a full time employee. It is rare for private sector consultants to fulfill this role for minor engineering works. As always the *Promoter* wants the best value for money and the *Contractor* wants a good profit. While this

relationship can involve complex and contentious issues, satisfactory performance can be broadly defined in terms of the three fundamental objectives of Quality, Time and Cost:

Quality: Has the work been done in accordance with what was specified?

Time: Has the work been satisfactorily completed within the time specified?

Cost: Has the work been completed within the costs agreed in the contract?

The paper is based on performance analysis of sample of 162 micro contracts, interviews with the key informants from the Clients and Contractors' organizations and review of the relevant contract documents.

AN OUTLINE OF A TYPICAL PROCUREMENT PROCESS

Procurement of urban infrastructure in the public sector is regulated by the relevant legal, financial, municipal and administrative rules. Many of these procedures have taken more of a prescriptive nature than was initially intended by the drafters of the procedures. Local governments in the study countries follow similar procurement rules, that is, Public Works Department (PWD) rules. PWD rules originated before 1947, when the sub-continent formed part of the British Empire and only slight changes have been made since independence. The basis for the law in the countries studied is English Law. The procurement processes based on the common legal systems can be considered comparable. Historic, cultural and socio-economic conditions are also very similar [2].

The key steps involved from the stage when the need for the infrastructure was established to the stage of completion is outlined in Table 1.

The associated costs are:

- 'Technical sanction cost' is the cost on which the approval of the project is based.
- 'Engineer's estimate' is the cost on which the tenders are called and later evaluated.
- 'Tender/Contract letting cost' is the cost on which the contract was awarded.
- 'Completion cost' is the final cost of the contract including variations.

The chain of responsibility involves action by many different officials. The whole process of procurement is very sensitive to delays in approval procedures causing delays in awarding the contract and consequently delays in the delivery of the infrastructure. Furthermore, the accuracy of the estimates upon which the contract cost is evaluated is critical, as departmental budgetary ceilings restrict payments to contractors. There were some cases where, in spite of the approval for the extra works by the officials, the payments by the finance department were stopped once the contract reached the budgetary ceiling. As a result, the contractor stopped the work and the completion of the contract was delayed. The monitoring of clients' performance (that is the urban local government in the countries concerned) in the procurement process has generally been neglected. The main reason for lack of performance monitoring is the non-availability of reliable performance indicators.

The paper determines the relationship between performance in these three parameters, but measures of quality were not available in numerical terms. In theory most micro projects were of adequate quality, since this was a prerequisite for payment to the contractor. In practice, interviews and random inspections suggested that quality was frequently inadequate. This study explores the relationship between time and cost performance. The benchmark used was the time taken in reaching the contract award stage as a proportion of the contract's duration. The delivery time was taken to be the sum of both the contract duration and time needed for pre-contract approval. The most important consideration for the end user of the urban services is the total delivery time and not just the contract duration.

The institutional context

Responsibility for the procurement of primary, secondary, and tertiary infrastructure in most developing countries lies with government institutions. However, the execution of these responsibilities involved private sector through the procurement process. The institutions responsible for procurement of urban services can be categorized as:

- *Municipalities*, which are usually subject to political control through elected councilors. Whilst many municipalities are inefficient and even paralyzed by poor management and lack of resources, they

remain crucial to long term implementation and maintenance institutions for neighborhood-level improvements.

- *Specialist agencies* set up to perform certain functions such as water supply, waste collection and disposal, regularization and development of low-income settlements and power supply. These agencies enjoy some autonomy, and are mostly involved with construction of trunk and secondary infrastructure.
- *External agencies* such as urban development authorities which are normally set up for a limited period to implement very large projects. Potential problems arise through duplication of the efforts of municipalities and specialist agencies.

Four institutions and programmes were involved in the study. A very brief description of these is given below:

The Karachi Metropolitan Corporation, is the municipal authority for the largest city of Pakistan with a population of 10 million. The municipal system in Karachi has undergone many changes due to the politically unstable situation in the last five years. The administrative system has two tiers. A metropolitan corporation was set up in 1988 along with the four zonal committees in four districts; Central, East, West and South. The Mayor is elected by the councilors from each local area, and is the chief executive of the corporation. The local councils have the powers to levy taxes. The salient compulsory functions of the corporation include provision and maintenance of urban infrastructure including water and sanitation, drainage, street lighting and solid waste management.

Sindh Katchi Abadi Authority (Pakistan), which is an autonomous specialist body formed in 1987 and responsible for squatter settlements and slums. Sindh is one of the four provinces of Pakistan, and includes Karachi, the largest city. The Director General is the chief executive and the post is generally held by a civil servant. The organization is responsible for development of Katchi Abadis.

Slum Improvement Programmes - India, which are donor-funded projects found in several Indian cities. The data in the study is from Calcutta, Cochin and Cuttack. The projects were integrated urban development projects involving public works, which were focused on improving the living conditions of the urban poor.

Colombo Municipal Council is involved in the provision of urban infrastructure for the capital city of Sri Lanka. It has various departments responsible for activities such as drainage, solid waste management, water supply and project implementation. The data in the study was collected from the drainage division.

In total 162 contracts awarded during 1992-97 were studied, and most were truly micro contracts in that their individual value was less than £10,000 and their duration less than one year (see Table 2).

PERFORMANCE MONITORING OF MICRO-CONTRACTS

At present, low income countries lack standards against which to measure the performance of micro-contracts. Developing performance indicators is a step to setting targets for further improvements. A performance indicator is an item of information collected at regular intervals to track the performance of a system. In some cases it makes sense to combine relevant indicators to measure performance on some indices. In this study the indicators developed were mainly quantitative in nature.

Benchmarking

There is a substantial body of general literature related to benchmarking [3] while other authors, such as Lema and Price [4], explore the definition, scope and applicability in the context of the construction

industry. It was defined by Kubal [5] as ‘measuring, recording, and evaluating a firm’s progress towards a particular quality goal’ and by Anderson and Peterson [6] as a tool for continuous improvement through comparison with a measured ‘best-in-class’ achievement in terms of performance or process. The approach is as follows:

- study and understand one’s own process
- find the best benchmarking partners
- study the partners’ process
- analyse the difference between ones’ own and ones’ partners process.
- implement improvements based on what has been learned from the benchmarking partner.

In this case, the benchmark is the level of performance of contracts in delivery of infrastructure and services to low income urban communities.

METHODOLOGY

There is very little reliable primary data which could help in the performance monitoring and benchmarking of small-scale contracts for the procurement of urban infrastructure in low-income countries. The collection of data in these countries is difficult due to a variety of factors such as the lack of data in the form required for analysis, the lack of understanding among researchers about the ways in which Government data is recorded, the fact that information related to government contracts is frequently confidential and the low priority given to such applied research. It is through the authors’ long relationship with the organizations involved that access to the data has been provided, coupled with an assurance of confidentiality.

A benchmarking framework was applied to data relating to 162 micro contracts awarded during 1992-1997 in India, Pakistan and Sri Lanka. During the research programme 125 detailed semi-structured interviews were conducted with contract administrators in the client and contractors’ organizations and contract files were also reviewed. This includes the necessary approvals, dates when

such approvals were obtained and who took the decision. The contract file is also important as it is used for the audit purposes.

Focus group discussions with twelve expert contract administrators were used to develop the performance-monitoring indicators and to propose the benchmarks. This technique is particularly useful in the exploration of processes [7]. The experts were selected on the basis of their experience in urban infrastructure procurement in low-income countries, their professional qualifications, willingness to participate in the research, accessibility to the authors and their potential role in influencing the performance of the contracts within their organizations. The total professional experience of the officials in one 12-person panel was 209 years, with a mean of 14.5 years and a standard deviation of 7.3. In some cases where a consensus was not forthcoming the practice was to temporarily move away from the topic of dissent and revisit it later, with a fresh discussion started from a point of known mutual agreement. The validation of the ideas developed in the focus groups was sought from independent officials in other departments as well as through group discussions and interviews.

Focus group discussions, interviews and analysis of archival records and questionnaires were used to:

- analyze the process of procurement in low income countries;
- identify the stakeholders involved at each stage along with the roles and responsibilities of the people involved;
- identify data relevant to each stage and its time and cost dimensions;
- define the key performance indicators; and
- propose benchmarks for contracts similar to those studied.

PERFORMANCE INDICATORS

A performance indicator can be defined as an item of information collected at regular intervals to track the performance of a system. A wide variety of indicators can be employed, and 69 were

developed and tested during the study. The following six indicators are of most relevance in the context of the present paper (see Table 3 for detailed description):

- R1 Cost growth
- R2 Time growth
- R3 Lead time
- R4 Accuracy of preliminary technical estimate
- R5 Relationship to initial contract cost
- R6 Relationship to final contract cost

The use of ratios made it possible to compare the cost-related data without normalization as the comparison is not between the costs themselves but the ratios. All the subsequent benchmarks are defined as ratios

DATA ANALYSIS

SPSS for Windows was used for statistical analysis. Table 4 provides the calculated performance indicators. The information required to calculate all the ratios for all the groups was not available. The 95% confidence intervals and standard deviations were also calculated. A measure of central tendency was chosen after examining the consistency of the measures. In general the mean gives a consistent measure of central tendency of the data. Considering low effects on the overall outcome, consistency across contracts of the different organizations, and with the previous studies (Fisher et al. 1995) [8], the average was taken as the most appropriate indicator. The results were as follows:

- The performance with respect to cost growth was superior to that of time growth, since there seems to be more effective control of cost than control of time.

- Cost growth performance was superior in groups with relatively smaller average contract cost, that is contracts from KMC and CMC. This factor indicates that the capacity to control relatively small-scale contracts is available in the organizations studied.
- The variation of R1 about the contract price was calculated. As the contract cost increases so does the cost growth. The variation of R2 about contract indicates the time growth increases with the contract size.
- Table 5 shows the best average ratios among the contracts of the organizations studied which reflect the best existing performance. There is no single group which stands out.
- Figure 1 depicts the performance indicators for each organization. SIP needs immediate improvement. For comparable ratios, KMC and CMC perform best.
- The best R3 for individual contract was found in SIP. The worst case could be 92% which is found within the same group. Figure 2 shows the mean of indicators across the groups. Indicators R2 and R4 need special attention.
- Cost growth (R1) and time growth (R2) across the groups were calculated. The mean R1 (n=157) was 1.0214 with the 95% confidence interval 0.9931-1.0496. The mean R2 (n=123) was 2.0021. The 95% confidence interval is 1.1733-2.8308. The worst scenario seems to be 4 per cent cost growth and 283% time growth.
- The non-parametric and parametric correlation coefficients (Siegel 1956) [9] were calculated. A weak correlation (-0.23) was found between R1 and R2.
- Table 4 shows on average, the best preparation time is 58% of the construction contract duration. In terms of the contract time, it can be as high as 227%, as can be seen in case of SIP.
- R4 gives indication of the accuracy of the estimates for sanction cost. The best performance is in SKAA (Table 4). The average sanction cost exceeds the initial contract cost by approximately 24%.
- The best R5 and R6 come out to be 0.9054 and 0.9633 respectively. SKAA was best in both R5 and R6.

- Table 6 shows the proposed benchmarks as a result of focus group discussion with the expert panel. Not all of the indicators were selected, as they were considered too ambitious for use in benchmarking.

DISCUSSION

Contracts having smaller average cost and duration performed better. This may indicate that as the contract becomes larger the capacity of the client and the contractors is stretched, as smaller contracts are more easily controlled. There is a need to increase the capacity for contract monitoring and control by both the client and contractor if larger contracts are to be more effectively handled. There is no general trend regarding overall superiority of performance of contracts in any particular organization.

The existing best performance in terms of cost growth in the 162 contracts studied compared well with construction industry benchmarks in the USA (Fisher et al. 1995) [8], an equivalent cost growth (R1) and time growth (R2) are 0.92 and 1.08 respectively. Kaka and Price (1991) [10] reported an equivalent R2 for their data related to infrastructure in the UK as being 1.035. The cost growth of the contract in this study was approximately 2 per cent cost growth which is close to that reported for the USA.

The indicators developed and benchmarks proposed in this study (Fisher et al. 1995) [8] could be tested using small-scale contracts from low-income countries. The organizations from which the data was collected could use the methodology and indicators developed in this study to further monitor the performance of their contracts.

The time growth was relatively high showing poor performance in time control. The officials did not attach much priority to time control, with the contract time extensions being routinely granted. However, cost escalation of more than ten percent may require further approval from higher officials. The other explanations which were given for the poor time performance were civil riots, monsoon rains, unavailability of materials, and unstable political situation.

The evidence on time growth points to the need for tighter schedule control and better duration estimation practices. One possible contribution could be the development of a model to depict the relationship between the value and duration of similar completed contracts. The indicators could subsequently be used to monitor the accuracy of the estimates.

There is much anecdotal evidence to suggest that there is a significant influence of corruption on the performance of some contracts. It was reported in many cases that inferior quality work was accepted for the same contract price. This could explain why there was very little association between the cost and time growth. The authors believe that the influence of corruption is probably similar in the different organizations. However, this paper does not focus on the determinants of the poor performance but simply develop effective performance-monitoring indicators.

It is surprising that there is a very small correlation between the time and cost growth, that is that only a very small proportion of the variation in time growth that can be explained by the effect of cost growth. If 'time is money', how can we describe this observation? One possible explanation could be that there is some other variable that is neutralizing the costs associated with the time growth. That factor may be quality. The quality may have been compromised to cover the cost growth associated with the time growth. The question to answer is how did the contractors survive such large time growth? One possible explanation is that in some cases for the same contract price the inferior quality was accepted.

The time taken for the preparation of the contract requires further examination. No data on lead (preparation) time indicators exists from countries other than those in this study. Lead times of almost fifty per cent of the contract duration are very high considering the standard conditions for public works. Any improvement in the lead time would facilitate the delivery of urban services to the consumers. There is a need to streamline the procedure for awarding small scale contracts to reduce these high lead times. The chain of administrative approval may be reduced by delegation of authority. There is also a need for officials to monitor their pre-contract performance, the indicators developed here could be used for that purpose.

The benchmarks for the procurement of infrastructure through small-scale public works, under the present situation, in low-income countries are proposed in Table 12. The key benchmarks proposed in this study are; cost growth of 1.1, time growth of 1.5 and time for contract preparation as 90 calendar days. These benchmarks were proposed by the panel after considering the existing performance of the contracts as targets to be met for future works. Whilst some of these benchmarks may not be applicable in some particular situations, specific local government organizations could decide benchmarks to choose. This study thereby contributes to the process of providing managerial tools for the monitoring of performance for small-scale contracts aimed at providing urban infrastructure improvements in low-income countries.

RECOMMENDATIONS

Further benchmarking needs to be performed on micro contracts using the indicators developed in the research.

A framework and tools should be developed for the appraisal, monitoring and evaluation of micro contracts for the procurement of local infrastructure using the developed indicators in different geographical locations. Such tools need to capture the wider impact of micro-contract procurement, particularly socio-economic impacts. As part of this impact analysis, the process and actors involved

in procurement through the micro contracts could be further explored using stakeholder analysis techniques.

Safety and Risk involved for micro-contractors need further exploration. This is particularly important should the micro-contract are used in the context of large international projects.

ACKNOWLEDGEMENTS

The Department for International Development (DFID), UK, supported our research and for that we are very grateful. The views expressed are not necessarily those of DFID. Special thanks are due to the contributors from the South Asia. to this work without whom progress could not have been made.

REFERENCES

- [1] United Nations Centre for Human Settlements. An Urbanising World. Global Report on Human Settlements-1996. UK: Oxford University Press, 1996.
- [2] Sohail M. An investigation into the procurement of urban infrastructure in developing countries. PhD: Loughborough University, 1997.
- [3] Jackson A.E., Safford R.R. and Swart W.W. Road Map To Current Benchmarking Literature. Journal Of Management In Engineering, 1994; ASCE, Vol. 10, No. 6: 60-67.
- [4] Lema N.M., Price, A.D.F. Benchmarking: Performance Improvement towards competitive advantage. Journal of Management in Engineering, 1995; ASCE, Vol. 11, No. ME1, US: 28-37.
- [5] Kubal M.T. Engineering quality in construction Partnering and Quality. McGraw Hill, Inc, 1994.
- [6] Anderson B, Pettersen, P. The Benchmarking Handbook. UK: Chapman and Hall, 1996.
- [7] Stewart D.W, Shamdasani P.N. Focus Groups: Theory and Practice. US: Sage Publication, 1990.
- [8] Fisher D., Meistschin S. and Pollock, D.R.Jr. Benchmarking In Construction Industry. Journal of Management In Engineering, 1995; ASCE, Vol. 11, No. 1:50-57
- [9] Siegel S. Nonparametric Statistics For The Behavioural Sciences. U.S.A: McGraw Hill Book Co., 1956.
- [10] Kaka A., Price A.D.F. Relationship Between Value And Duration Of Construction Projects. Construction Management And Economics, 1991;383-400.
- [11] Cotton A.P., Tayler W.K. Community Management of Urban Infrastructure in Developing Countries. Proc.Instn Civ.Engrs Mun.Engr, 1994;103: 215-224.
- [12] United Nations Centre For Human Settlements. Global Report On Human Settlements-1986. Nairobi: United Nations Centre For Human Settlements, 1987.

TABLE 1. Standard Engineering Department procurement procedure

Narrative	Commentary
1. Formulation of a scheme and its requirements	Need not necessarily be done by the Engineering Department (ED); the ED procurement procedure starts once the requirements of the scheme have been put before it, regardless of their origin. In general, the basis is 'rule of thumb' and past data.
2. Preliminary cost estimates are prepared.	
3. Administrative approval of estimates.	Approval by the designated officials authorises the initiation of the work. The larger the scale of the works the more senior is the approving official. Some officials, such as the Chief Engineer, have unlimited powers.
4. Preparation of surveys, designs and detailed cost estimates	The basis of these cost estimates is the government approved Schedule of Rates and approved details. PWD is the main source of reference.
5. Approvals by appropriate officials in the ED; this usually involves the Chief Engineer; termed technical sanction.	Technical and financial feasibility authorization. The official giving such approvals assures that the proposed work is technically feasible and financially viable. The designs and estimates are scrutinized in detail. The procedure prescribes the level of official to give the approval depending on the scale of the works.
6. Notice inviting tender	A notice to the potential contractors to submit tenders for the notified work. The procedure prescribes the level at which the notice should be advertise: in case of some very small scale only pasting notice on a board in the offices is sufficient; in some case larger contracts the notice should be given in the national or international newspaper for a minimum number of days.
7. Tender opening.	Offers are opened in the presence of a committee. The committee comprises of technical section, legal branch and accounts. The offers are read aloud in the presence of the tenderors and recorded in a register. The committee then signs the register. The idea is to ensure that no changes are made in the bid price after the opening.
8. Work order start date	This signifies that start of the contract. This is a letter issued by the authorized official advising the contractor to start the work within the/ a certain number of days. The contract duration starts from the date of issue of this letter.
9. Actual start date	The date work starts on site may differ from the authorised date. Though in micro-contracts there is no prescribed mobilization advance, many work orders demand that the work to be started within 7 working days from the date issue of the work order.
10. Completion of the work.	This is marked by the date of the last measurement done at site. In many cases a 'measurement book' is used and the designated official takes the measurements and enters them in the presence of the contractor. In public sector procurement governed by the PWD rules, the entry in the measurement book is the final recording and cannot be challenged.
11. Facility becomes operational.	In some cases, the infrastructure is not used at the same time as the work contract is completed. There are some time lags involved, for example, between the time when water supply line is completed and when actually the water is supplied through them. For the end user, the operational date of the infrastructure is important rather than just the date when the contract is completed.
12. End of the defects liability period.	Marked by the last entry of the measurement book, as reflected in the completion certificate. Usually six months after completion of the work.

TABLE 2 Average contract cost and duration in different contexts.

Promoter	Number of Contracts	Mean Cost Local currencies	Equivalent UK Pounds	Mean Duration Calendar days
Sindh Katchi Abadi Authority, Pakistan	53	PR 404,724	5,782	93
Slum Improvement Programmes, India	37	IR 557,550	8,578	161
Karachi Metropolitan Corporation, Pakistan	30	PR 21,930	313	NA
Colombo Municipal Council, Sri Lanka	42	SLR 15,259	190	9
Total	162	-	-	-

NA - Not available

Notes: For conversion:

1£ = 80 Sri Lankan Rupees (SLR)

= 65 Indian Rupees (IR)

= 70 Pakistani Rupees (PR)

Table 3 Performance Indicators

Indicator	Definition	Description
R1 Cost growth	Final contract cost /Initial contract cost.	<ol style="list-style-type: none"> Why: performance of cost control. Key sources of information: contract files and key informants. How: determine the costs at the start of contract and at the time of completion; divide the completion cost by the initial cost Comments: the ratio reflects the cost control used in the project. There may be many reasons for the high or low cost growth, for example political situation, inflation, climate but here we are focusing on the magnitude and not the reason.
R2 Time growth	Final contract duration / Initial contract duration.	<ol style="list-style-type: none"> Why: performance of schedule control Key sources of information: contract files and key informants. How: determine the initial and final contract duration. Divide the final contract duration by the initial contract duration. Comments: this indicates the control of time schedule. Reasons for delays could be riots, rainy seasons or lack of performance of the contractor.
R3 Lead time	Time required to reach the stage of commencement of works or services.	<ol style="list-style-type: none"> Why: promoter efficiency in contracting out the work. Key sources of information: project file and key informants. How: determine the time lag between the establishment of requirement and the contract commencement. Divide that time lag by the contract period. The units in which the duration is measured should be consistent. Comments: this provides the time required to award the contract as a proportion of contract duration. The lead time is important in the overall delivery time of infrastructure. This indicator along with the time lags indicates the performance of the procurement process.
R4 Accuracy of preliminary technical estimates	Technical sanction cost/Engineer's detailed estimates.	<ol style="list-style-type: none"> Why: accuracy of the cost estimate Key sources of information: contract files and key informants. How: determine the preliminary estimates and detailed Engineer's estimates. Divide the preliminary estimates by the detailed estimates. Comments: This reflects on how good or bad the preliminary estimates are. The preliminary estimate is important as this dictates the approved cost of the project.
R5 Proximity of Engineer's estimated cost and the initial contract cost	Engineer's detailed estimated cost /contract initial cost.	<ol style="list-style-type: none"> Why: to monitor the proximity of Engineer's estimates and the contract initial cost. Key sources of information: tender document, project files and contract document. In the case of verbal or informal contracts equivalent information may be found from the key informants. How: determine the Engineer's estimated cost and the initial contract cost. Divide the Engineer's estimated cost by the initial contract cost. Comments: the ratio reveals how close or otherwise the estimate is to the initial contract price. This government approved schedule of rates is the basis of the Engineer's estimates. This in turns also reflects the relevance of government rates to the market rates.
R6 Proximity of Engineer's estimated cost and the final contract cost	Detailed estimated cost / completion cost.	<ol style="list-style-type: none"> Why: to monitor the proximity of Engineer's estimates and the contract final cost. Key sources of information: tender document, project files and contract document. In the case of verbal or informal contracts equivalent information may be found from the key informants. How: determine the Engineer's estimate and the final contract cost. Divide the estimated cost by the final contract cost. Comments: The ratio reflects the accuracy of the estimates regarding the completion cost. This complements the idea of cost growth ratio (R1) above.

Table 4Summary of performance analysis

Items (1)	size- n (2)	Mean (3)	Std. Dev. (4)	Median (5)	95% C. I (6)
Group 1-SKAA					
R1	49	1.0716	0.2427	1.0122	1.0019-1.1413
R2	49	1.5804	0.9876	1.1250	1.3084-1.8524
R3	46	0.5068	1.3983	0.1333	0.0916-0.9221
R4	44	1.2390	0.2464	1.1778	1.1641-1.3139
R5	44	0.7829	0.1206	0.8147	0.7462-.8195
R6	44	0.7657	0.1974	0.7882	0.7057-.8257
Group 2-SIP					
R1	35	1.0475	0.2206	1.0301	0.9717-1.1233
R2	35	4.0380	8.3044	2.0600	1.1854-6.8907
R3	35	1.6245	1.9005	1.7485	0.9717-2.2774
R4	35	6.1561	12.3761	1.0001	1.9047-10.4074
R5	35	1.5854	2.1429	1.0434	0.8493-2.3215
R6	35	1.5608	1.9900	1.0132	0.8772-2.2444
Group 3-KMC					
R1	30	0.9412	0.0507	0.9586	0.9222-0.9601
R5	30	0.9054	0.0828	0.9187	0.8745-0.9364
R6	30	0.9633	0.0853	0.9757	0.9316-0.9952
Group 4-CMC					
R1	35	0.9949	0.0453	1.0000	0.9793-1.0105
R2	35	0.6047	0.5923	0.4286	0.4012-0.8082

TABLE 5. Existing best in four groups performance

Benchmarks (1)	Value (2)
R1	0.9412
R2	0.9187
R3	0.5068
R4	1.2390
R5	0.9054
R6	0.9633

Table 6 Benchmarks For Future Monitoring

Benchmarks (1)	Value (2)
R1	1.10
R2	1.50
R3	0.50
R4	1.24
R5	0.90
R6	0.96

FIGURE 1
Group Cluster of Performance Ratios

FIGURE 2

Mean indicators across the Groups

REFERENCES:

- [1] United Nations Centre for Human Settlements. An Urbanising World. Global Report on Human Settlements-1996. UK: Oxford University Press, 1996.
- [2] Sohail M. An investigation into the procurement of urban infrastructure in developing countries. PhD: Loughborough University, 1997.
- [3] Jackson A.E., Safford R.R. and Swart W.W. Road Map To Current Benchmarking Literature. Journal Of Management In Engineering, 1994; ASCE, Vol. 10, No. 6: 60-67.
- [4] Lema N.M., Price, A.D.F. Benchmarking: Performance Improvement towards competitive advantage. Journal of Management in Engineering, 1995; ASCE, Vol. 11, No. ME1, US: 28-37.
- [5] Kubal M.T. Engineering quality in construction Partnering and Quality. McGraw Hill, Inc, 1994.
- [6] Anderson B, Pettersen, P. The Benchmarking Handbook. UK: Chapman and Hall, 1996.
- [7] Stewart D.W, Shamdasani P.N. Focus Groups: Theory and Practice. US: Sage Publication, 1990.
- [8] Fisher D., Meistschin S. and Pollock, D.R.Jr. Benchmarking In Construction Industry. Journal of Management In Engineering, 1995; ASCE, Vol. 11, No. 1:50-57