

Information and Communication Technologies for Effective Contract Administration of Public Procurement of Works in Mbeya Region

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Abstract: The study aim at assessing the effects of integrating information and communication Technologies (ICT) and effective contract administration of public procurement of works. This assessment was conducted following a number of cases over ineffective follow up, monitoring and evaluation of a contract/project which happen that a project is not visited since the time of awarding the contract. This then revealed to have a trickledown effect of a contract not to perform or simply the end deliverable found with uncounted variations different from the expectations of project owner (client) in which to our case procuring entity entails. The discrepancy was that project administration was found not effective in fact that the project was found not subjected to serious follow up and monitoring towards its completion. Only to notify that the project is completed while it was under ineffective monitoring and evaluation which was then found be the cause of variations of the end deliverable being part of most contracts. It is from the field in which it was found that being adopted and used to ICT would be an effective solution in uncovering such discrepancies. To uncover what was behind the scene, the study used positivistic philosophy and casual-research design. Indeed from 4,000 population of registered contractors in Mbeya region and from the five districts, the study used to systematic sampling technique to derive to 97 respondents. Moreover questionnaire was a data collection tool applied from which the collected and cleaned data were analyzed inferentially by applying the ordinary least square, canonical correlation and runs homoscedastic testing. The results were as follows:- information and communication technology (ICT) found to be positive and significant determinants of effective contract administration. This indeed was revealed over $p < 0.05$ for significance reached over assurance over punctuality of contractor towards, proper scheduling of work and sustaining of the service level agreements. It from the positive and significant results thus the study recommend that the policy makers, contract managers, project management team, contract executors should be adopted and used to ICT and other automated systems for revelation of effectiveness over contract administration.

Keywords: Information and Communication Technology (ICT), Contract Administration, Public Procurement of Works

1. Introduction

Time delivery has been one of the issues in any procurement undertakings which have to be taken care off. Time delivery implies execution of one of 'R' in 5R's that have to be met for the customer/ client /project/contract owner satisfied. The philosophy over trade-off occurs when both the contractor and the client/project owner benefit the contract [9]. The time delivery extracted from 5Rs entails over "right time". Normally in procurement indeed in

procurement of work, the time to complete the project has implication over the cost and quality of the deliverable. Delay in project completion lead into time schedule risks which is the major cause of deviations/variations over the end deliverable [16]. It is with this then that is why a follow up, monitoring and evaluation require to be concrete and effective. That means the follow up and over all contract administration that involve use of information communication technologies such that over use of automated systems sophisticate the process [18].

Use of automated, information communication technologies has revealed to offer for proper capturing of the contractor punctuality and busy time, effective scheduling of work in a day and through to completion and thorough execution of service level agreement. Contractors' punctuality, arrival and departure time is traced through the use of ICT. Normally the effective punctuality of a contractor to work has a direct implication over achieving of the targets of the day and through to completion of the project [7]. Also it was reported that the high the contractor become punctual to work define how time is optimally utilized towards coming to the close-up time of a contract [17]. Better tracing /keeping track to the extent of making a contractor become punctual is through use of automated systems than physical visitations which has found to be un-accurate, not effective, and tiresome for human resources errors dictates the whole contract administration process. The random errors due to omissions and errors created by human being have furthermore revealed to be a source of deviations over the end deliverable [20].

For proper scheduling of the work of the day, then use of ICT has proven an appropriate approach. This is from the fact that whatever work plan in place then it is subjected to flexibility and every change is immediately communicated to the parties of the contract [19]. This either foster for a work plan which curb for unnecessary delays. It through the use of mobile apps in which the schedules are fed and then the project/contract manager/administrator/follower get access to those schedules even when at homes. Use of ICT for creation and increase in accessibility implies the extent to which a contractor is competent over use of technologies i.e. technical competence, one of the criterion needed for a contractor to be revealed credible or potential to be awarded a contract.

Effective execution of service agreement has been found to be fostered indeed if information communication technologies are used [14]. It is through the use of geographical information system (GIS) in which monitoring over the demarcations, designs, drawings is simplified. Instead of a project administrator scheduling for travel to the site work for expediting purpose, but just in the office, the level of service executed is traced and offset with regards to the time duration of the project. Indeed efficient use of bill of materials, the needed quantity, prices and its optimal use are easily kept track. It is through use of automated systems in contract or project administration in which the expected variations to occur are pro-acted before their realisation.

From the field it was realised that use of manual system indeed through physical visitation has revealed to create deficiencies which have been the cause of 80% of the end deliverable found with variations. The use and adoption of automated/ICT systems for effective contract administration was found to be a discrepancy not uncovered, thus being addressed by this study. Because of human errors, manual project/contract administration found with a project awarded to a contractor was not then followed up until its completion which was then the major cause of most of project delays which then confront the cost and quality of the end deliverables. To fulfill this gap the study employed the

contract performance theory supplemented by technology diffusion model respectively [3, 13]. It is through these two models from which for a project /contract realise performance then effective administration which is to be sustained through employment of sophisticated/automated information and communication technologies. Moreover it is through this study in which it was revealed that utility/punctuality tracking, effective scheduling of the service level agreement were the innovations brought through adopting and using of automated systems. These results were from three objectives established guiding the study which were:- to analyze the effects of use of ICT on sustaining the punctuality in work, the effective contract administration practice; examine the effects of ICT on proper scheduling of work which is an effective contract administration practice; and assess the contributions of adopting ICT platforms for effective execution of service level agreements an effective contract administration innovative practice.

2. Literature Review

2.1. Theoretical Literature Review

The study was guided by contract performance theory while being supplemented by technology innovation diffusion model. The contract performance theory proposed on effective follow up, monitoring and evaluation managerial practice to realisation of contract (project) performance [3]. A Effective follow up shows commitment over the contract manager/administrator/owner have in making sure that the project come to the end on time [8]. Monitoring ensures that there is no or there is optimal deviation over the end deliverable. Monitoring is to remind the contractor over the designs, dimensions and demarcations that the end deliverable conform to expectations. The project evaluation is motivated to examine the cause of deviations (variations) over the end deliverable and draft the way to overcome once upon in future, the same discrepancy might happen.

Despite of good proposals by contract performance theory, but it has been silent on how most effective project/contract administration might be achieved by intruding the automated-information communication technology, thus where Technology innovation diffusion model comes in [14]. The most effective follow up, monitoring and evaluation over the contract as it has uncovered by this study, entailed to be sustained through the revealed punctuality over the work, its proper organization and effective execution of service level agreements [10], but not explicit as it has done by this study underhand.

2.2. Empirical Literature Review

In China it was found that use of right resources, materials profound to the quality deliverable by 90% [5]. It was more over stipulated that normally the quality use of materials and adequate allocation of financial resources has consistent results over quality outputs. Use of quality and competence

contractors in construction projects has the similar positive effects over quality end deliverables. Moreover the study conducted in China employed descriptive design while collected and processed data were analyzed using simple frequency distribution tables, graphs [5]. Different from this study underhand is that the construct under examination was over managerial competence on contract on contract or project performance of which the managerial competence stipulated by using constructs follow up, monitoring and evaluation to be most effective executed by using automated systems. Indeed, this study underhand used causal design and data being analysed inferentially.

In Africa and specifically from the study “the adoption and use of information and communication technologies” it stipulated on advantages of effective project planning brought through employment of information and communication technologies targets on hand being realized [6]. In this study, it was revealed that managerial competence over forgoing for risks and find ways of mitigating them is an innovative managerial approach that entails over a performance of the project. The study used to descriptive–survey design while purposive sampling technique being applied to derive to 70 respondents from 12,500 total population [6]. Different from this study under investigation that the two variables in association were contract administration and its performance through adopting and using information communication technologies. This study more over used to causal design while simple random sampling technique was employed to derive to 97 sample of respondents from 4,000 total population.

Nature of contract has positive effects on its performance, the fact which were revealed in the study, “the correlational study analysis between the nature of the contract and its performance” [11]. This study used correlation research design and the assessment involved the contractors, managers from TANROADs and TBA in Mbeya City. This study under discussion differ from that one [11] in a manner that it has involved the variables the most effective administration and contract performance to be fostered through the use of ICT and automated systems. Moreover this study under hand has been undertaken in Mbeya region from which managers, administrators from TANROADs and registered contractors were involved.

The reviews above were summarized through the conceptual framework shown as Figure 1. Operationalization of model was consorted by ICT which was independent variable and contract administration was dependent variable.

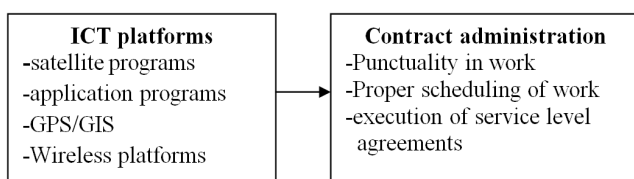


Figure 1. Conceptual framework of Use of ICT for Effective Contract Administration of procurement of works.

3. Methodology

The study was conducted in Mbeya region from which 4,000 population of registered contractors, contract managers, contract administrators were involved. The area was chosen while exemplifying other areas were public constructions under administration of the TANROADs was conducted. The administration of the construction projects were revealed ineffective and non-innovative especially the manual visitation in which it was found that the project was left on the hand of the contractor or project executors until the end while non-visited. This then has been revealed to the major source non-performance of most of contract, different say if innovative ways such that over use of automated, ICT systems could be used what this investigation is recommending. The survey research design was used and the systematic sampling was employed to derive to 97 sample of respondents given the level of confidence=90% and margin error=0.1. From five districts in Mbeya region at most 20 respondents were chosen. Moreover the sample of 97 respondents obtained was involved in gathering data from which questionnaire was used. The collected and processed data were analyzed by employing ordinary least square, canonical correlation and runs test. The analysis either was guided by the following structural equations:-

$$P_{ATW} = \beta_0 + \beta_1 AT + \beta_2 BT + \beta_3 DT + e \quad (1)$$

where P_{ATW} = punctuality and attendance to work; AT=arrival time; BT=busy time; DT=departure time.

$$SW_D = \delta_1 PW + \delta_2 AHR + \delta_3 GC + \delta_4 BS \quad (2)$$

where SWD = Scheduling of work of the day; PW = Plan of the work of the day; AHR= Allocation of human resources; GC= Ghant chart displaying; BS= Budget schedule

$$SL_A = \alpha_1 EBP + \alpha_2 ED_R + \alpha_3 EBOQ \quad (3)$$

where SL_A = service agreement level; EBP =Execution of blue prints; ED_R =Execution of drawings; EBOQ= Execution of bill of quantities.

$$P_j = \beta_1 \sum PATW + \beta_2 SW_D + \beta_3 SL_A \quad (4)$$

4. Findings & Discussion

4.1. Findings

4.1.1. Punctuality in Work and Use of ICT

In here the study aimed at assessing the effect of using information communication technologies say use of satellite application program towards capturing for the extent to which punctuality is sustained. Normally there is a linear association between being punctual to work and its completion. Punctuality has positive effects over meeting the project deadline. This either comprehended with what was revealed from the field given $R = 0.64$ while $\beta = 0.04$ for the strength of association between the two variables i.e

punctuality and on time completion of the project without face to face follow up but use of ICT (See Table 1).

Table 1. Ordinary Least Square Analysis.

Independent variables	Dependent variable: P _{AWTW}
	Model 1
AT	0.50 (0.04)**
BT	0.71 (0.03)**
DT	0.60 (0.04)**
Constant	-0.01 (0.02)*
R	0.59

Note: P_{AWTW} = Punctuality and attendance to work; AT=Arrival time; BT = Busy time; DT=Departure time.

**p<0.05; *p<0.1.

From Table 1 above, given $R = 0.50$, $\beta = 0.04$, this shows a positivistic and statistical significance that existed between use of computerized platforms, satellite and proper capturing of the arrival time of the contractor without physical follow up. As it has noted above is that the high punctuality (arrival) rate is the high probability of a contractor meeting the target and indeed the effective contract/project administration approach of meeting the deadline.

With greater probability of utility time (λ/μ) programmed by the follower's means the probability of the project coming to the end is also great. The more busy time means the contractor is committed and accountable to the work to realize that the scheduled time for a project to the completed on or before time. Thus with $R = 0.71$; $\beta = 0.03$, this is a proven facts over the positivistic and statistical significance existed between the use of automatic systems in project follow and ease capturing of the extent to which a contractor is busy at work. As it has noted above with great idle time means a contractor is using most of his time not at work or simply the contractor uses most of his time for leisure and thus the deviation over end deliverable is there probable.

Use of automated systems was revealed to increase a chance of capturing for contractors' departure time. As it was with arrival time reading $R = 0.60$, $\beta = 0.04$, the same was revealed with departure time. With this positivistic and statistical significance between the variables under discussion meant the high busy time and reduced early departing time has a meaning that more time is used by a contractor at work.

4.1.2. Proper Scheduling of Work and Use of ICT

With this sub title, the study aimed at revealing the impacts of using ICT in proper scheduling of work. As it has said above is that using of automated systems such that of computerized application programs in which efficient use of resources is realized even without physical visitation of the client/project manager/administration to the site works. It is through use of satellite automated systems in which a contractor just upload the plan of the day showing activities, human resources, financial resource and time allocation. This either despite of offering an effective statement of work but it also demonstrate the extent to which a contractor is used to professionalism to ensure the said efficient procurement. The

reality from the field was deduced and presented as shown in Table 2.

Table 2. Canonical Correlation Analysis Results.

S/N	Variates	R ^c	Chi2
1.	PW	0.53	0.4
2.	AHR	0.65	0.3
3.	GC	0.54	0.3
4.	BS	0.60	0.3

Note: PW=Plan of the work of the day; AHR= Allocation of human resources; GC=Ghant chart displaying; BS= Budget schedule.

With $R^c = 0.53$ at $Chi2 = 0.4$ shows that use of automated systems demonstrate a proper organization of work of the day. This is either a positivistic or statistical significance that indicates that adopting and using of information communication technology in achieving the most effective project administration create something new in realizing optimized variations over the end project. The statement of work of the day is easily accessed and easily captured through automated systems.

Moreover with $R^c = 0.65$ at $Chi2 = 0.3$, $p < 0.05$ pertaining effects over use of GPS/GIS/satellite automated systems and sustained allocation of human resource is demonstrated. Normally what has frequently revealed in most cases over non performance of the contract is over misuse of or none efficient use of human resource. It is through use of ICT where the work plan showing activity and allocated human resource is made open [9]. This then was revealed to increase professionalism and transparency on how a contract is used to perform. This efficient allocation was then feed into computerized systems for a contract manager easily access.

Use of automated platform has revealed to increase availability of the project duration to come an end given $R^c = 0.65$ at $Chi2 = 0.3$, $p < 0.05$. This is from the perforated day to day time schedule displayed which is the determinant and accumulation of the whole time project duration. Normally the printed or displayed highly scheduled project reflects show time shortly the project is going to be completed. The short time day to day schedule reflects the long or delay over the project in progress to be completed.

It is through use of automated system in which it was revealed effective execution over hybrid contract i.e. time and materials. In here the point was over $R^c = 0.53$, $Chi2 = 0.3$ showing positivistic and statistical significance to be sustained following invention over ICT platform and ease access to the budget schedule. This either offer quick reminder to the either part of the contract responsible to provide materials and financial resources to ensure the contract or project come to the end while conformed to its expectations.

4.1.3. Execution of Service Level Agreements and Use of Automated Systems

In here the study aimed at determining the extent to which service level agreements are fostered through use of information communication platforms. Service level agreements are demarcations or scope on how the end

deliverable has to look like. Service level designs and delimitations of the project deliverables. Thus it is through use of ICT, automated systems in which adhering to these demarcations has been revealed to be most effective. The reality from the field was deduced and presented as shown in Table 3 below:-

Table 3. Runs Test Analysis Results.

	Sustaining service level agreements through use of automated systems
Test value	1
Cases <= test value	632
Case >= test value	1258
Total cases	1890
Number of runs	653
z	-2.894
Sig. (2-tailed)	0.04

Source: Field data (2019).

From Table 3 above the $z = -2.894$ being observed runs is less than the expected runs ($z = 3.235$) and this therefore indicate a correlation to exist between sustainability over service level agreements and use of automated systems. Indeed with significance, p , obtained $= 0.04 < 0.05$ is the indicator of significance for null hypothesis to be accepted in favor of alternative hypothesis. These positivistic results is the indication that use and adoption of automated information and communication technologies has a significant impact over thorough meeting of service level agreed and confined in the contract of service. The positivistic results over runs test either did not ignore the fact that the automated system that could be fostered through use of information communication technologies was not intruded in the field area.

4.2. Discussion

Normally on time arrival of a contractor at work is the prior initiator /strategy towards meeting the operation/day to deadline schedules given by $R = 0.50$, $\beta = 0.04$ (Refer Table 1). This either has revealed to be operational in observing the project is completed on time. Since from the fact that delay of project pile up the operational and total ownership cost that always have negative effects over the quality of end deliverable. More over use of computerized systems such that over use satellite, application software installed in the app store, play store of mobile phones of the project follower/ managers/administrator revealed to help realize the contractors busy (utility) time. This fact was proven with $R = 0.71$; $\beta = 0.03$.

More use of time at work and delay in departing time is a clear proof that the project has great assurance of being completed as it was scheduled ($R = 0.60$, $\beta = 0.04$) [12]. Only what this study reminds is that the instead of using or opting for manual recording of contractors' departure time, then stakeholders in project management would be used to automated systems which therefore come in between as a mediating variable. This is then a revolution brought in and thus it is a new knowledge this study has intruded over the contract performance theory. The fact is that contract

performance theory proposed on the effective contract administration brought through managerial competence over follow up, monitoring and evaluation but the theory has been silent on how project/contract administration might be done in a most effective way through intruding or adoption and use of computerized and automated systems.

Use of computerized and automated systems do not require use of paper work and therefore reducing transaction cost and thus helping to meet the effective contract administration given $R^c = 0.53$ at $\text{Chi}^2 = 0.4$ (See Table 2). Use of ICT has shown to help reveal the extent to which a contractor is experienced and competent towards use of technology [2]. Use of ICT indicated to play role in effective drafting for mini-tasks or day to day activities. It is moreover through use of e- platforms in which technical competence of every human resource found to be easily identified by the managers/administrators/procuring agent to realize with no doubt over the end deliverable to be that which conform to quality standards expected by the client with $R^c = 0.65$ at $\text{Chi}^2 = 0.3$, $p < 0.05$.

Either with $R^c = 0.54$ at $\text{Chi}^2 = 0.3$ (See Table 2) shows that adoption and use of ICT reveal to increase accessibility of time/ghant chart online which then does not demand much a project manager/administrator or project owner fear for physical access to these documents. Also increasingly access to these schedules following inventions over use of automated systems has created environment for most effective contract/project administration. Consistent results was with increase of visibility over the budget or cost schedule ($R^c = 0.53$, $\text{Chi}^2 = 0.3$) through use of ICT technologies. This found to help to overcome the problem in most cases happening over more financial resources or more cost being incurred while to find the end deliverable is of not that quality expected [4].

Either the positivistic findings revealed from the field found that use of automated systems showed a technical competence over contract on adhering to the blue prints (See Table 3). The blue prints are rules and regulations or demarcations over the project and what expectations, the project owner/client and /procuring entity would like to realize. The blue prints are principles, procedures and model what is to be adhered by a contractor for expected quality standards executed.

The positivistic results more over entails that use of automated systems has been most effective for contractor demonstrate technical experience by biting within the dimensions/designs. Either what an additional thing executed through use of ICT is that these dimensions, drawings are shared online [1]. In here whatever stage a contractor move or reaches then using say what sap, then the project deliverable is pictured and sent to the project owners/managers/administrator. Indeed use of Mobile apps then the piece works or simply wherever stage the project is reached, a photo is taken, fed in these applications for the project manager/administrator download and conform over the project progress and indeed if the drawings are followed. Use of e-platforms, then does not require a follower /project

manager/administrator have a face-to-face visit to the site work.

Use of satellite for instance and in one point was revealed the cause of the positive results though it was out of the recommended level [15]. The use of satellite automated systems used to insure for efficient execution of bill of quantities given $z = -2.894 < 3.235$ (the recommended level). The bill of quantities in tabulated items, quantities and its prices, thus little use of one of the item has the same over poor quality of end deliverable. Indeed more use of the items/materials has a trickle down effects over more resources (financial and materials) use. Use of more materials is ineffective and un-optimal use of resources which has the same multiplier effects over the low quality end project deliverable.

5. Conclusion and Recommendations

Contract administration involves follow up, monitoring and evaluation so that the targets (service level agreements), economic use of resources and value for money is realized. Manual contract administration revealed from the field found to be ineffective way of doing. Either it was reported that use of physical visitation caused a project to be left to the contractor from when the contractor was awarded to the time of its completion. This either found to be the root cause of deviation over the end deliverable, but use of innovative ways such that over employment of ICT revealed to reverse the burden. Use of ICT and other automated systems found to help sophisticate the punctuality acting's of a contractor to work, proper scheduling of the work of the day and sustainability of service level agreements. It is from insignificant adoption to ICT and other automated systems to facilitate effective project/contract administration what this study therefore recommends that, the policy makers, Ministry of Constructions, PMU, Tender Board should be invented on use of automated and ICT systems. Indeed the policy makers should effectively prepare the organization for transformation, supporting infrastructures, resources and platforms are to be made accessible and available. Furthermore the implementers i.e. the contract managers and the whole project / contract management team and the project executor (s) should be used to technology and technological competence should be one of the criterion for a bidder to be awarded a contract.

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