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Assessment of Project Monitoring and Control Techniques in Ondo State Agency for Road Maintenance and Construction (OSARMCO)

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ABSTRACT

Monitoring and control is an essential process in construction project management and delivery. It is therefore imperative for construction companies to employ the usage of the most effective monitoring and control techniques available to meet project objectives. This study examined project management techniques employed by Ondo State Agency for Road Maintenance and Construction, a construction company in Ondo State, Nigeria.The research design that was used for this study is the survey method where copies of a well-structured questionnaire were distributed to elicit appropriate information from respondents. The results showed thatthere is a relationship existing between the type of project monitoring and control technique used by a construction company and project delivery/success and that the use of Program Evaluation and Review Technique (PERT) for time/schedule control and Earned Value Management (EVM) (alongside other monitoring and control techniques) for cost control as used by the company are very effective in meeting set project objectives.Based on the findings, a number of recommendations were made. Among these are, that monitoring and control units should be established withinconstruction companies and well-trained workers/professionals should be put in charge of handling these units and the techniques and tools used therein.

Keywords-- Construction, Monitoring and Control, Project, Project Management

I. INTRODUCTION

Projects are one of the most important components of today's organizations. According to PMI (2000) and Nokes (2007), the term project is a temporary endeavor designed to produce a unique product, service or result with a defined beginning and end (usually time-constrained, and often constrained by funding or deliverables) undertaken to meet unique goals and objectives, typically to bring about beneficial change or added value. A project has a clear time frame (start and end), and a clear strategy of how to use resources to produce results. The temporary nature of projects stands in contrast with business as usual or operations, which are repetitive, permanent, or semi-permanent functional activities to produce products or services (Dinsmore, 2005). Projects are also characterized by general attributes such as the purpose, life cycle, uniqueness, interdependencies and conflict (Meredith & Mantel, 2000). Projects are designed and implemented to address developmental needs or problems (Woodhill, 2000).

Project monitoring and control process is done to make sure everything goes according to plan. In other words, it identifies discrepancies, handles change management, and provides feedback to update and progressively elaborate the plan (Jack, Okeke, Okechukwu & Akinola, 2016). To put formally, a project monitoring and control system works to minimize the deviations from the project plans and consists of identifying and reporting the status of the project, comparing it with the plan, analyzing the deviations, and implementing the appropriate corrective actions. Hence it includes the set of policies, methods and tools that would ensure the achievementof the project targets (Hazir, 2014). The development of a suitable Project Control system is an important part of the project management effort (Shtub, Bard & Globerson, 2005). There have been a number of articles published to support the importance of control in the achievement of project objectives, Project performance can be improved if more attention is given to the issue of control.(Avison, Baskerville & Myers, 2001). A project control system is not the development of something entirely new. It is more the bringing together of many proven project control techniques. Furthermore, because the exact combination of control techniques varies significantly to meet the unique needs of each project, no single detailed control system is appropriate for every construction environment. Therefore, every owner, contractor and engineer should become aware of all

project control techniques in order to be able to employ the most appropriate technique to his or her project (Attalla, 1996).

The construction industry is indeed an integral component of a nation's infrastructure and industrial growth (Tom & Paul, 2013). The industry is considered one of the oldest industries organized on a project basis (Chitkara, 2012; Roberts & Wallace, 2004). The purpose of construction project management is to plan, coordinate and control the application of project objectives in the most effective way according to stakeholders' needs (Harris & McCaffer, 2013).

Therefore, this study aims at assessing various monitoring and control techniques and their effects on construction project delivery/success, taking Ondo State Agency for Road Maintenance and Construction, a construction company inOndo, Nigeria as a case study.

II. LITERATURE REVIEW

2.1 Concepts of Control

2.1.1 Time Control

A. Critical Path Method (CPM)

According to Guo-li (2010), based on the original plan (Gantt charts), we can analyze what activities are on the critical path, what activities have no free float and what activities have less than a specified float via the network diagram. Then we can monitor these activities and take control actions to avoid delay. Once an activity on the critical path is going to cause delay, commonly, there are three ways to avoid delay or even shorten the duration of activities:

a. Increasing resource levels, such as adding labour.
b. Improving resource efficiency, such as transferring highly-skilled employees to the activity, improving efficient tools.
c. And employing means that can shorten critical path timescales to bring a project back on target, such as overtime, outsourcing, etc.

B. Optimal Timing

Falco and Macchiaroli (1998) opine that considering optimal timing of project monitoring and control points is significant to success. They suggest that we should determine the optimal frequency of the monitoring and reviewing to different activities in different stages. It can help us to efficiently monitor and correct control so as to reach time and cost target.

C. Crashing

In recent years, network crashing was developed along with the CPM (Critical Path Method) for planning and controlling large scale projects. The purpose of crashing is the minimization of the pessimistic time estimate in Program Evaluation and Review Technique (PERT) networks by investing additional amounts of money in the activities on the critical path. Sometimes, crashing methods are required to combine in the monitoring and controlling process when the duration of the activity has to be completed within a specified time (Abbasi&Mukattash, 2001).

2.1.2 Cost Control

Guo-li (2010) stated that the main cost of a project includes staff cost, material cost and delay cost. To control these costs, managers should first set up a cost control system to:

a. Allocate responsibilities for administration and analysis of financial data.
b. Ensure all costs are properly allocated against project codes.
c. Ensure all costs are genuinely in pursuit of project activities.
d. Ensure contractors' payments are authorized.
e. Check that other projects are not using the budget.

As a project is dynamic, sometimes the project managers know the project is going off target by monitoring, but don't know the best action to take. In this circumstance, net present value (NPV) should be used as an ongoing monitoring and control mechanism, because NPV takes account of the time element and discounts future cash flows, it is the result of the time effect on cash (Gardiner & Stewart, 2000).

2.1.3 Quality Control

Quality control is considered to be the process of testing and inspecting material and workmanship for compliance with the specifications and the applicable codes. This process is also impacted by the type of organization, contract format and the project life cycle. Quality control may be studied in a lump sum contract environment and within the execution and finish stages of the project life cycle. Also, quality control is highly related to both cost and schedule functions. Furthermore, quality may be considered as a product of cost and schedule control (Atalla, 1996).

2.1.4 Change Monitor and Control

Voropajev (1998) states that dynamic changes of project environment will influence the process of project implementation, the project itself and may cause heightened risk. When carrying out some activities, the methods different from that in the original plan must be used to keep the process moving forward (as experienced under practice). Therefore, changes are inevitable and need to be managed during project life-cycle. An effective change control system should be established to ensure change procedure is clear and unambiguous and easy for employee to request a change. And the following things need to be concerned:

a. Monitoring and forecasting key factors that generate change to ensure good results
b. Ensuring that change is beneficial
c. Request for change must be checked by suitable person before being approved
d. Changes should take place once it is approved and be monitored to check whether it worked as expected
e. All changes in project should be recorded in the project documentation (Voropajev, 1998)

2.2 Theoretical Review

2.2.1 Theory of Control

The theory of control consists of two models: themostat model and the scientific experimentation model (Koskela& Howell, 2002).

A. Themostat Model

The themostat model conceptualized that in the production process, there is a process to control, a unit for performance measurement, a standard of performance, and a controlling unit, while the scientific experimental model of control as advocated by Shewhart and Deming (1983) cited in Koskela and Howell (2002) focuses on finding causes of deviations and acting on those causes, instead of only changing the performance level for achieving predetermined goals in the case of deviation.

B. Scientific Experimentation Model

The scientific experimentation model adds the aspect of learning to control (Koskela & Howell, 2002). Thus, project control involves gauging performance, identifying deviation and learning what are the causes of deviations, their effects and the best means of countering them. The learning process is an avenue that can be used by contractors to improve on their project management potentials.

2.3 Review of Empirical Literature

In a study carried out by Kenley and Harfield (2015) on "Construction Project Control Methodologies and Productivity Improvement: EVM, BIM, LBM". The main objective of the study was to identify the project control methods used by organizations to improve production efficiency. Upon adopting the critical realism methodology for their explorative research and numeral analysis for data description, they identified project control as a contributing factor to project success, and stated that the project management literature is replete with models promising control of cost and duration, process models for more effective project delivery and software to support their research findings. They also concluded that controlling external and internal uncertainty is considered a major part of any construction project for the implied outcome of improving overall project productivity.

In another study undertaken by Shanmuganathan and Baskar (2016) on "Effective Cost and Time Management Techniques in Construction Industry" to identify the most successful cost and time management techniques and software's used to control projects in the construction industry. Data was collected using questionnaire survey. A 5-point likert scale was used to understand respondents' responses and the Relative Importance Index (RII) for data analysis, the results of which revealed that cost management and time management techniques are important to succeed the project in the construction industry. It was concluded that time management software helps to control and monitor the project whether the project goes in right path or not. Based upon their research, they established that cost management techniques like cost flow forecasting and cost planning control are important for controlling cost, that time management techniques like critical path method (CPM) and program evaluation and review technique (PERT) are the effective time management techniques in the construction industry.

III. METHODOLOGY

The study area for this study is Ondo State Agency for Road Maintenance and Construction, a construction company in Ondo State, Nigeria.The population of the study consisted of respondents who are part of the project management team (both lower level and higher level team members)of Ondo State Agency for Road Maintenance and Construction (OSARMCO) in Ondo State amounting to 51 employees. The population for the study was limited to the project management team of the construction company to allow for elicitation of information relevant to title and objectives of the study.

A sample size of 45 was computed from the population using the formula for calculating sample size in research activity as stated in Yamane (1967).

Primary source of data was employed as a gathering instrument for the survey by means of a structured questionnaire which was designed in line with the conceptual framework of the study and was personally administered by the researcher. Responses were ranked using a five-pointlikert scale to give an indication of the degree of the aspect being measured. The scale was used as it is simple to construct, easy to read and complete and likely to produce highly reliable data.

The data pulled together from the field survey were analysed using descriptive statistics in form of Percentages and Frequency Tables. Relative Importance Index (RII), Linear Regression Analysis, ANOVA, and Pearson Product Moments Correlation Coefficient were used for the analysis of the research questions. SPSS (Statistical Package for Social Sciences) version was used to analyse the data.

IV. RESULTS AND DISCUSSION

4.1 Assessing Time/Schedule Control Technique

Table 1 depicts:

a. the time monitoring and control technique employed at the study area. 8.9% of respondents selected the usage of Critical Path Method (CPM) and 91.1% selected the employment of Program Evaluation and Review Technique (PERT).
b. the effectiveness of the time/schedule monitoring and control technique used in the study area in identifying project activities that are critical. 44.4% of respondents strongly agreed that it is effective, 51.1% agreed while 4.4% were neutral.
c. the effectiveness of the time/schedule monitoring and control technique used in the study area in monitoring planned versus actual progress. 53.3% of respondents strongly agreed to its effectiveness, 33.3% agreed while 13.3% were undecided.

d. the effectiveness & reliability of the time/schedule monitoring and control techniqueused in study area in meeting set project delivery dates, 44.4% strongly agreed to its effectiveness& reliability, 37.8% agreed while 17.8% were neutral.

Table 1: Assessment of Time/Schedule Control Techniques

	Frequency	Percentage	Cumulative Percentage
Which time/schedule control technique is employed by OSARMCO?			
Critical Path Method (CPM)	4	8.9	8.9
Program Evaluation and Review Technique (PERT)	41	91.1	100.0
Earned Value Management (EVM)	0	0.0	100.0
Others	0	0.0	100.0
Total	45	100.0	
Does or do the time/schedule monitoring and control technique(s) effectively identify project activities that are critical?			
Strongly agree	20	44.4	44.4
Agree	23	51.1	95.6
Neutral	2	4.4	100.0
Disagree	0	0.0	100.0
Strongly disagree	0	0.0	100.0
Total	45	100.0	
Is or are the time/schedule monitoring and control techniques effective in monitoring planned versus actual progress?			
Strongly agree	24	53.3	53.3
Agree	15	33.3	86.7
Neutral	6	13.3	100.0
Disagree	0	0.0	100.0
Strongly disagree	0	0.0	100.0
Total	45	100.0	
Would you say that the time/schedule monitoring and control techniques are effective and reliable in meeting set project delivery dates?			
Strongly agree	20	44.4	44.4
Agree	17	37.8	82.2
Neutral	8	17.8	100.0
Disagree	0	0.0	100.0
Strongly disagree	0	0.0	100.0
Total	45	100.0	

Source: Field Survey (2018)

4.2 Assessing Cost Control Technique

Table 2 depicts:

a. the cost control technique employed at the study area. 95.6% of respondents chose the usage of Earned Value Management (EVM) while 4.4% selected the use of other cost control techniques

b. the effectiveness of the cost monitoring and control techniqueused in the study area in identifying potential cost overruns. 28.9% of respondents strongly agreed to its effectiveness, 57.8% agreed and 13.3% were undecided.

c. the effectiveness of the cost monitoring and control techniqueused in the study area in mitigating unfavourable variations in project cost. 57.8% of respondents strongly agreed to its effectiveness, 40.0% agreed while 2.2% were neutral.

d. the effectiveness & reliability of the cost monitoring and control techniqueused in study area in delivering projects within budget.40.0% of respondents strongly agreedto its effectiveness and reliability, 55.6% agreed and 4.4% were neutral.

Table 2: Assessment of Cost Control Techniques

	Frequency	Percentage	Cumulative Percentage
Which cost control technique is employed by			

OSARMCO?			
Earned Value Management (EVM)	43	95.6	95.6
Cost Flow Forecasting	0	0.0	95.6
Others	2	4.4	100.0
Total	45	100.0	
Does the cost monitoring and control techniques effectively identify potential cost overruns and underruns?			
Strongly agree	13	28.9	28.9
Agree	26	57.8	86.7
Neutral	6	13.3	100.0
Disagree	0	0.0	100.0
Strongly disagree	0	0.0	100.0
Total	45	100.0	
Cost monitoring and control techniques are highly effective in mitigating unfavorable variations in project cost			
Strongly agree	26	57.8	57.8
Agree	18	40.0	97.8
Neutral	1	2.2	100.0
Disagree	0	0.0	100.0
Strongly disagree	0	0.0	100.0
Total	45	100.0	
Would you say that the cost monitoring and control techniques are effective and reliable in delivering projects within budget?			
Strongly agree	18	40.0	40.0
Agree	25	55.6	95.6
Neutral	2	4.4	100.0
Disagree	0	0.0	100.0
Strongly disagree	0	0.0	100.0
Total	45	100.0	

Source: Field Survey (2018)

4.3 Measurement of Project Delivery/Success

Table 3 depicts the satisfaction of clients (which is also the measurement of project delivery/success) with projects delivered to them using the monitoring and control techniquesadopted in the study area. 20% of respondents strongly agreed that clients are highly satisfied and the remaining 80% agreed.

Table 3: Clients' Satisfaction

	Frequency	Percentage	Cumulative Percentage
Clients are highly satisfied with projects delivered to them using the aforementioned monitoring and control techniques			
Strongly agree	9	20.0	20.0
Agree	36	80.0	100.0
Neutral	0	0.0	100.0
Disagree	0	0.0	100.0
Strongly disagree	0	0.0	100.0
Total	45	100.0	

Source: Field Survey (2018)

4.4 Establishing the Value of Project Monitoring and Control to Project Execution

Table 4 depicts the value of project monitoring and control to construction projects. 48.9% of respondents strongly agreed that it is indispensable to construction project execution and success, and 51.1% agreed.

Table 4: Value of project monitoring and control

	Frequency	Percentage	Cumulative Percentage
Monitoring and control is a major part of any construction project and plays a vital role in decision making			
Strongly agree	22	48.9	48.9
Agree	23	51.1	100.0
Neutral	0	0.0	100.0
Disagree	0	0.0	100.0
Strongly disagree	0	0.0	100.0
Total	45	100.0	

Source: Field Survey (2018)

4.5 Test of Hypothesis

The hypothesis tested in this study is to determine if there is a relationship between type of project monitoring and control technique used by a construction company and project delivery/success. This was tested using regression analysis at a level of significance p = 0.05 and the result is shown in tables 5–7.

H_0: there is no relationship existing between type of project monitoring and control technique used by a construction company and project delivery/success.

H_1: there is a relationship existing between type of project monitoring and control technique used by a construction company and project delivery/success.

From Table 5, the R value = 0.839 for project monitoring and control technique represents the simple correlation which indicates a normal degree of correlation between project delivery/success and the types of project monitoring and control techniques used in the study area. R Square value = 0.703 shows project delivery/success is affected by 70.3% of the project monitoring and control techniques used in the study area. Table 6 shows that p = 0.037 which is less than 0.05. This implies that the project monitoring and control techniques regression model predicts project delivery/success significantly.

Thus, we reject the null hypothesis H_0 and accept the alternate H_1 which states that 'there is a relationship existing between type of project monitoring and control technique used by a construction company and project delivery/success.' and it can be predicted by the regression formula below from the coefficients in Table 7.

$Y = 5.82 + 2.549X_1$

Where Y = Project delivery/success and

X_1 = Project monitoring and control techniques.

Table 5: Model Summary

Model	R	R Square	Std. Error of the Estimate
1	.839[a]	.703	.12898

a. Predictors: (Constant), Project monitoring and control techniques

Source: Field Survey (2018)

Table 6: ANOVA

Model		Sum of Squares	df	Mean Square	Sig.
1	Regression	.039	1	.039	.037[b]
	Residual	.017	1	.017	
	Total	.056	2		

Dependent Variable: Project delivery/success

Predictors: (Constant), Project monitoring and control techniques

Source: Field Survey (2018)

Table 7: Regression coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.822	2.739		2.126	.028
	Project monitoring and control techniques	2.549	1.656	.839	1.540	.037

Dependent Variable: Project delivery/success

Source: Field Survey (2018)

V. CONCLUSION AND RECOMMENDATION

This study assessed the project monitoring and control techniques used by Ondo State Agency for Road Maintenance and Construction (OSARMCO). The result of the assessment conducted to identify the monitoring and control techniques used in the study area and their effects on project delivery revealed that the major techniques used are Program Evaluation and Review Technique (PERT) for time/schedule control and Earned Value Management (EVM) for cost control, and that these techniques aid in timely delivery of projects and mitigate against cost overruns.

Also, the result of the assessment carried out to establish the value of project monitoring and control to the project execution of the construction company in the study area revealed that the project management process is indeed fundamental and indispensable to project execution and success.

Finally, the result of the test conducted to assess the relationship between the type of project monitoring and control technique used by a construction company and project delivery/success revealed that there is indeed a critical relationship existing between type of project monitoring and control technique used by a construction company and project delivery/success.

Based on the findings of this study, it is therefore recommended that construction companies should have or establish monitoring and control departments/units within their companies as this is essential and integral to the successful execution and delivery of projects and qualified and well-trained persons/professionals should be put in charge of handling the project monitoring and control departments/units of construction companies and the techniques and tools used therein. In addition, it is recommended that construction companies should adopt the use of Program Evaluation and Review Technique (PERT) and Earned Value Management (EVM) along with other effective monitoring and control techniques or tools for monitoring and controlling their projects as they have been proven effective in this study. Finally, it is recommended that particular attention and emphasis should be given to controlling 'cost' as it is a very delicate and volatile aspect of every construction project.

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