



MBA Dissertation

EARNED VALUE MANAGEMENT ANALYSIS AND FORECASTING: A
CASE STUDY OF THE NIGERIAN CONSTRUCTION INDUSTRY

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Earned Value Management Analysis and Forecasting: A case study of the Nigerian
Construction Industry

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Declaration

'I Anukwe Chukwudumebi declare that this dissertation that I have submitted to Dublin Business School for the award of MBA Project Management is the result of my own investigations, except where otherwise stated, where it is clearly acknowledged by references. Furthermore, this work has not been submitted for any other degree and is compliant with the academic policies of Dublin Business School.'

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Abstract

The construction industry, which contributes significantly to the Nigerian economy, has grown in the past few years, however, the industry is plagued with many problems ranging from; project abandonment, project delays, poor resource management, poor financing, unethical practices etc. For the industry to progress, effective time, resource and cost management is necessary and Earned Value Management is on way to solve the problem. Earned Value Management is useful in monitoring and controlling project cost, schedule and scope to ensure successful completion. This research applies earned value analysis to a construction project using Microsoft Project 2016 to measure the performance and analyze the construction project with respect to cost and schedule. Interviews were used to obtain project information and determine the knowledge level and acceptance of earned value in the Nigerian construction industry. The research revealed very low use of earned value management in by construction managers. It is recommended that professional bodies focus on enhancing awareness and training of construction managers in the use of earned value management and bring the industry up to international standard.

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Chapter 1: Introduction

The construction industry in recent years has been a major contributor to economic development in many countries due to its ability to create employment and infrastructure, as well as its GDP contribution (Ogunmakinde, Sher and Maund, 2019). According to the Deloitte (2018) Africa has seen significant growth in the construction sector, with Nigeria being the center of the highest number of projects in West Africa with 30% of the regional total, valued at about €56.6bn.

The building and construction industry in Nigeria has grown significantly in the past two decades (Emiedafe, 2016) and as such has one of the highest expansion rate among other sectors in the Nigerian economy. This has created a plethora of problems that are to this day preventing the industry from reaching its full potential.

Quite a few authors have discussed the major challenges facing the Nigerian construction industry, these include but are not limited to; Poor planning, poor management, scope creep, poor quality control, corruption, lack of skilled labour and poor funding.

Iheme and Chiagorom, (2018) in their research chose to focus on constraints peculiar to the Nigerian construction industry, ranked on a severity index scale of 1-9. Although their results pointed to ethical issues as the main source of the problems, some constraints like scope creep, funding, quality control and rising project costs received rankings of; 7, 2, 6 and 3 respectively. They concluded that these would ultimately lead to continuous degeneration of the industry. The PMBOK guide (p.28 2017) points out that the importance of each constraint differs by project therefore, the project manager tailors the approach for managing constraints based on the project environment, organizational culture, stakeholder needs, and other variables.

Ogunmakinde, Sher and Maund, (2019) in their research attempt to identify all problems that exist in the Nigerian construction industry, identifying 25 challenges that they categorized into the following.

- Industry-related: which includes client-related challenges like insufficient finance and professional related challenges like unethical practices and resistance to change or unwillingness to innovate.
- Government-related: unstable price of materials, political and social unrest.
- Construction firms-related: incompetent companies winning bids and insufficient finance.
- Project-related: time performance, delays, project abandonment, changes in site condition and materials shortage.

In general, the the Institute of Project Management Ireland (PMI Ireland, 2017) gave a summary of three most common reasons for project failure which fit into most scenarios.

Project Objectives: before the start of any project, the objectives must be clear to all parties involved, the project team and stakeholders must reach an agreement on the scope of the project. Once there are unclear or un-agreed objectives, the failure of the project is eminent even before it starts.

Project Communication: communication is considered the most important aspect of a project for a project manager. Lack of communication leads to project failure; therefore, it should be planned into the project with communication matrices of what to communicate and who to, and when to communicate and who to. Encouraged collaboration between the project team and the stakeholders through open plan office arrangements, social events etc. helps communication

in local projects. Technology like emails, mobile phones and on-line workspaces make communication easier for international projects.

Project Tracking: clear objectives, a project plan and good communication do not mean the danger of project failure has been eliminated, if the project progress is not monitored against the project plan it will fail. Changes can only be noticed when the project progress is tracked against the plan and deviations are found. Projects need to be tracked in terms of time; cost and quality in order to be successful, deviations from the project plan will require the project to be re-planned.

This research will look at these challenges from a project management point of view and focus specifically on the problems that can and should be addressed using Earned Value Management. Earned Value Management (EVM) is a project management technique used to measure project progress in an objective manner (Naeni, Shadrokh and Salehipour, 2011).

Since feedback is critical to the success of any project because it can enable project managers to identify problems early and make adjustments that can keep a project on time and on budget. Earned Value Management (EVM) has proven itself one of the most effective performance measurement and feedback tools for managing projects. (PMI, 2012). EVM can be defined as a monitoring methodology that enables integration of the work performed with the planned and actual project time and costs, and quantification of project technical performance (Avlijas, Avlijas and Heleta, 2015) or as a management technique that relates resource planning and usage to schedules and to technical performance requirement (Kim, Wells and Duffey, 2003). EVM focus on forecasting final costs and project duration, what is deemed crucial to alert managers and

enforce their reaction to overcome delays and costs overruns. (Cândido, Heineck and Barros, 2014).

A distinguishing feature of EVM is the ease of integration of project cost, schedule and scope into a single performance measurement system (De Marco and Narbaev, 2013). It provides a tool for project managers to evaluate the overall health of a project during its life cycle and has been applied in various scenarios to –

- Estimate cost and completion time,
- Identify cost and schedule impact of known problems,
- Accurately state the incurred cost of a project;
- Trace problems to their sources;
- Portray the schedule status of a project;
- Identify new problems areas during a project life cycle, and provide timely reports on projects. (Chen and Zhang, 2012)

EVM provides organizations with the methodology needed to integrate the management of project scope, schedule, and cost. EVM can play a crucial role in answering management questions that are critical to the success of every project, (PMI, 2012).

1.1 Objectives of the research

This research aims to determine whether earned value methodologies can be successfully used to increase the success of construction projects in Nigeria and eliminate some persistent challenges in the industry. In addition, to determine the methods used in project monitoring and control by the construction managers. Specific objectives are as follows.

- Collect current construction management methodologies via structured interviews
- Collect relevant data by applying EVM through case studies
- Analyse the collected data to determine the effectiveness of EVM methodologies in the industry.

1.2 *Research Question*

- Can EVM be a useful tool in reducing construction project problems in Nigeria?

Sub Questions

- What is the present knowledge of EVM methodologies among construction management professionals?
- What are the present problems in the Nigerian construction industry?
- What are the currently used or implemented PM methodologies in the industry for performance measurement?
- How much resistance to change is expected for EVM implementation?
- What are the key implementation drivers for EVM?

1.3 *Research Beneficiaries*

This research will be beneficial to the following:

1. Researchers and scholars in the academic world. This research will contribute to the study of the project management body of knowledge (Earned Value Management). It will serve

lectures and students looking to conduct various studies into Value management in Nigeria and beyond.

2. Practicing Project management professionals across the country. Since earned value management can directly influence their duties (resource and time management, cost estimating, monitoring project progress etc.), this research will prove useful in team and stakeholder management in construction projects.
3. Professional Bodies in Nigeria related to construction and engineering. This research will be especially useful to the professional bodies that implement project management methodologies in the construction industry like the Federation of Construction Industry (FOCI) and Council for the Regulation of Engineering COREN as well as the PMI Nigeria chapter.

1.4 Research Justification

The justification or reason that makes this particular topic interesting for the researcher may be summarized in three parts;

- The state of the Nigerian Economy
- The degradation of the construction sector in the county
- The researcher's academic background and interest in the earned value methodology

A study by Abubakar, Abdullahi and Bala, (2018) found that there is a need to improve the efficiency and productivity of the Nigerian construction industry. The study confirmed that the industry had the potential for driving up the growth and development of the economy.

With the continued decline of the construction sector brought about by regular project failures the researcher believes that the road to improving project execution lies in the implementation of proper project management techniques.

Having a background in civil engineering, the researcher sees this as an opportunity to gain valuable knowledge that will be instrumental in reversing the decline in the construction industry.

1.5 *Research Organization*

Chapter 1; the researcher discusses the research rationale, introduces the origin of the research, the research objectives, research question and research beneficiaries.

Chapter 2; the literature review highlights previous academic research and publications related to the topic. It helps to create a better understanding of the topic and looks at the background, knowledge areas and usefulness of earned value management.

Chapter 3; describes the methods and methodology. The approach taken to answer the research question. The researcher explores available options and chooses the most suitable data collection and analysis techniques. The chapter also explains the research philosophy, strategy and approach used.

Chapter 4; the analysis of results from semi-structured interviews and case study are presented.

Chapter 5; Discussions of results and findings from the case study and interviews. Recommendations for further study.

Chapter 6; the researcher's personal reflection on the learning process experienced through the dissertation period.

All consulted journals, texts, articles and websites cited are referenced. Supporting material are included in the appendix.

Chapter 2: Literature Review

2.1 *Introduction*

The literature review will provide an in-depth look at the core elements of this research through analysis of previous research. The literature to be examined will be related but not limited to; Earned value management analysis, concepts, implementations and challenges. The insight gathered from past research work will help in charting a course on the data collection and analysis techniques required to achieve the objectives of this research and answer the research questions.

2.2 *Background of Earned Value Management*

Earned value Management was developed between the 1950s and 60s to help with the growing complexity of military projects within the department of defense. The creation arose from a need to measure project performance reliably, and to answer the question: “what did we get for the cost we incurred?” (Griffin, 2013). In short, as stated by Abba, (2007), increasing project complexity, inadequate industrial management techniques and industry concerns led to the development of earned value management.

Of course, there was always the option of waiting until the end of the project to review deliverables and final costs. However, seeing that problems always arise throughout a project life cycle, this was not a viable idea. The stakeholders could also want a progress report at any stage of the project. Hence, it was better for the project manager to carry out performance reviews throughout the project. The confidence project management professionals have in EVM is shown

in the fact that it emerged as a tool very well suited to track project progress and cost in complex project environments and its ability to provide answers to stakeholder questions.

Since its development, EVM has helped project managers overcome the time versus budget problem that comes with every project and keep them on schedule and on budget. It has been applied to the construction, IT, defense and hospitality sectors etc.

According to Khan and Reza (2018) and (*Earned Value Management and its Significance*, 2012), EVM initially emerged as a financial analysis tool in the united states Government programs during the 60s, but has since gained significance as an effective branch of project management, cost engineering and project control. Research shows significant impact in areas such as planning & control by EVM techniques, because it provides an overall analysis and view of project performance meaning that EVM techniques can be implemented on projects of various scopes and complexity (*Earned Value Management and its Significance*, 2012).

The initial approach of monitoring called PERT (Project Evaluation and Reporting Tool) and PERT/Cost (PERT with Cost Data) were considered inconvenient and not very flexible by project managers; they began adapting variations of it into different procurement programs.

Between the 80s and early 90s, EVM became a project management technique recognized and used by managers and executives, not just by specialists. In 1989, EVM became an important part of program management and procurement in the United States. Thanks to the construction industry, the popularity of EVM grew further in the 1990s. In 1999, with the Performance Management Association merging with the Project Management Institute (PMI) to become PMI's

first college (the College of Performance Management), the use of EVM was made mandatory by the United States Office of Management and Budget in all public sector agencies.

Fostel (2011) gave a contrasting account of the history of earned value management. He stated that most literature on project management devoted little space to explaining the origins and justification for the development of the EVM technique. In his opinion this lack of knowledge on EVM has made its implementation suffer in various fronts, in other words, project managers and controllers who do not understand its importance would not cooperate with its implementation.

The conclusion was that there were no records of the first implementation of EVM in a project. However, it must have happened around the early 1950s. Since its earliest commercial implementation EVM has answered the need to manage cost risk, it permits the earliest implementation of corrective action to minimize cost risk and permits senior management to look into the future of a project to decide whether to cut losses sooner rather than later.

2.3 Earned Value Management terminologies

Earned Value Management is a methodology that combines scope, schedule, and resource measurements to assess project performance and progress ('PMBOK guide', 2017). Chen and Zhang, (2012) define Earned value management (EVM) as a project management tool that integrates the project scope of work with cost, schedule, and performance elements. According to Khan and Reza, (2018) it is a technique that finds the stage at which cost and time overrun in a project and acts as an early warning system for the project team to get back on track

with budget and schedule. While Dubey, (2015) defined it as an industry standard method of measuring a project's progress at any given point of time, forecasting its completion date and final cost, analyzing variances in the schedule and budget as the project proceeds.

Khan and Reza, (2018) went ahead to state that progress monitoring and tracking is the most important part of project management because it focuses on periodic project performance reports, which are useful for process control. This is a fact agreed on by various sources and the Practice Standard (PMI, 2012) classifies the terminology into two categories:

- the basic elements, planned value (PV), earned value (EV) and actual cost (AC),
- and the performance measures (variances, indices and forecasts).

Planned value: is the numerical reflection of budgeted work, it shows how far along project work is meant to be at any given time (PMI, p.7 2012). It measures budgeted cost of individual tasks based on assigned resources and fixed costs when scheduling (Rudresh and Shashank, 2017). It is the established baseline against which actual project progress is measured (Performance Measurement Baseline). It is also referred to as *Budgeted Cost of Work Scheduled (BCWS)*.

Earned Value: is a snapshot of work progress at a point in time. It shows the actual amount of work done to date. It is also known as *Budgeted Cost of Work Performed (BCWP)* (PMI, p.8 2012).

Actual Cost: sometimes called *Actual Cost of Work Performed (ACWP)*, is an indication of the level of resources that have been expended to achieve the actual work performed to date (PMI, p.8 2012). It is the actual amount of money spent for the corresponding planned and earned value (Khan and Reza, 2018).

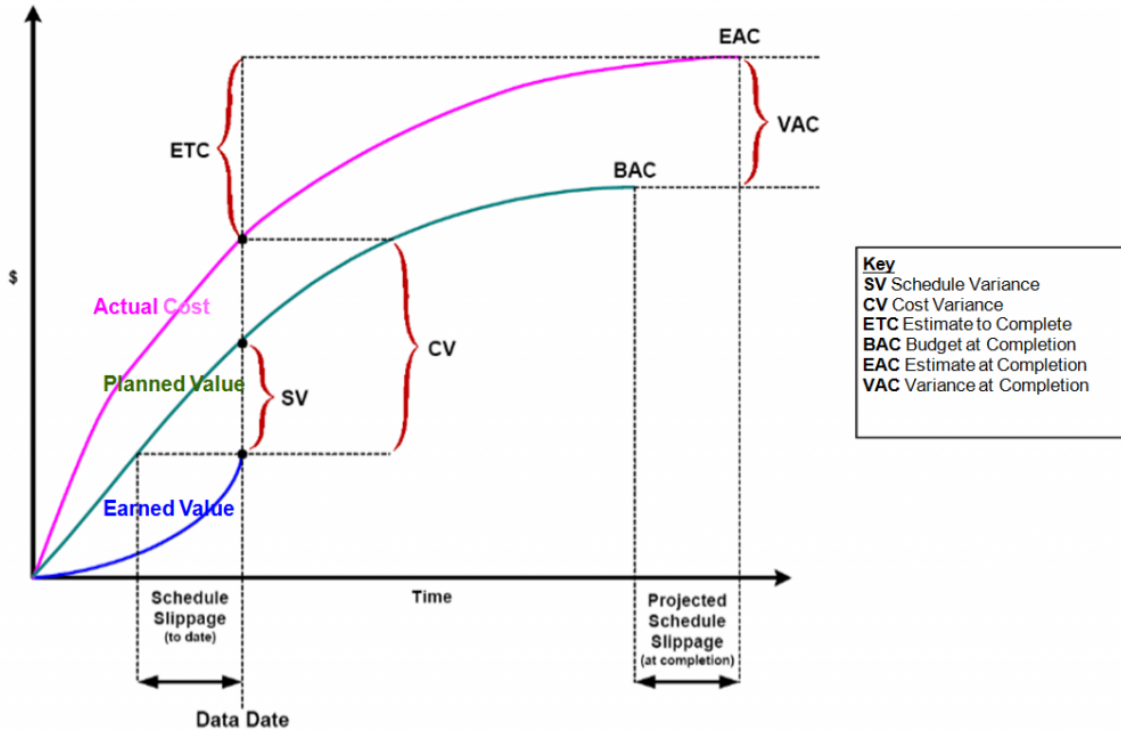


Figure 1: EVM elements

Source: <https://www.projectcontrolacademy.com/wp-content/uploads/2017/07/17-Image-768x491.png>

Variations:

Variations are typically designed in a way that they will be negative when a project is behind schedule or over budget. However, these variations can also be expressed as ratios as with the Cost performance index (CPI) and schedule performance index (SPI). These measures depend on the accuracy of completion estimates of project activities or work packages (Meredith, Shafer and Mantel, 2018).

Cost Variance: asks the question, are we over or under budget? , (CV) is a comparison of budgeted cost of work performed, EV with actual cost, AC, expressed mathematically as;

$$CV = EV - AC$$

A negative (-) cost variance means the project is over budget, while a positive (+) cost variance means that the project is progressing as planned. The CV can be expressed as a percentage by dividing the Cost Variance (CV) by the Earned Value (EV).

$$CV \% = CV / EV$$

Schedule Variance: The Schedule Variance (SV) determines whether a project is ahead of or behind schedule. It is calculated by subtracting the Planned Value (PV) from the Earned Value (EV). A positive value indicates a favorable condition and a negative value indicates an unfavorable condition (PMI, 2012).

$$SV = EV - PV$$

The Schedule Variance can be expressed as a percentage by dividing the Schedule Variance (SV) by the Planned Value (PV):

$$SV \% = SV / PV$$

Indices:

Cost performance index (CPI): indicates the cost efficiency of a project, it essentially asks the question on how effectively available resources are being used. It is determined by dividing the Earned Value (EV) by the Actual Cost (AC).

$$CPI = EV / AC$$

CPI > 1 (indicates that project is under budget)

CPI < 1 (indicates that project is over budget)

CPI = 1 (indicates that project is running on budget)

Schedule performance index (SPI): It is a measure of schedule efficiency on a project. An SPI equal to or greater than one indicates a favorable condition and a value of less than one indicates an unfavorable condition. It is the ratio between Earned Value and Planned Value.(Khan and Reza, 2018)

$$SPI = EV / PV$$

SPI > 1 (means that project is ahead schedule)

SPI < 1 (means that project is behind schedule)

SPI = 1 (means that project is on schedule)

To-Complete Performance Index (TCPI): this index helps a project team determine the efficiency that must be achieved on the remaining work for a project to meet a specified endpoint, either a specified BAC or a revised EAC. In order to achieve a specified BAC the formula is as follows.

$$TCPI = (BAC - EV) / (BAC - AC)$$

Forecasts:

Estimation at Completion (EAC): this calculates the final cost of a project, assuming current trends continue through the remainder of the project.

$$EAC = BAC / CPI$$

Time Estimate at Completion (EACt): It predicts the completion time of a Project based on its current performance. In other words, if things continue as they are, when is the work likely to finish?

$$EACt = (BAC / SPI) / (BAC / months)$$

Estimation to complete (ETC): is the estimated additional cost to complete the project at any point time of project (what the remaining work will cost)

$$ETC = (BAC - EV) / CPI$$

Or $ETC = EAC - AC$

Variance at completion (VAC): this shows whether the project will finish under or over budget, by subtracting the EAC from the BAC.

$$VAC = BAC - EAC$$

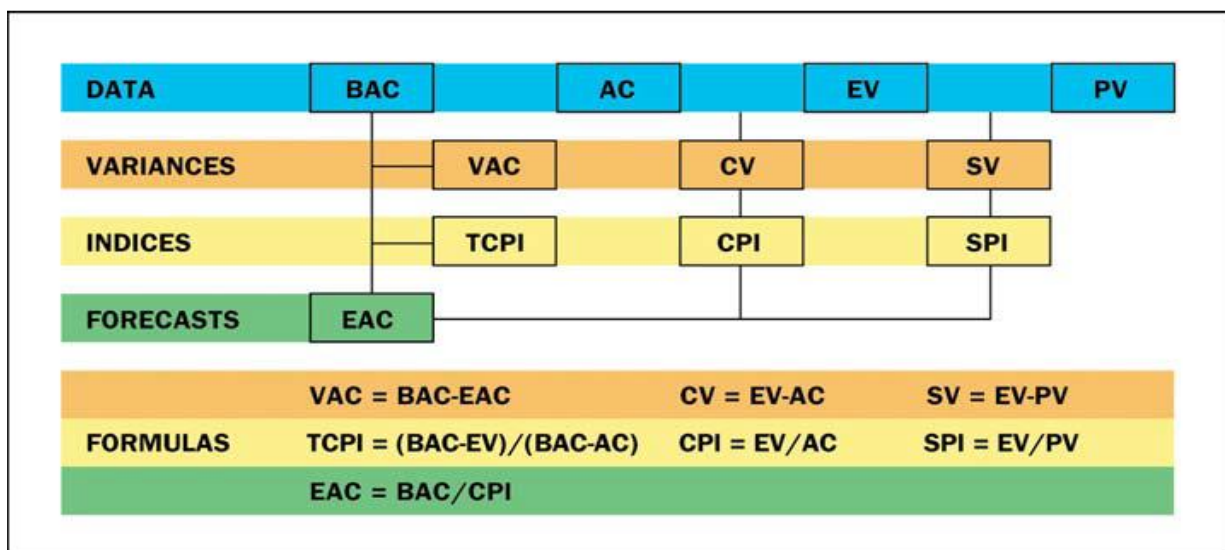


Figure 2: EVM Performance Measures

Source: (PMI, 2012)

2.4 *EVM in construction*

Different conventional methods exist for day-to-day monitoring and tracking of construction projects like review meetings, performance reviews and audit reports. These conventional approaches usually rely on two data sources, budgets and actual expenditure (Khan and Reza, 2018). However, comparison of these sources only indicate budget vs actual at any given time with no method of determining actual amount of physical work done, it neither shows what has actually been produced for the amount of money spent nor whether it is being produced at the rate, or according to the schedule, initially planned. They described EVM as a single multifunctional system that was necessary for project managers to conclude their projects successfully in any industry.

Dubey, (2015) in his research emphasizes the use of modern software like Microsoft project and oracle primavera P6 in conjunction with the EVM techniques in order to have better management over a project. He concluded that proper use of earned value management analysis and forecasting could be used to determine the actions a project manager can take to get an optimal solution to cost or time over-run. While Naik and Reddy (2016) looked at enhancing the analytical usage of EVM indices, particularly the Cost performance Index (CPI). Forming a theorem for cost efficiency, they concluded that early tracking of cost greatly reduced cost overrun without affecting overall project quality or completion time.

Although EVM concepts have been increasingly referred to and used it has seen little implementation in the building construction and transport industries as elaborated by Boydak, (2013). He believes that many construction customers are starting to recognize the effectiveness

of EVM principles in project monitoring, control and risk management. He believes that reason lies with the high-risk exposure to these projects and by adopting EVM principles, construction project participants can control risk exposure.

According to Burke, (p.313, 2013), earned value can be a very useful tool from a client's perspective due to the planning and control options it provides. For instance, it can help a client track project progress in terms of man-hours or guide against over claim (assuming a sub-contractor claims 80% of a contract value with only 50% completion of work, the client loses financial leverage)

Perhaps as suggested by Bergerud (2015) this is mainly because of the stringent and detailed standards associated with it. Earned value Management constantly suffers from the perception that it is a burden to use rather than a benefit; because of these complexities organizations are therefore not too keen on implementing EVM. Bergerud, (2013) went further to state that Although organization executives are aware of the possible benefits of EVM implementation however stories of costly, unsustainable implementation problems and ever changing government policies give them a false understanding of what it actually takes.

Some of the problems are cultural as the work from Valle and Soares (2006) explains, organizational culture brings about negative resistance from some project team members due to perceived efforts needed for implementation, without clearly seeing the benefits. From the analysis of Valle and Soares (2006), the implementation of EVM in a construction project did demand great effort in order to orient and train the related people in the project, elaborate reports, analyze consistency of results and deal with scope changes. However, the benefits were

worth it; better vision of the project in terms of scope and procurement, early alert to problems; vision of trend for some deviations, reduced time to perception and understanding of problems and solutions; motivation the project team to the project control process.

2.5 *Earned Value Analysis*

Earned value analysis (EVA). Earned value analysis uses earned value methodology to compare the performance measurement baseline to the actual schedule and cost performance. EVM integrates the scope baseline with the cost baseline and schedule baseline to form the performance measurement baseline (Burke, 2018). Contrary to project management professionals sometimes referring to EVM as EVA. Ray (2018) also gives a similar definition of EVA stating that It is a quantitative project management technique. It evaluates project performance by figuring out the likely results of the project. It does this by comparing the progress and budget of work planned to the actual costs. It allows the project manager to measure the actual amount of performed work on a project beyond just cost reviews and schedule reports (Reichel, 2006).

2.6 *Variance Analysis*

Variance analysis reviews the differences (or variance) between planned and actual performance (Burke, 2018). Variance analysis helps to review the overall variance on a project and allows for immediate action to be taken by the project team, either to correct or prevent negative performance ('PMBOK guide', 2017).

According to Gaur, (2018), Project variance analysis is an important technique that allows project teams to constantly compare planned performance with actual project data. Therefore, it aids project teams in identifying and analyzing project performance deviations. He believes that since many organizations do not use EVM for project monitoring and control, variance analysis can be an important tool for project performance analysis.

While analyzing variances may not be difficult, it requires a lot of care and discipline in data collection and interpretation. The process follows the identification of a performance baseline deviation by the project team, and then they determine the cause of the variances and assess the severity. Corrective actions will then implemented to improve project performance followed by proposal of preventive measure to avoid future occurrences.

Variance analysis is an important earned value practice used for management decision-making on projects worldwide. Attention however, should not be given only to projects that show variances, projects with zero variance should be examined closely as well. The values may have been miscalculated or manipulated and could be masking variances (AACE, 2015).

Gaur also suggests that a well-structured variance analysis should include the following aspects:

- Identification of affected key performance indicators
- Assess the smallest amount of deviation
- Estimate the degree of impact on project performance
- Identification the causes of variation
- Establishment the corrective actions
- Estimate of resources required to implement the corrective actions

- Establishment of time schedule required to implement the corrective actions
- Recommendation of preventive action

Written variance analysis reports are sometimes used by project teams to give detailed explanations for variances, analysis results and for proposing corrective actions required to mitigate or correct the variances.

According to the AACE, a Variance Analysis report (VAR) contains:

- Information on the root causes of the variance
- Identification of any corrective actions or mitigation actions required
- Identification of changes to the budget at completion (BAC), estimate at completion (EAC) or estimate to completion (ETC)
- Documentation of any management actions

The PMBOK guide (2017) lists variance analysis as one of the data analysis techniques for monitoring and controlling scope, schedule, cost and risk.

Scope Control

Scope creep – which is the tendency of the project objectives to be changed by the client, senior management or project participants without prior discussion with project team members (Meredith, Mantel and Shafer, 2016) – affects most projects. Sometimes project teams cannot control it and fail to ascertain its impact

Steps to control scope changes include the following;

- Implement change control processes

- Regular review of project scope baseline

Schedule Control

Variance analysis as a schedule control technique is also part of earned value management methodology, the Schedule Variance (SV) and Schedule Performance Index (SPI). Since many organizations do not use EVM similar techniques have been used to measure deviations in schedule. For example, project teams may measure variations in planned start and finish dates then propose corrective actions through their analysis.

Cost Control

As far as cost control is concerned organizations have not made full use of the EVM methodologies available (Cost Variance and Variance at Completion) to determine cost variances. However, these organizations usually implement procedures that track actual cost booked on work packages or on various project activities (Gaur, 2018).

Risk Control

Project risk analysis relies on data obtained from variance analysis of scope, schedule, and costs. This not only allows project teams to set risk thresholds but also compare with existing ones. If risk variances exceed the desired threshold then project risk mitigation plans come into effect (Gaur, 2018).

Causes of Variance in Projects

Projects are unique and constantly evolving, therefore changes during a project life cycle are inevitable. Successful completion of a project requires managing these changes.

Some factors that may bring about variances in project performance include:

- Changes in project scope
- Modifications to client's requirements
- Market factors such as changes in raw material prices and exchange rate variations.
- Changing business needs
- Wrong activity duration estimates.

2.7 *Trend Analysis*

Trend analysis is used to forecast future performance based on past results (Burke, 2018).

Trend analysis provides an early warning system and allows managers to take corrective action.

In essence, trend analysis provides a glimpse into the future of a project in an attempt to identify performance dips – assuming all activities remain the same – and warns the project manager ahead of time. Results of trend analysis can be used to recommend preventive actions if necessary. Trend analysis information is often available early in the project life cycle allowing time for corrective measures to be put in place, however, its use is sometimes restricted to long-term projects because of the time needed to correct the situation. ('Trend Analysis [Technique] - Project Management Knowledge', 2018)

In many ways, the graphical aspects of trend analysis are valuable for understanding to-date performance and in comparing future performance goals in the form of Budget at Completion (BAC) vs Estimate at Completion (EAC). It also comes in handy in cost, schedule and

resource control. During the project life cycle, the project team can use trend analysis to determine required resources for upcoming stages of the project.

Examples of some trend analysis techniques include:

EV Charts: the three basic parameters for earned value analysis – planned value (PV), earned value (EV) and actual cost (AC) – can be monitored and reported periodically (weekly or monthly) and on a cumulative basis using S-curves to display earned value data for a project performing over/under budget and behind or ahead of schedule.

Forecasting: When forecasting in EVM, the basic assumption is that all current conditions and performance as determined using the performance indices regarding a project will remain the same. These conditions are used to predict the final duration and cost of the project. Applying different methods to determine completion time estimates $EAC(t)$ and completion cost estimates EAC offer a range of possibilities. The choice of a specific forecasting method depends on the project, the expertise of the project manager and many other unknown factors (Vanhoucke, 2011)

“Forecasting in project management may well be a self-defeating prophecy” (Anbari, 2001). Management may sometimes show greater interest in dealing with large deviations, as opposed to smaller ones that may be considered insignificant. EVM helps keep focus on the activities or work packages that need most attention by quantifying the deviations, thus improving decision-making efficiency.

Forecasting using EV

$EAC1 = AC + (BAC - EV)$. Most Optimistic EAC.

$EAC2 = BAC / CPI$ Most Likely EAC (as shown earlier)

$EAC3 = AC + \{(BAC - EV) / (CPI \times SPI)\}$ or $= BAC / (CPI \times SPI)$. Most Pessimistic EAC

2.8 *EVM as a cost control tool*

The usual query from management and Clients mostly concern project status and progress, some clients may not be interested in daily reports however, would rather prefer to visualize money spent for amount of work done or completed so far. In the past, project managers used to have two parameters: planned and actual expenditure (Usmani, 2019). This information was always incomplete because it only compared how much was planned and how much has been spent to date. It did not provide any idea about completed work and was incapable of relating amount spent with completed work. EVM provides the parameters necessary for cost performance of a project to be determined successfully.

2.9 *Benefits and Limitations of EVM*

2.91 Limitations.

Earned value management is a technique that gives project managers a fair amount of control over project performance; however, EVM cannot solve every problem. According to the PMI, EVM is not a magic bullet that always works and it does have some flaws.

According to Ray (2018), since EVM simply calculates from one data point it cannot be exclusively relied on and earned value on a project can change rapidly.

When it comes to quality of a project and customer satisfaction, there is no way of monitoring them using EVM. Though schedule and budget are tracked, it takes more than those for a project to be completed successfully. If a customer is unsatisfied or project quality is poor, schedule and budget target achievement means little. When reporting the numbers to stakeholders or customers, providing a context to the values is also important for their understanding. Being able to effectively communicate EVM is as important as being able to do the analysis (Ray, 2018).

EVM calculations heavily rely on accuracy of data. If data inputted does not reflect reality, the analysis results will not truly reflect the project performance. This can mislead management and can cause performance to suffer. Using software does not ensure genuine results either because critical data can be omitted during input.

EVM does not provide solutions to variances. Though the earned value metrics can reveal the existence of a variance and show where the variance is located, it does not provide corrective action. It is up to the project team to determine the cause and solution to the variance.

Earned value data can be manipulated. When reports show unfavorable conditions, project team members may alter the data to make the results more favorable. To avoid this, it is usually better to create an environment that encourages reporting unfavorable or poor performance as early as possible to allow adequate planning of corrective measures (Griffin, 2013)

Earned value Analysis may be required at different stages of a project because uncertainties may occur anytime (Khan and Reza, 2018).

2.92 *Benefits*

Some of the benefits provided by the application of EVM include; better decision making in business, improved products and services to customers by understanding their needs and giving them due priority accordingly. Enhanced competitiveness by facilitating technical and organizational innovation. Improved internal communication and knowledge of the critical success factors of the organization (Oke and Ogunsemi 2011).

It provides an early warning system using the cost performance (CPI) and schedule performance index (SPI) for project managers, allowing preemptive actions to keep a project on track (Gasparotti, Raileanu and Rusu, 2017).

Value Analysis can be done at any point to ensure the project is kept on track, and is the only method which tracks project work in terms of progress, duration and cost (Khan and Reza, 2018). Regular performance measurements using EVM ensures that a project is always kept on schedule.

EVM also provides other benefits for contractors and customers such as, providing consistent and clear communication of progress at all management levels; improving project visibility and accountability; enabling accurate reporting of cost and schedule impacts of known issues; improvement of the planning process and encourages a clear definition of the project scope (Humphreys, 2012).

2.10 EVM Practices in developing countries

With all the know benefits from the application of Earned Value Management, it has yet to be widely applied in modern day projects in developing countries and sub-Saharan Africa as a whole. Though the need is evident with the amount of abandoned projects in the region, use of EVM still depends largely on the project management professionals.

Oke and Ogunsemi (2011), in their research found that the poor adoption of EVM in Nigeria can be attributed to inadequate knowledge of Earned Value Management, government policy, unstable economy etc. The involvement of professionals in most cases ends at the pre-contract stage, one of many reasons being the belief of the client that the contractor is well equipped to carry on without the consultants. The project stakeholders' limited experience in the construction management field, fixed contract prices, scope changes, costs incurred from implementation of the control technique and variances occurring during the construction stage were discussed by Mahdi *et al.* (2018) as contributors in preventing the implementation of EVM as a control technique.

Some of the barriers hindering EVM use in other developing countries include issues like lack of properly trained personnel, lack of support from upper management, among others listed below along with suggested remedies (Edjenekpo, 2017):

Table 1: EVM challenges & remedies in developing countries

Challenge	Aspect	Remedies suggested
lack of support from management	<ul style="list-style-type: none"> • Poor EVM acceptance by PMs • Inability to show benefits of EVM to management • Lack of executive understanding 	<ul style="list-style-type: none"> • Show usage success by measuring & reporting progress on a pilot project • Conducting executive training • Bonuses tied to successful use of EVM.
lack of qualified or properly trained personnel	<ul style="list-style-type: none"> • Lack of qualified personnel to implement EVM • Unmotivated employees • Unavailability of qualified people when needed 	<ul style="list-style-type: none"> • Training internal candidates • Augmenting available staff • Recruitments
Long reporting time	<ul style="list-style-type: none"> • Reporting takes more time than performance measuring. • Too many reports 	<ul style="list-style-type: none"> • Standardize reports • Automate reporting where possible
Inconsistency across programs	<ul style="list-style-type: none"> • Different approaches by different divisions • No compliance with process from team members 	<ul style="list-style-type: none"> • Standardize processes and communicate across teams • Gain management support • Use standard tools

Chapter 3: Methodology and Methods

3.1 *Introduction*

This chapter will focus on the research methodology, which Saunders, Lewis and Thornhill (p.595, 2009) described as the theory of how research should be undertaken, including the theoretical and philosophical assumptions upon which research is based and the implications of these for the method or methods adopted. Techniques and other procedures for the purpose of this research will be listed and explained as well as other relevant data analysis methods used. The chapter will help the researcher understand the methodologies available and the main criteria in choosing between them, these include research design, sample selection, data collection and analysis. It is also necessary to clarify the difference between methods and methodology, the former as earlier explained focuses on theoretical and philosophical assumptions that guide research procedures, the latter involves techniques and procedures like questionnaires, interviews used to collect and analyze data.

As a guideline for the research methodology, the “research onion” – a method used in analyzing and choosing data collection methods through a series of layers (Saunders, Lewis and Thornhill, p.136, 2009) – will be used. Starting from the outermost layers, research philosophy and research approach, then moving on to discuss and consider options from the next layers, research strategy, choices, time horizons and data collection techniques and analysis procedures.

3.2 *Research Design*

The research design is about the structure or overall plan that will help answer the research question (Tharenou, Donohue and Cooper, 2007). It refers to the overall strategy chosen to integrate different parts of the research to make it more structured and coherent, this allows the researcher to effectively address the research question; it also forms the background for data collection and analysis (Labaree, 2019). According to Dudovskiy, (2019) research design can be divided into exploratory and conclusive. While exploratory research aims to explore specific aspects of the research area, conclusive research design is applied to generate findings that are useful in reaching conclusions or making decisions.

Conclusive research design can be broken into two, descriptive, which describes specific elements, causes or phenomena, and casual (or explanatory) research design, which is conducted to study cause-and-effect relationships.

The research design chosen for this study is descriptive. The reason for this choice is that descriptive research is useful when attempting to shed light on a current problem through a process of data collection such as case studies or surveys that allows the situation to be described completely. (Dudovskiy, 2019)

Some advantages of descriptive design include its effectiveness when analyzing non-quantified issues and the opportunity to integrate qualitative and quantitative data collection methods.

3.2.1 Research Philosophy

Research philosophy is a term that relates to the development of knowledge in a particular field and the nature of that knowledge (Saunders, Lewis and Thornhill, 2009). In other words, it deals with how data about a phenomenon is collected, its source, analysis and how it is used. In a sense, this research work will create knowledge by collecting and analyzing data relative to the research question. However, the philosophies chosen for this research will reflect the way the researcher views the world.

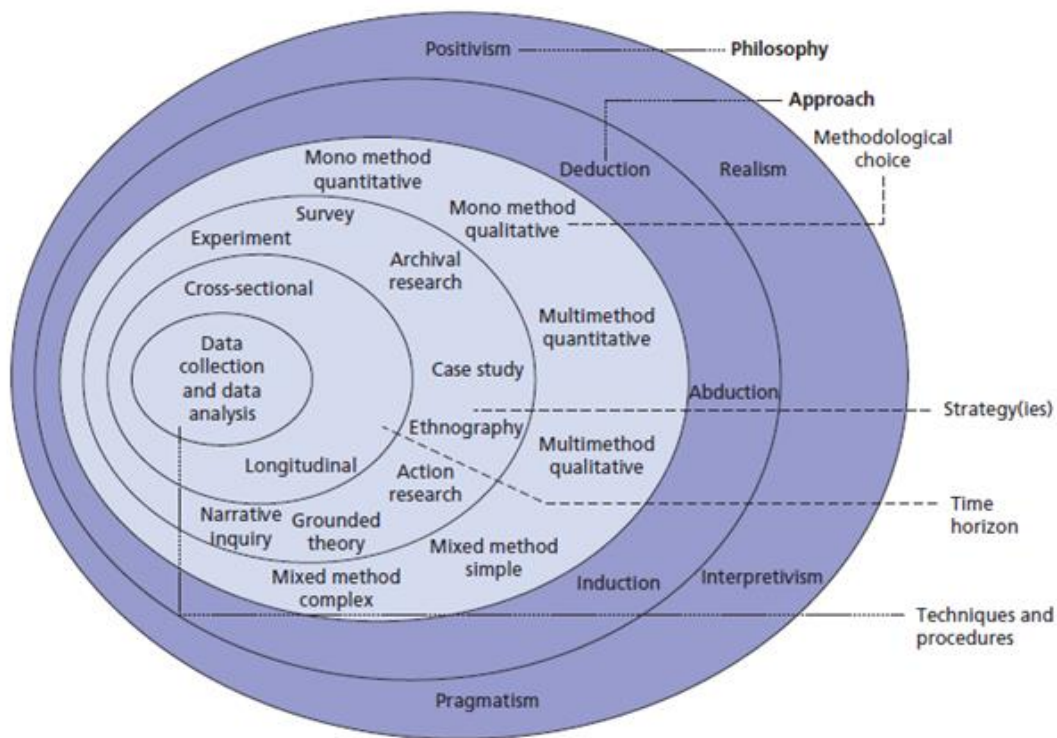


Figure 3: Research philosophy in the 'research onion'

As shown in the figure above, each stage of the research process is based on assumptions regarding the nature and sources of knowledge (Dudovskiy, 2019). The researcher's assumptions are reflected in the chosen research philosophies and will serve as a foundation for the research

strategy. Four main branches of research philosophy that will be of interest will be positivism, pragmatism, realism and interpretivism.

The type of research will influence the choice of philosophy, for instance, philosophical differences exist between studies that focus on facts and figures like the analysis of the effect of student immigration on the population of Ireland and a study of cultural effects on managerial styles.

Positivism: is defined by Saunders, Lewis and Thornhill, (p.598, 2009) as the epistemological position that advocates working with an observable social reality. It holds a point of view that only facts gained through observation is trustworthy and the researcher is involved in only data collection and analysis in an objective way, akin to natural scientists.

Interpretivism: this is the epistemological position that advocates the necessity to understand differences between humans in their role as social actors (Saunders, Lewis and Thornhill, p.593, 2009). It integrates the human interest into the research.

Pragmatism: this view argues that it is possible to use both approaches from positivist and interpretivist positions; hence, it applies an integration of different perspectives in collection and interpretation of data. The philosophy argues that the research question is the most important factor for determining a research philosophy.

Realism: realism is the epistemological position that objects exist independently of our knowledge of their existence. It is based on the assumption of a scientific approach to knowledge development.

The philosophy that most suits this research would be the interpretivism or interpretivist philosophy, since the research question – “•Can EVM be a useful tool in reducing construction project constraints in Nigeria?” – focuses on human action, inactions and interests. Arguments around conducting research in the social world, particularly concerning organizational behavior suggests that it is quite different from research regarding objects and that the human element is a key factor in the research. There must be interaction between the researcher and the subjects in order to understand the world from their point of view (Saunders, Lewis and Thornhill, 2009).

Interpretivism (interpretivist) Research Philosophy

According to Dudovskiy, (2019), Interpretivism (also known as interpretivist), involves researchers to interpret elements of the study, thus interpretivism integrates human interest into a study. This therefore suggest that, interpretive researchers access to reality can only be achieved through social means for example language, consciousness, shared meanings, and instruments. Dudovskiy went on to state that the interpretivist philosophy came about as a critique of positivism in social sciences, it emphasizes qualitative analysis over quantitative analysis.

Collins, (2010) states that “Interpretivism is associated with the philosophical position of idealism, and is used to group together diverse approaches, including social constructivism, phenomenology and hermeneutics; approaches that reject the objectivist view that meaning resides within the world independently of consciousness”. For the interpretivist approach there is a need for the researcher to appreciate differences between people, this is evident in the focus

of interpretivism studies on meaning and it may use multiple methods to reflect different aspects of the issue (Dudovskiy, 2019).

The interpretivist philosophy is based on the naturalistic data collection approaches like interviews and observations. The answers and meanings sought usually emerge at the end of the research process. The interpretivist philosophy also make use of secondary data research.

Some important variations of interpretivism include:

- **Hermeneutics:** this refers to the philosophy of understanding and interpretation. It mainly focuses on biblical texts and wisdom literature, therefore business research has little need of it.
- **Phenomenology:** defined as “the philosophical tradition that seeks to understand the world through directly experiencing the phenomena” (Dudovskiy, 2019).
- **Symbolic interactionism:** According to Dudovskiy, “this accepts symbols as culturally derived social objects having shared meanings”. In other words, symbols provide the means by which reality is built.

According to Dudovskiy (2019), the interpretivist philosophy is based on the following beliefs:

The Relativist ontology, which perceives reality as intersubjective, that is based on meanings and understandings on social and experiential levels and the **Transactional or subjectivist epistemology;** which holds the idea that people cannot be separated from their knowledge, that is to say there is a clear link between the researcher and research subject.

Differences between positivism and interpretivism as listed by Dudovskiy (2019):

Table 2: Differences between positivism and interpretivism

Assumptions	Positivism	Interpretivism
<i>Nature of reality</i>	Objective, tangible, single	Socially constructed, multiple
<i>Goal of research</i>	Explanation, strong prediction	Understanding, weak prediction
<i>Focus of interest</i>	What is general, average and representative	What is specific, unique, and deviant
<i>Knowledge generated</i>	Laws: Absolute (time, context, and value free)	Meanings: Relative (time, context, culture, value bound)
<i>Subject/Researcher relationship</i>	Rigid separation	Interactive, cooperative, participative
<i>Desired information</i>	How many people think and do a specific thing, or have a specific problem	What some people think and do, what kind of problems they are confronted with, and how they deal with them

Advantages and Disadvantages of Interpretivism

Because of the adoption of interpretivism, in-depth studies of qualitative research areas such as cross-cultural differences in organizations, issues of ethics, leadership and analysis of factors impacting leadership among others has become possible. The validity of primary data acquired through interpretivist research is of in high standards because the data in the studies are trustworthy.

Disadvantages of interpretivism usually relates to its subjective nature and possibility of bias on behalf of researcher. Due to the possible influence of personal opinion and values, primary data generated cannot be generalized; this also means reliability of the data is compromised to a certain extent.

3.2.2 Research Approach

For this research, the inductive and deductive approaches are considered prior to choosing a suitable one. The deduction approach involves testing theories, which is why it is a dominant approach for natural science research but not uncommon in social sciences. A deductive approach would involve deducing a hypothesis from a theory, testing the hypothesis and finally accepting or rejecting the results.

An induction is the alternative approach to deduction, it starts with observations and testing, and then towards the end theories are proposed because of the observations. It usually involves collecting data on research subject through interviews and then analyzing the data to make sense of the situation, the result would then be formulating a theory (Saunders, Lewis and Thornhill, 2009).

Some differences between deduction and induction.

Table 3: differences between deduction and induction

Deduction	Induction
The researcher is independent of the research	The researcher is part of the research
Deals with collection of quantitative data	Collection of qualitative data (interviews)
Highly structured	Flexible to allow changes as research progresses

For this research, the **inductive** approach will be used; this is because there is no hypothesis and would require conducting interview to get a general overview of the situation involving the implementation of earned value management in the construction industry. The sample size of subjects to be studied will be relatively small compared to requirements for a deductive approach.

Inductive Approach

The inductive approach (or Inductive reasoning), begins with observations, from these observations the theories are proposed towards the end of the research process (Dudovskiy, 2019). It involves the search for patterns through observation and development of theories; a hypothesis would not be required at the beginning of the research. The researcher is therefore free to choose the direction of the study once the research process starts.

According to Dudovskiy, adopting the inductive approach does not mean disregarding theories when establishing research questions and objectives. The approach rather aims to create meanings from the collected data for identifying patterns and relationships for theory building. The inductive approach does not prevent the use of existing theory to form a research question. This approach relies on experience; by observing patterns and regularities, conclusions can be reached.

The inductive approach starts with observation of the world around the researcher, moving towards abstract generalizations and ideas (Dudovskiy, 2019). Starting with the topic, the researcher develops empirical generalizations, identifying preliminary relationships while progressing through the research. There are no hypothesis found at the early stages of the research, and the researcher may not be certain about the type and nature of the findings until the research is complete.

As shown in the figure below, inductive approach is sometimes referred to as a “bottom-up” approach to knowing, in which the researcher uses observations to build an abstraction or to

describe a picture of the phenomenon that is being studied (Lodico et al (2010) cited in Dudovskiy, 2019).

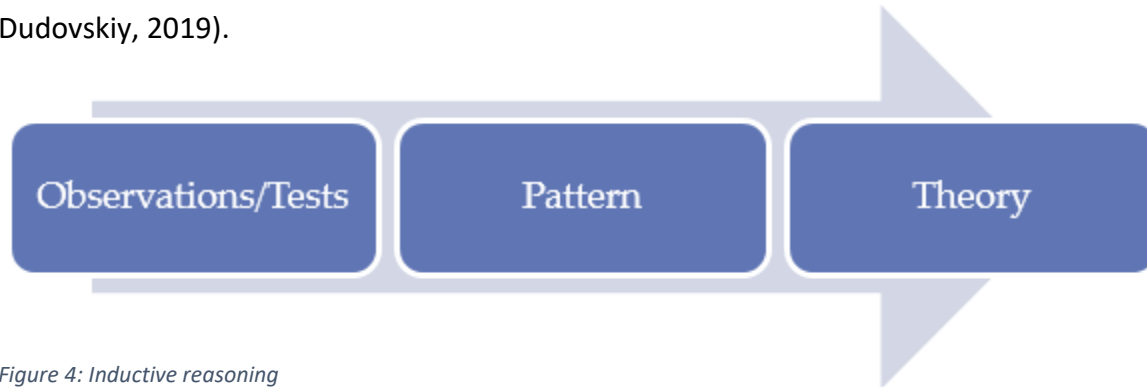


Figure 4: Inductive reasoning

Source: <https://research-methodology.net/wp-content/uploads/2013/07/Inductive-approach-inductive-reasoning1.png>

3.2.3 Research Strategy

Methodical Choices

Qualitative and quantitative are terms used to differentiate data collection techniques and analysis procedures in research. In simple terms qualitative can be likened to techniques and procedures involving non-numeric data while quantitative is to numbers or numeric data. Examples of these would be questionnaires and analytical processes involving statistical data or graphs, interviews would be a good example of a qualitative data collection technique.

Choosing a research method therefore may be a little complicated because qualitative and quantitative data collection techniques as well as analysis procedures can be used separately or combined, the various choices are as follows;

Mono method: involves using a single data collection technique – either qualitative or quantitative – and a corresponding data analysis procedure.

Multiple methods: using more than one data collection technique and analysis procedure. This is further sub-divided into two categories shown in the table below.

Table 4: research methods

Multi-method	Multi-method quantitative studies	Using quantitative data collection techniques and analyzing with quantitative procedures
	Multi-method qualitative studies	Using qualitative data collection techniques and analyzing with qualitative procedures
Mixed-methods	Mixed-method research	Quantitative and qualitative data collection techniques and analysis procedures are used at either the same time or sequentially, however the analysis is not combined.
	Mixed-model research	Data collection techniques and analysis procedures can be combined at any stage.

This research will make use of the mixed-method design that combines data collection techniques because it will involve the use of interviews and for the purpose of triangulation, that is, to get a clear picture of the research question.

Strategies

Saunders, Lewis and Thornhill (p.600, 2009) defines research strategy General plan of how the researcher will go about answering the research question(s). It is important to adopt a research strategy based on the chosen research approach. Below are research strategies with the methodological approach they are based on.

Inductive approach strategies

Ethnography: Research strategy that focuses upon describing and interpreting the social world through firsthand field study (Saunders, Lewis and Thornhill, 2009). This is a time consuming strategy and is avoided by studies from a business perspective (Datt and Chetty, 2016).

Action Research: Research strategy concerned with the management of a change and involving close collaboration between practitioners and researchers. It is based on four themes; first is the purpose of research, second the role of researcher within the research study, third the process of diagnosing, planning and taking action and fourth is an indication that action research results should inform other contexts (Saunders, Lewis and Thornhill, 2009).

Archival research: this research uses administrative records and documents as its source of data, the data collected can be recent or historical. These data are collected for different purposes and result from day to day activities.

Deductive approach strategies

Experiment: this strategy first applied to natural sciences involves the definition of a theoretical hypothesis; selection of samples of individuals from known populations; allocation of samples to different experimental conditions; introduction of planned change on one or more of the variables; and measurement on a small number of variables and control of other variables (Saunders, Lewis and Thornhill, 2009).

Survey: this involves collection of structured data from a large target group or population; the data can be analyzed using descriptive and inferential analysis tools. This is a method well adopted in studies relating to business and management. The term can often be mistaken for a method of data collection however; it encompasses structured interviews and observations.

Mixed approach strategies

Case Study: this strategy is an opposite of the experimental strategy and it involves using empirical investigations to study contemporary phenomenon using multiple sources of evidence (Saunders, Lewis and Thornhill, 2009). A case study is a suitable way to gain in-depth insight on a research context.

Grounded theory: a strategy used to explain and predict a behavior; it is the best example of a mixed approach with emphasis on theory building. New theories are generated on the basis of a theoretical framework (Datt and Chetty, 2016).

A research strategy allows the researcher to answer those questions that shape the flow of the study. The choice of research strategy is dependent on the objectives of the research or study at hand, it is important to take into account the availability of time and existing knowledge in the research area.

The choice of research strategy for this research is case studies. The case study is usually suitable for analyzing specific issues within the boundaries of a specific situation or organization. The case study has the versatility needed to generate answers for the research question, it is an ideal strategy for both explanatory and exploratory research and it allows for a combination of data collection techniques like interviews and questionnaires. As mentioned earlier, there will be a need for triangulation the multiple data source - Triangulation refers to the use of different data collection techniques within one study in order to ensure that the data are telling you what you think they are telling you (Saunders, Lewis and Thornhill, 2009).

Additional information on the research strategy is that the case study dimension will be single case and embedded, meaning that an organization will be used as a single case study and because the interviews will involve more than one sub-unit (project managers and members of a project team) it is classified as embedded.

3.3 Sampling - Selecting Respondents

Sampling is a practical way of studying people and their activities, thoughts attitudes, abilities, relationships etc. in relation to business (Greener, 2008). According to Dudovskiy, (2019), sampling can be described as a specific principle used in selecting members of a population to include in a research. However, researchers can only choose a portion to represent a larger population for study.

Sampling provides some advantages to research studies. With sampling researches of any size can be managed with more accurate results, the data collection and processing can be done quickly and efficiently and it saves costs for the researchers.

The process of sampling (for primary data collection) can be explained as follows:

- **Defining target population:** this refers to a specific group within a wider population that are best suited to be the main data source of the study or research.
- **Choosing sampling frame:** choosing from the target population a list or group of people that can contribute to the research.
- **Determining sampling size:** from the sampling frame, individuals that will take part in the data collection process, while taking into account that;

- i. Sampling error can be reduced by increasing sample size
- ii. A larger sample size is needed for survey-based research than in experimental research
- iii. Availability of subject and cost factors are crucial when choosing sample size

- **Selecting and applying a sampling method.**

Types of sampling

Probability sampling: sampling techniques where each population member has a known chance of taking part in the study. They include simple, stratified systematic, multistage, and cluster sampling methods (Dudovskiy, 2019).

Non-probability Sampling: In this case, the sample population members are not selected randomly. Therefore, not everyone has a chance at participation. They include purposive, quota, convenience and snowball sampling methods.

As described by Saunders, Lewis and Thornhill (p.212, 2009) the population represents the full set of cases from which the sample is taken. In this case, the population is made up of construction management professionals. For ease of access, the sample will then consider construction managers in construction firms in Nigeria.

The sample technique will be a non-probability sampling, and will have a minimum of 5 to 12 participants for the interviews.

The focus will particularly be on relevant individuals within the selected company who can influence the activities of a project from initiation to completion, these include; the Project

manager(s), assistant project manager(s), the project team and one member of the company's top management.

3.4 Data Collection

Data collection is a process that involves collecting information from all sources relevant to a research in order to answer the research questions, test hypothesis and evaluate outcomes (Dudovskiy, 2019). Data collection methods can be divided into primary methods of data collection and secondary methods of data collection.

Primary Data Collection Methods

Primary data collection methods can be divided into quantitative and qualitative.

Quantitative data collection methods involve various forms of mathematical calculations. The methods include questionnaires with closed-ended questions, methods of correlation and regression, mean, mode and median etc. quantitative methods are cheaper than qualitative methods, require a shorter duration of time to apply and comparison of findings is easier.

Qualitative data collection methods are not numerical and do not require mathematical calculations, being closely associated with non-quantifiable elements like emotions and feelings. Qualitative research is concerned with providing more depth of understanding. Qualitative data collection methods include interviews, questionnaires with open-ended questions, focus groups, observation, game or role-playing, case studies etc. (Dudovskiy, 2019)

Secondary Data Collection Methods

Secondary data refers to data published in journals, books, websites etc. Since abundance of data is available in the mentioned medium, it is important to apply appropriate criteria when selecting secondary data to be used in a research. This will help ensure a high level of validity and reliability of the data. Such criteria include; publication dates, source reliability, author's credentials, depth of analysis and extent of contribution of the text to the development of the research area.

For the primary data collection method, qualitative methods: interview and case study will be used. The qualitative method to be used will be semi structured interviews with the project management team, as in the literature reviewed from the case of Wei (2016) and Kim, Wells and Duffey, (2003), the interviews will provide current information on implementation and usage challenges with earned value management. Other relevant data, which include cost and schedule data of a real project under progress, will be collected through case study and will be used for analysis as was done by Rudresh and Shashank (2017).

The semi-structured interview to be used will have properties of both structured and unstructured interviews. The researcher has prepared a set of questions that all respondents will be able to answer but at the same time are not close ended questions, allowing the respondents to explain their answers in detail. Additional questions may also be asked by the researcher in order to clarify certain points.

Advantages and disadvantages of interviews

Advantages include the chance to gather detailed information concerning the research questions, control over the flow of the interview process, and chance to clarify issues

immediately if necessary. Disadvantages such as long time requirements involved in preparation for the interviews and difficulty making changes to a set date and time once the respondents have agreed. There is also a risk of interviewee bias that can compromise the data collection process and the results.

According to Dudovskiy (2019), it is important to keep an open mind and avoid showing disagreement with conflicting opinions and ideas from the respondents. The timing and location need to be agreed on ahead of time; ideally, the interviews should be held in a relaxed environment that is free of pressure for the interviewee.

An introductory mail will be sent to the interviewees to create a non-threatening atmosphere; this will be followed by a summary of the research and a participation consent form. Details of the consent form will be covered in the research ethics section.

For the case study, the aim is to analyze the viability of Earned Value Management as a performance measuring and forecasting tool within the construction industry in Nigeria. However, case studies in business are categorized into three: explanatory, descriptive and exploratory, this research will make use of exploratory case study.

Exploratory case studies focus on the 'what' or 'who' and are usually accompanied by additional data collection methods (Dudovskiy, 2019), in this case semi-structured interviews.

Advantages and disadvantages of case studies

Advantages include the integration of quantitative and qualitative data in the analysis process, ability to capture data from real life situations and study them in great depth. Some of

its disadvantages include very little basis for generalization of findings and conclusion as well as, data analysis challenges.

3.5 *Data Analysis*

Analyzing qualitative data obtained from interviews, focus groups and experiments usually involves identifying patterns with the individual responses and analyzing them in order to achieve the objectives and aims of the research. For quantitative data, analysis involves interpretation of numerical values in an attempt to rationalize the main findings. In both cases, comparing primary research data with the literature review or secondary data is necessary.

Qualitative Data Analysis can be divided into five categories as follows:

- Content analysis: this process is for categorizing verbal and behavioral data; summarizing, classifying and tabulating the data.
- Narrative analysis: this method is used to preserve the integrity and narrative value of data collected. It is a revision of primary qualitative data by the researcher.
- Discourse analysis: this involves naturally occurring talk and all forms of written text.
- Framework analysis: this is an advanced method involving various stages; familiarization, Identifying themes, patterns and relationships, coding, charting, mapping and interpretation.
- Grounded theory: this method begins with a case analysis in order to form a theory, followed with examination of other cases to confirm if they contribute to the theory.

Quantitative Data Analysis

As explained earlier, turning numerical values into meaningful data through application of critical thinking is expected in quantitative data analysis. The analysis may involve calculation of frequencies of variables and differences between variables. Quantitative data analysis also involves finding evidence to support or reject a hypothesis formed earlier in the research process. Since data can be interpreted in many ways, careful judgment is often required (Dudovskiy, 2019)

Case Study analysis

Following the collection of cost and schedule data of a real project in progress, earned value analysis will be carried out to determine the future of the project on cost and timeline. The procedure will be carried out as follows:

- Collection of project cost and schedule data through interviews
- Creating and developing a Work Breakdown Structure
- Tracking the progress and establishing a performance measurement baseline
- Run the EVA on chosen dates
- Generate reports for the EVA

Microsoft Project 2016

Microsoft Project is a project management software created and marketed by Microsoft designed for use by project management professionals, students and others interested in project management. It helps a project team complete tasks such as resource allocation, budget management and progress monitoring (Rudresh and Shashank, 2017). The version used for this research is MS Project Professional 2016. The basic steps used to carry out the procedures listed above on MS project include:

1. Creating and initiation project
2. Creating project calendar
3. Entering task and its relationships
4. Defining work breakdown structure
5. Assign resources, its analysis and levelling
6. Progress Tracking
7. Earned value analysis
8. Report generation

Semi structured interview analysis

The interviews will be analyzed using a summarized content analysis. The objective in content analysis is to systematically transform a large amount of transcribed interview text into a highly organized and concise summary of key results (Erlingsson and Brysiewicz, 2017). The main aim will be to provide answers for the research questions.

3.6 Research Ethics

Research ethics according to Saunders, Lewis and Thornhill, (p.183 2009) is the appropriateness of the researcher's behaviour in relation to the rights of those who become the subject of or are affected by the research. Bell, Bryman and Harley, (2019) listed some points to show some of the important principles concerning ethical considerations:

- Participants of the research must not be exposed to harm
- Their dignity must be respected
- Consent must be obtained and anonymity of individuals or organisations ensured

- Appropriate level of confidentiality must be maintained
- All communication concerning the research must be done transparently.

Research ethics vary based on the research topic and they can have significant implications on gaining access to people, resources and organisations. For this reason, the ethical issues that may arise from this research have been reflected on and considerations have been made.

Possible ethical issues

- Interview data leak
- Invasion of privacy
- Conflict of interest
- Breach of trust
- No top management approval
- Failure to follow DBS guidelines

Ethical considerations

1. All information obtained will be kept confidential. The data obtained from the participants will be used in the earned value analysis only and the results used for the research. The participants personal information will not published in the research.
2. Research will be conducted in accordance with DBS ethical guidelines for research
3. Research will follow DBS ethics review process
4. Administration of consent form to interview participants; the participants will receive a consent form for their endorsement, the form will contain details of their participation

requirements and confidentiality assurances. It will provide a summary of the research as well. See appendix b for a sample of the consent form.

3.7 *Limitations of Methodology*

Limitations

- Lack of previous knowledge in the research area presented a challenge as well as lack of experience with business and management related research.
- Scope of discussions; as a first time researcher and scholar in this field it was challenging writing in such volume about various aspects of this research.
- Very limited previous research done on EVM in Nigeria and Africa
- Time constraints

Some efforts to overcome the limitations

- Some limitations were mitigated by choosing a research that directly relates to previous academic and professional experience in construction, which provided some ease in studying and understanding previous literature.
- Time management; the researcher started early to seek out the participants for the interviews and case study. This was done to allow the research process to be completed within the allocated time.
- Meeting with supervisor; regular meetings with the research supervisor will allow the researcher to overcome challenges related to project management and earned value management.

Chapter 4: Analysis & Findings

4.1 Introduction

This chapter discusses all information obtained from interviews and case study analysis as well as secondary data. Data analyzed from interviews will not be referenced, however the secondary data obtained from other academic sources will be referenced.

The case study analysis will be carried out with the aid of Microsoft Project professional 2016 while the data obtained from the semi-structured interviews will be analyzed using content analysis (summary) method.

4.2 Semi-Structured Interviews Findings

Six interviews were conducted with participants who were all construction management professionals with varying degree of knowledge and experience in the field. The chosen participants had an average work experience of 6.8 years and were all corporate members of their respective professional bodies. The interviews were analyzed and summarized. The responses from the participants were categorized in relation to the research question and explored further using secondary research data.

Table 5: characteristics of participants

S/N	Professional Role	Number of participants	Experience	Organization designation
1	Civil Engineers	3	7-10 years	Construction manager, Structural Engineer
2	Architects	2	7-10 years	Construction Manager, Project Architect
3	Quantity Surveyors	1	10 years	Construction manager, Quantity Surveyor

Knowledge of Earned Value Management methodology

The respondents were evenly split on their knowledge and understanding of Earned Value Management. While the methodology was a new term for 50% of the participants and was not part of the project management techniques currently used by their organization, the other half of the interviewees were familiar with the methodology. Those familiar with it had different reasons on its limited or lack of use in the industry, the noted reasons were the recognition of EVM as a viable performance measurement tool by construction firms, secondly was the preferred use of other less structured techniques like the schedule of work. Lastly, the methodology had been shelved because very few project team members have the basic knowledge of EVM.

The results correspond with research conducted by Oke and Ogunsemi (2011), in which their findings showed that most participants asked about their level of knowledge of value management and their perceived level of adoption of value management on construction projects in Nigeria had average knowledge of it. Their results also concluded that most respondents ranked level of use of EVM below average with a majority ranking low.

Current problems in the Nigerian construction industry

Most of the responses from the interviewees pointed to financial problems or lack of funds as the number one cause of most project failures in Nigeria. The government was the most mentioned cause of poor funding or payment delays when the interviewees were asked, this

problem is posed by clients from all levels of government – local, state and federal – a project that lacks funding can end up abandoned, delayed or have poor quality (Ogunmakinde, Sher and Maund, 2019). “...having the government as a client can bring about to be the biggest challenge regarding funding” stated a participant while answering the question, because the firm will be expected to bare the initial mobilization costs to get the execution phase of the project started. It is then expected that the payment certificates will be sorted out and project funds approved in due time, this would allow the firm to recover their funds and receive the funds required to complete the project.

Other problems mentioned include poor resource management, poor communication, challenges with construction equipment. The second and third most mentioned problems are lack of skilled or qualified labor and constant fluctuation of construction material prices. According to Ogunmakinde, Sher and Maund (2019), the lack of regulations and other factors that include high import rate are mainly responsible for the unstable and high prices for construction materials. This becomes worse because of the country’s unstable economy and a misconception that locally produced construction material are mostly inferior to imported ones. Ogunmakinde, Sher and Maund (2019), also commented on the lack of skilled labor as a problem that has resulted in slow growth of the industry, this according to their research is brought about by the drop in quality of education in technical school that fail to pay adequate attention to changing trends.

Finally, an interesting problem mentioned by an interviewee was the rigid attitude of some professionals who are resisting change and hence continued to rely on outdated methods. Although time is crucial to all construction management professionals, continuing to resist

change or learn new methods will keep affecting time management where it counts most (Ogunmakinde, Sher and Maund, 2019).

Performance measurement methodologies currently in use

The use of previous similar projects as a benchmark for active projects was the response from some participants whose organizations have no traditional project management methodology in use.

Some of the participants' responses were that the project management methodologies in use during construction project management included the critical path method and PERT.

The critical path method is used to estimate the minimum project duration and determine the amount of schedule flexibility on the logical network paths within the schedule model ('PMBOK guide', 2017), while the PERT (Program Evaluation and Review Technique) is used to project activity and risk. PERT looks at overall cost and schedule risks not on individual activities to calculate the likelihood of a project to be completed on time (Larson and Gray, 2018).

Though some organizations do not use traditional project management methodologies, they implemented change management plans and stakeholder management was at the top of their lists to speed up decision-making. Only one participant confirmed using Earned Value Management as a monitoring and control tool.

Possible challenges to EVM implementation

Some concerns raised by the participants interviewed were that while their organizations are open to new ideas, any system or methodology will fail if not executed properly. Due to the many issues plaguing the country, like, ethnic clashes, changes in government policies and regime changes, most project managers would prefer to stick with established methods that they are used to in order to avoid surprises.

More concerns like time and cost required to train and retrain project team members and existing professionals respectively, many organizations and governing institutions will not be eager to pursue the implementation of earned value management and it would come off as an added complication to the already chaotic system. This has made many professionals are comfortable with the current practices. Since many factors can delay the start of a project well before there is a need to implement performance measurement techniques. Some construction managers challenging to dedicate time to learning new processes and would likely have excuses for making out the time, there is also the fact that Earned value management is still widely unknown in Nigeria and some will be reluctant to try a methodology that they considered new in the industry.

Oke and Ogunsemi, (2011) did record similar challenges in their research, Inadequate knowledge of benefits of value management; Lack of understanding of the concept; and Lack of information are a few of them.

Key EVM implementation drivers

All participants stated that a change in the current monitoring and control practices were necessary, but they also stated that for EVM to work in the construction industry, the problem of financing or project mobilization funds must be solved. The terms and conditions of a contract or project charter needs to be adhered to, payments as at when due to allow organizations that have provided mobilization funds to recover them and stay on track. Educating the stakeholders on the importance of using project management methodologies.

The participants that were part of the upper management in their organizations stated that the implementation of EVM has their support and they would be willing to provide the opportunity for their subordinates to learn.

Other participants were of the opinion that the Nigerian construction industry currently uses old methodologies; it needs updated or modern project management techniques that will incorporate the use of digital technology. The use of project management software is growing and this will make it easier to introduce any new methodologies to the construction management professionals in the country.

4.3 Case Study Data Analysis

The case study was carried out on a construction project in eastern Nigeria; earned value analysis was carried out in the construction of a retaining wall 35.5m in length and 5m high. The wall construction is a repair of a collapsed section of the Federal Prison in Onitsha Town, due to the sensitive nature of the site the project would have to be completed as quickly as possible.

The budgeted cost of the project was ₦3,140,412.50 (€7723.73), the wall would be made up of two main sections, a reinforced concrete retaining wall forms the base 1.5m high and a reinforced sandcrete block wall 3.5m high.

The project information, which includes costs, resources and schedule, were obtained through interviews with the construction firm and the project was then created in Microsoft Office Project Professional 2016. A Work Breakdown Structure was created and resources were assigned to the tasks with the appropriate quantities. Next, the project start date (September 19 2019) and end date (October 10 2019) were inputted. Progress was recorded up to October 2 2019 and a baseline was saved for the earned value analysis.

4.3.1 Earned Value Analysis

From the project status taken on October 2 2019, the project was recording 52% on overall completion status; however, there were delays on some tasks. Aside from tasks that had not yet started as of status date, progress had been affected and the project was behind schedule.

- The table below shows the values of EVM parameters recorded, from here it can be concluded that the project is running 7% behind schedule, which is costing the project ₦132,949.00 (€326.78).
- The planned value or budgeted cost for work done until status date is ₦1,697,393.75 (4172.09) and is lower than the earned value, which confirms that there are still unfinished tasks. However, with a much lower actual cost and cost variance of +6% the project running within budget.

Table 6: analysis results of EVM elements

1	Planned value (PV or BCWS)	₦1,697,393.75	
2	Earned value (EV or BCWP)	₦1,588,244.75	
3	Actual costs (AC or ACWP)	₦1,477,456.25	
4	Cost performance index (CPI)	1.07	
5	Schedule performance index (SPI)	0.93	
6	Cost variances (CV)	₦110,788.50	
7	Cost variances % (CV%)	6%	
8	Schedule variances (SV)	(₦132,949.00)	
9	Schedule variances % (SV%)	-7%	
10	Budget at completion (BAC)	₦3,140,412.50	
11	Estimate at completion (EAC)	₦2,943,183.49	
12	Estimated to completion (ETC)	₦1,563,656.25	
13	Variance at completion (VAC)	₦197,229.01	

The figure below is the graphical representation of actual cost, planned value and earned value, as explained earlier the actual cost is lower than the planned value meaning that the project is under budget.

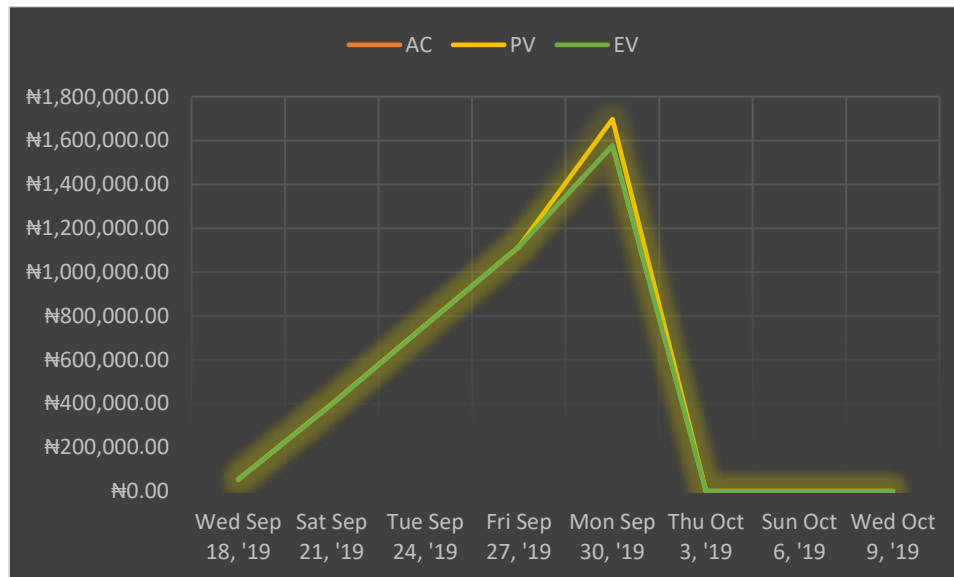


Figure 5: Graphical representation of PV, EV & AC

4.3.2 Variances

The schedule and cost variances are shown in the figure below. From the analysis, the cost variance (CV) is ₦110,788.50 and the percentage cost variance +6%. This means that there is no cost overrun, but because there are still unfinished tasks it is advisable to retake the analysis on a later status date. The schedule variance is a different story, with a value loss of ₦132,949.00 (€326.78), which expressed in percentage is -7% (SV%). This means that the project is running behind schedule due to the incomplete tasks.

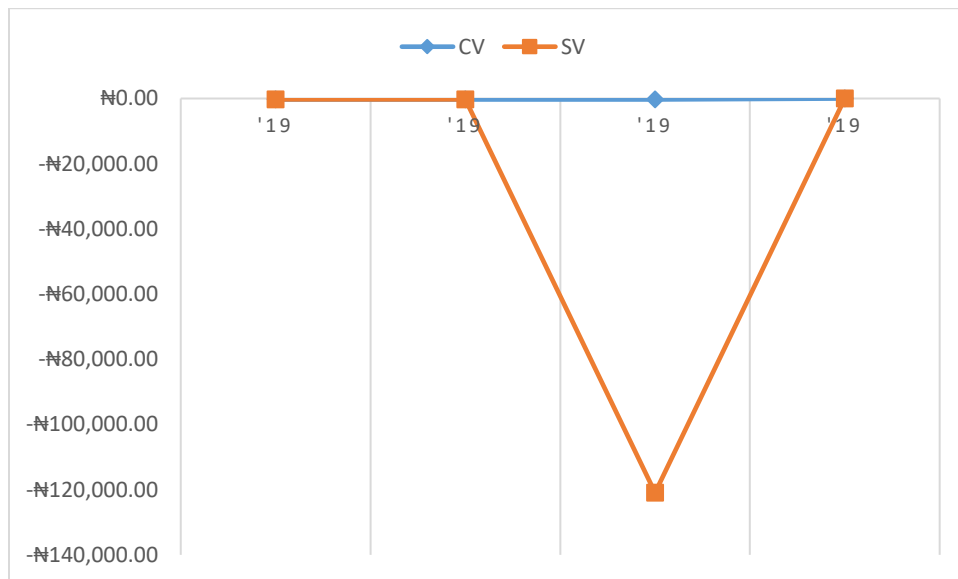


Figure 6: Graphical representation of CV & SV

4.3.3 Indices

The schedule performance index and cost performance index report 0.93 and 1.07 respectively. For the SPI and CPI, values below 1 show a negative performance while values above 1 show good performance.

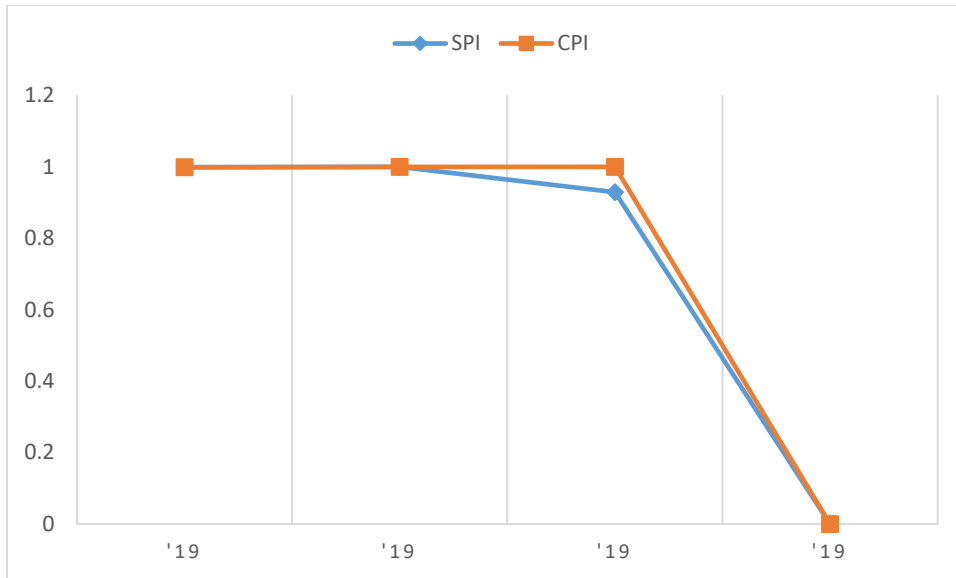


Figure 7: Graphical representation of CPI and SPI

4.3.4 Forecasting

The ETC (Estimate to Complete) represents remaining costs from the status date to the project completion date is ₦1,563,656.25 (€3843.37), assuming all conditions remain the same. The VAC (Variance at Completion) indicates the cost overruns expected at the end of the project. In this case, it is ₦197,229.01 (€484.78) meaning the project completion cost will be lower than planned. The EAC indicates the total expected project completion costs, which is ₦2,943,183.49 (€7234.17).

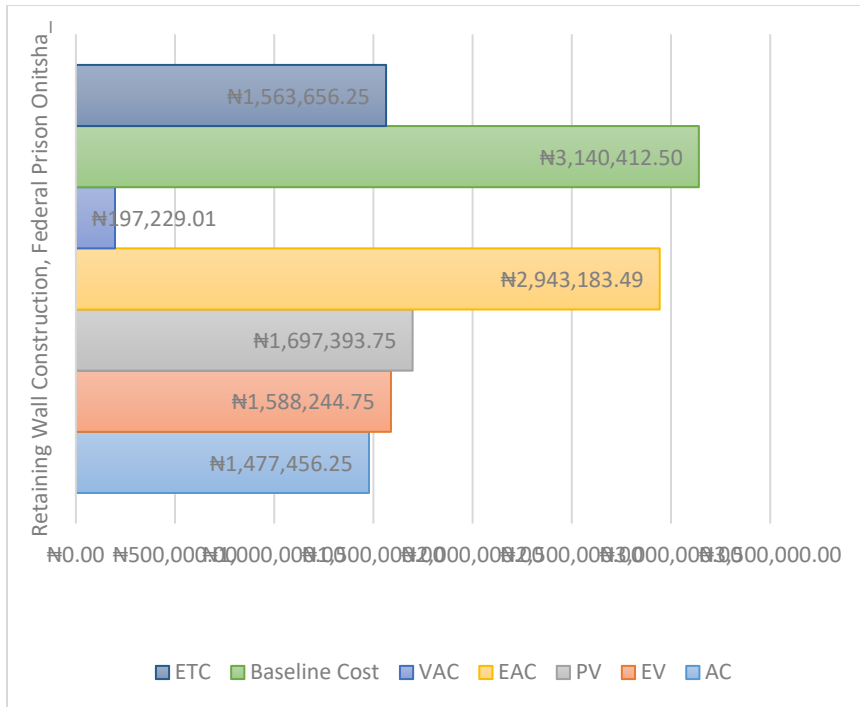


Figure 8: Graphical representation of forecasting indices

The analysis has shown that the construction manager needs to complete the unfinished tasks and close the gap in the schedule. Although this delay did not affect the overall progress of the project as at the time of doing the analysis, it will have an impact on the cost because additional man-hours will be spent to increase the work rate and get the project back on track.

Chapter 5: Discussion & Conclusion

5.1 Introduction

This chapter will focus on discussing the findings from the previous chapter – the interviews and case study. The objective of the research is to find out if Earned Value Management can be helpful when implemented in the Nigerian construction sector to help reduce the rate of project failure by improving the performance. The use of semi-structured interviews helped investigate the possibilities, the problems at hand, the willingness of those involved to welcome change and the current knowledge of Earned Value Management. The interview data confirms results from previous studies related to EVM in Nigeria and problems the construction industry is facing in the country. The case study helped confirm EVM as a viable tool for monitoring and control processes in a project, it serves as proof that if EVM is implemented properly will offer significant benefits to the project team.

5.2 Observations

Knowledge of Earned Value Management methodology

From the interviews, it was clear that when it comes to general knowledge of project management methodologies, Earned Value Management still is not well known to be discussed or used in the Nigerian construction industry. This was also observed in past study by other researchers, some of the construction managers interviewed were aware of EVM but the preference for other less complicated methodologies prevented it from gaining favor. Oke and Ogunsemi, (2011) observed that the cause could be attributed to client interference with

professional methods that may cost more money and are sometimes willing to only allow expert involvement at the beginning of the project. Thus, the contractor takes charge of the project, relegating professional process control and monitoring techniques to the opinions of the project management professionals. There is a need to encourage Nigerian construction clients – especially the Nigerian Government – to use EVM in their construction projects (Oke and Ogunsemi, 2011).

Educating the construction management community is key if new and better methodologies are to survive in the industry. This means that professional bodies, institutions and government agencies need to make it possible for construction managers to have in-depth knowledge of EVM; this could be achieved through training seminars, construction policies and professional certifications.

Problems in the Nigerian construction industry

Comparing the problems observed from the interviews to those discussed by IHEME and CHIAGOROM (2018) with their severity index, financial challenges rank as one of the highest causes of project failure, followed by fluctuating costs of construction materials, lack of skilled labor and poor acceptance of innovation from some professionals in the industry. Even though there are other problems, tackling the most obvious ones will pave the way for recovery in the construction industry.

The government still has a big role to play in this scenario, with the economy declining steadily construction clients will continue to seek cheap/unskilled labor that will undermine the efforts of construction professionals.

The delay in payment especially in government contracts and bidding process needs to be addressed effectively. Larger construction firms may take advantage of these delays to inflate their costs, this can make quotation/Bill of Quantities from smaller firms seem unrealistic further causing a general increase in government project costs.

Support from professional bodies in Nigeria such as the NIS (Nigerian Institute of Surveyors), COREN (Council for the Regulation of Engineering in Nigeria) etc. is necessary for the implementation of PM methodologies like EVM.

Possible challenges to EVM implementation

The first line of resistance to the implementation of EVM as observed from this research is the acceptance of innovation or change. Many professionals are not eager to change their current methods and this can only change through the support of the professional bodies.

Training costs and time may prevent some organizations from accepting the idea, however moving to secure top management support will be of great importance in that regard. From the research interviews the participants acknowledged that this is possible as long as the benefits are clear. According to Edjenekpo (2017) the need to comply with international standards, performance improvement initiatives and demand from clients to use EVM will help persuade construction firms.

EVM implementation drivers

The benefits of EVM show that it is a methodology greatly underestimated in Nigeria. Oke and Ogunsemi (2011) mentioned these benefits should be convincing enough to make EVM worth the effort;

- it brings new ideas to the industry
- cost effectiveness, value improvement and effective project delivery
- delivers value of money to clients
- provides the opportunity for high technical advancement

One very implementation driver lies in the function of EVM, which is to integrate the costs, scope and time in a project making it possible to perceive possible problems that can delay or stop a project. The most important point to note as observed from this research is the willingness of the participants to advance their knowledge and improve their organizations' competitive edge in the construction industry.

5.3 Recommendations for further study

Given the limitations surrounding this research, there was little time to investigate to greater depth. The findings however will serve as a stepping-stone for further studies in this area. There are very little studies directly related to the Nigerian construction industry with respect to Earned Value Management. The number of participants used for the interviews also reflect the limitations, for further look into this area, a more robust set of participants is necessary. This

would include more participants with significant construction management experience, more in top management, participants from government agencies and regulation agencies.

A case study on a project with longer duration to allow the earned value analysis progress for a longer period and generate more in-depth results. This will ensure that the analysis can explore various other possibilities and uncertainties in the application of EVM in Nigerian construction projects.

Chapter 6: Self Reflection

6.1 *Dissertation Initiation Process*

6.1.1 *Choosing a topic*

In preparation for this dissertation, the first thing that came to mind was a suitable topic. The researcher had many different questions on what to work on, where to start and who to talk to. The decision reached was to look at experiences and plans and hopefully an idea on a research topic will be somewhere within.

For experiences, the researcher looked at academic background and work, then looked at current course of study and intended career after graduation.

Firstly, the researcher's first degree was received in Civil engineering and has worked in organizations that specialize in construction and infrastructure development. Second, experiences in team management, which led to the decision to study for a masters degree in a management related field. Lastly the career path that would follow after graduation.

The conclusion was to stick with a project management related dissertation, in part because the researcher was already studying MBA Project Management and in part because of the need for a dissertation that would provide a learning experience that is applicable in a wide variety of roles. Once this was decided, the next step was to choose a specific area of project management to focus on. The idea to use earned value management came after receiving a lecture on the subject, though there was much to learn about the concept, it seemed like the right project management methodology that was desperately needed in the construction sector. It provided the opportunity to monitor and control cost, time and quality of a project process and

its application was not limited to construction alone. With that in mind, the researcher decided the next step would be to look for more information on EVM.

6.1.2 Gathering Information

Gathering information about Earned Value Management was not difficult. Texts, academic journals and conference papers provide a wealth of information. The challenging aspect was gathering information on EVM use in the construction industry. With this kind of research it is easy to stray from the intended course, understanding the reasoning behind the chosen topic was the ideal way to stay focused. The formulation of an initial research question helped make the search for information a lot easier because it put things in perspective, helping the researcher to narrow or broaden the search as required.

The use of DBS library facilities was of great importance, the library staff played a key role in teaching the researcher the proper methods to search for information hidden between similar search criteria. The learning experience and information gathered during the research proposal phase also helped the researcher towards refining the topic and themes of the dissertation.

6.1.3 Identifying and evaluating resources

The researcher learned while gathering information the relevant, viable and accepted sources for DBS dissertations. Sources like Wikipedia, which sometimes do not provide proof of academic backing for their material were not acceptable. The academic repository provided by Dublin Business School, Academia.edu, Researchgate.net and the PMI website (Project Management Institute) were rich with peer-reviewed journals and other texts.

Once there was a means to source for information, the next challenge was picking the relevant data. The danger that always presented itself was going too wide and off the intended topic. To avoid this the researcher occasionally referred to the aims and objectives of the research, the research questions and the subject of the research.

6.2 *Dissertation Execution*

6.2.1 *Primary Data collection*

After conducting the initial search for information and narrowing down the research options, the researcher decided to use the Nigerian construction industry as a case study. Though earned value research data concerning Nigeria was scarce, the researcher believed that the use of semi-structured interviews to gather information would be very helpful. The next challenge to overcome would then be the selection and contacting of participants. Choosing the right people to talk to was one thing, getting their cooperation was another. In order to ensure success in the sample selection he researcher made efforts to establish early contact with potential participants, this way all declines will be swiftly managed by moving to secure alternative participants.

From the participants the researcher selected one construction firm that would provide the data for the case study analysis. This was another rigorous process because most of the participants were not willing to share confidential project information. Finally, a short-term project that was about to commence was agreed on with one of the participant's firm.

6.2.2 Secondary data collection

Secondary data used for the research was sourced through the internet mostly, using the websites mentioned earlier: the PMI website etc. other sources were text books from the DBS library.

The literature review was perhaps the most challenging part of the research, taking up at least 80% of the total project time. The researcher benefited from experience gained during research on module assignments and other course work at DBS.

6.2.3 Support from supervisor and peers

The dissertation process while a solo endeavor sometimes require gathering information and learning from others. The researcher was able to think creatively through the guidance of the dissertation supervisor. Regular review meetings and discussions helped build the dissertation, by correcting mistakes, adapting new styles, learning from mistakes and revealing the important things that should be added and those to be ignored.

Meeting with peers to discuss problems and proffer solutions was also helpful. Sometimes the researcher benefited from seeing things from a different perspective or thinking outside the box. Situations that seemed to challenging to overcome became easier by talking to others and this was necessary because dissertation supervisors are working with many students at a time and may not provide immediate responses.

6.3 *Dissertation Conclusion*

6.3.1 *Learning Outcome*

The outcome of this whole process has enlightened the researcher in many ways; the work that went into preparing this dissertation has built the confidence needed to tackle tasks that are more challenging. Strictly sticking to only academic material was challenging, mostly because this style was new to the researcher, adapting was necessary but went surprisingly well. Previous studies done by the researcher for a first degree was mainly laboratory work and quantitative analysis, this dissertation provided a good opportunity to work on something different and using very different methods that until now had not been tried by the researcher.

6.3.2 *Learning style*

Learning style as defined by Whetten and Cameron (p.132, 2011) is the way in which individuals perceive, interpret, and respond to information. There are four main learning styles.

Visual: visual learners retain information by using learning techniques that associate images with words, concepts and ideas. This means that they can make use of photographic memory, spatial awareness, color/tone/brightness contrasts and other visual information to learn. Research has shown that around 65% of people are visual learners (Croman, 2017)

Auditory: these learn faster when sound, music and rhythm are involved. Roughly, around 30% of people fall within this category. Auditory learners prefer listening to information but can combine audio with visual aids.

Reading/Writing: these learners get information through reading, writing and speech. Written outlines assist verbal learners to view and speak out the information.

Kinesthetic: learns best through activities or by engaging in activities. They make use of their bodies and sense of touch when learning. This is a less frequent style seen in only about 5% of the population. This learning style can often be blended with visual and auditory styles (Croman, 2017).

Using the VARK test the researcher was able to determine the most suitable learning style, which is kinesthetic. This was helpful in choosing the research design, opting to use a case study which involved analysis of an ongoing project using MS project was a result.

VARK (Visual, Aural, Reading/writing and kinesthetic) is an instruments which can be used to determine learning styles. It uses the VARK questionnaire which was developed by Lincoln University of New Zealand in 1998 (Peyman et al., 2014).

6.3.3 Expectations of this Degree

Project management as a profession requires leadership skills, leadership abilities and communication skills. The researcher's expectations upon completing this course is to have significantly improved those qualities. Building a career in management will require those skills in order to tackle challenging positions and take on increasingly challenging professional responsibilities. The researcher also expects to gain more development in areas like teamwork and time management.

6.3.4 Activities schedule and progress Gantt chart

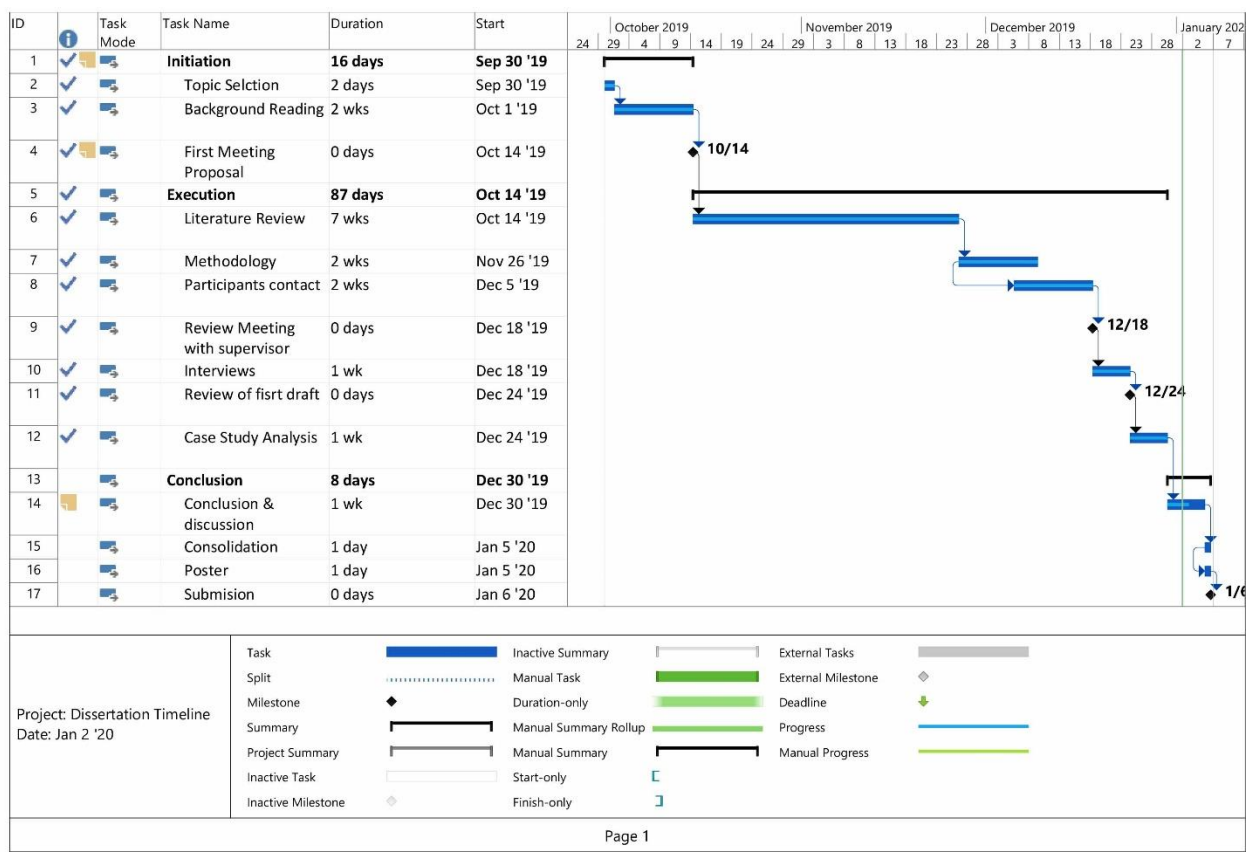


Figure 9: dissertation progress Gantt chart

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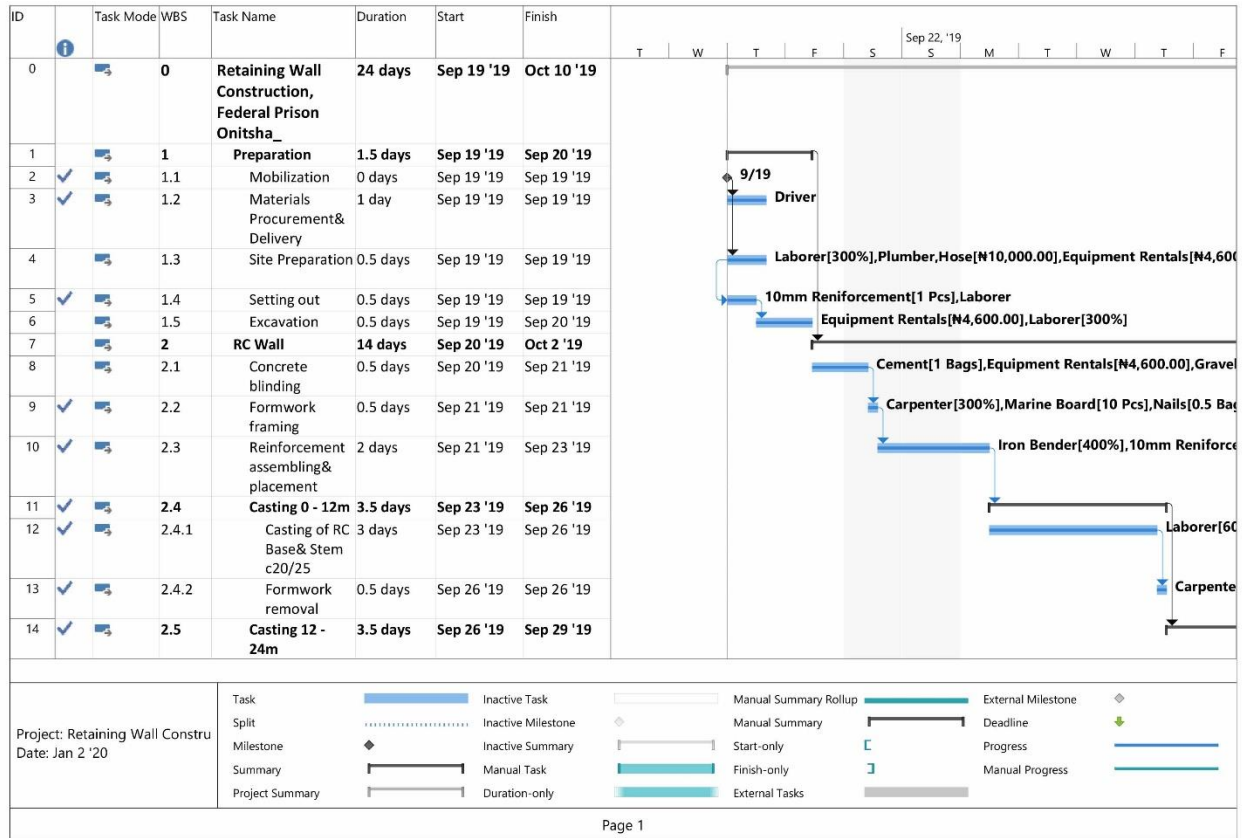
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Appendix

Case Study: Work Breakdown Structure



Case study: Project images



Case Study: Earned value analysis

ID	Task Name	Planned Value - PV (BCWS)	Earned Value - EV (BCWP)	AC (ACWP)	SV	CV	EAC	BAC	VAC	
1	Preparation	N28,050.00	N37,444.00	N19,050.00	19,806.00	(18,394.00)	432,215.91	447,250.00	15,034.09	
2	Mobilization	N0.00	N0.00	N0.00	N0.00	N0.00	N0.00	N0.00	N0.00	
3	Materials Procurement & Delivery	N5,000.00	N5,000.00	N5,000.00	N0.00	N0.00	N5,000.00	N5,000.00	N0.00	
4	Site Preparation	N6,500.00	N13,662.00	N6,500.00	7,438.00	(7,162.00)	21,313.13	21,100.00	213.13	
5	Setting out	N3,050.00	N3,050.00	N3,050.00	N0.00	N0.00	N3,050.00	N3,050.00	N0.00	
6	Excavation	N4,500.00	N6,732.00	N4,500.00	2,368.00	(2,232.00)	9,191.92	9,100.00	91.92	
7	RC Wall	N1,415,812.50	N1,301,469.50	N1,215,375.00	18,943.00	(86,094.50)	328,774.48	420,412.50	91,638.02	
8	Concrete blinding	N21,250.00	N23,344.50	N21,250.00	2,505.50	(2,094.50)	26,073.93	25,850.00	223.93	
9	Formwork framing	N130,500.00	N130,500.00	N130,500.00	N0.00	N0.00	130,500.00	130,500.00	N0.00	
10	Reinforcement assembling & placement	N120,125.00	N120,125.00	N120,125.00	N0.00	N0.00	120,125.00	120,125.00	N0.00	
11	Casting 0 - 12m	N353,312.50	N353,312.50	N353,312.50	N0.00	N0.00	353,312.50	353,312.50	N0.00	
12	Casting of RC Base & Stem c20/25	N349,312.50	N349,312.50	N349,312.50	N0.00	N0.00	349,312.50	349,312.50	N0.00	
13	Formwork removal	N4,000.00	N4,000.00	N4,000.00	N0.00	N0.00	N4,000.00	N4,000.00	N0.00	
14	Casting 12 - 24m	N353,312.50	N353,312.50	N353,312.50	N0.00	N0.00	353,312.50	353,312.50	N0.00	
15	Casting of RC Base & Stem	N349,312.50	N349,312.50	N349,312.50	N0.00	N0.00	349,312.50	349,312.50	N0.00	
16	Formwork removal	N4,000.00	N4,000.00	N4,000.00	N0.00	N0.00	N4,000.00	N4,000.00	N0.00	

Project: Retaining Wall Constru Date: Jan 2 '20	Task		Inactive Task		Manual Summary Rollup		External Milestone	
	Split		Inactive Milestone		Manual Summary		Deadline	
	Milestone		Inactive Summary		Start-only		Progress	
	Summary		Manual Task		Finish-only		Manual Progress	
	Project Summary		Duration-only		External Tasks			

Page 1

Case study: Project images



FIRST MEETING PRESENTATION - SUMMARY OF PROPOSED RESEARCH (1,000 words max)

Student Name: Anukwe Chukwudumebi

Student Number: 10503857

What is the research problem/ issue you are trying to solve?

Project management challenges in the Nigerian construction industry that are hindering productivity.

Why is this subject area/ topic interesting to you?

Earned Value Management tackles issues related to time, cost and, scope management that are present in the construction industry. Fixing these problems will improve the efficiency of the industry and drive economic growth in Nigeria.

Why do you think this subject area/ topic may be interesting to the business world? (Cite research to support your answer – at least 3 key research studies)

1. The Nigerian construction industry contributes to the country's GDP growth, in 2018 the industry grew by 44.09% which represents 5.47% of the country's GDP (Ogunmakinde, Sher and Maund, 2019).
2. Foreign Direct Investment opportunities: Nigeria continues to be home to the greatest number of projects in West Africa, with 30.5% of the regional total, valued at US\$63bn (Deloitte, 2018).
3. For construction customers, implementing earned value management in projects will reduce the risk exposure of the project and ensure timely and cost effective conclusion Boydak, (2013).

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<p>What kind of people would you need to survey/ interview/ collect data from? (indicate the specific group(s) to be sampled, and the estimated sample size/ number of cases)</p>
<p>The sample technique will be a non-probability sampling, and will have a minimum of 5 to 12 participants for the interviews.</p> <p>Construction project managers (est. 4) Architects (est. 2) civil engineers (est. 2)</p>
<p>What are the three most important questions you would pose to the respondents? (i.e. the key variables for your proposed study)</p>
<p>Since the main research question seeks to confirm how successful EVM will be versus the current conventional methods used, the key questions to the respondents will be;</p> <ol style="list-style-type: none"> 1. What are the current methods of project progress tracking and reporting you use? 2. How effective are these methods in revealing cost and time overruns? 3. Will you be willing to make significant changes to your current system of monitoring and control?
<p>What will be the value of the information this study will generate?</p>
<p>The research will add to available yet scarce material discussing Earned Value Management. It will build on existing studies to create more opportunities for others who wish to explore EVM in more detail.</p> <p>Professional Bodies in Nigeria related to construction and engineering will find the results useful for future implementation of EVM methodologies in the industry.</p>
<p>How is this study linked to your career/ future career?</p>
<p>This research will increase my knowledge in project management, especially in areas related to schedule and cost management. It will also serve as guideline/reference for future endeavours as a project manager.</p>
<p>Do you prefer working with numbers (quantitative) or words (qualitative)? (Explain your past experiences at undergraduate level etc. in relation to each approach).</p>
<p>As an engineering graduate a quantitative approach would be ideal. However, the nature of the research would require that both qualitative and quantitative methods be used.</p> <p>Previous research undertaken at undergraduate level – “<i>Compressive strength test on varying concrete mixes using quarry dust as fine aggregate</i>” – involved iterated calculations on test results. The research was mostly based on data collected from lab work and field tests. There were some qualitative work done, this involved informal interviews with artisans who worked with concrete and collecting data on their concrete mix batching ratios.</p>

Information Form and Consent Sheet

INFORMATION SHEET FOR PARTICIPANTS

PROJECT TITLE: Earned Value Management Analysis and Forecasting: a case study of the Nigerian Construction Industry

You are being asked to take part in a research study on using earned value management as a performance measurement tool that will improve project success in Nigeria. This research is being carried out by Anukwe Chukwudumebi and supervised by Paul Taaffe, in partial fulfilment of the requirements for the degree of MBA Project Management at Dublin Business School.

WHAT WILL HAPPEN

In this study, you will be asked to answer questions regarding construction projects you have managed regardless of the success, your control and monitoring techniques used, knowledge of EVM, problems encountered during the project life cycle, suggested techniques for improving project success and opinion on using EVM. The interview will be by phone or skype, whichever you prefer.

TIME COMMITMENT: The interview typically takes 30 – 45 minutes and will have one session only.

PARTICIPANTS' RIGHTS

You may decide to stop being a part of the research study at any time without explanation required from you. You have the right to ask that any data you have supplied to that point be withdrawn / destroyed. You have the right to omit or refuse to answer or respond to any question that is asked of you. You have the right to have your questions about the procedures answered (unless answering these questions would interfere with the study's outcome. A full de-briefing will be given after the study). If you have any questions as a result of reading this information sheet, you should ask the researcher before the study begins.

CONFIDENTIALITY/ANONYMITY

The data I collect does not contain any personal information about you except Name, Qualification, Position and Organisation. The data you provide will be used for research analysis only and will not be used in presentations, conferences or publications. Your identification will only serve the purpose of establishing your suitability for the interviews and will be confidential afterwards.

FOR FURTHER INFORMATION

I or / and Paul Taaffe will be glad to answer your questions about this study at any time. You may contact my supervisor at paul.taaffe@dbs.ie.

INFORMED CONSENT FORM

PROJECT TITLE: Earned Value Management Analysis and Forecasting: a case study of the Nigerian Construction Industry

PROJECT SUMMARY: the construction industry in Nigeria has one of the highest expansion rates among other sectors and is full of potential. However, studies have shown an increase in abandoned/failed construction projects. Causes of project failures have been analysed by various authors but suitable solutions are still being explored.

Some identified problems include scope creep, funding, quality control, rising project costs and lack of qualified personnel.

This research proposes the use of a project management technique known as Earned Value Management. EVM combines project scope, schedule and resource measurements to assess project progress and performance. It has been tested and implemented successfully in many countries but is still not widely practiced in Nigeria and many developing countries.

The main objective of the research is to determine if EVM can be used in Nigeria to improve project success rates and solve some problems currently faced by construction management professionals.


By signing below, you are agreeing that: (1) you have read and understood the Participant Information Sheet, (2) questions about your participation in this study have been answered satisfactorily, (3) you are aware of the potential risks (if any), and (4) you are taking part in this research study voluntarily (without coercion).

Participant's signature

Anukwe Chukwudumebi

Student Name (Printed)

Participant's Name (Printed)



Student Name signature

Date