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Development of a Project Management System, Case Study: FUTA Step-B Center of Excellence on Food Security

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ABSTRACT: In this research, we model a project management system for FUTA Step-B and other management programme by using non-learning data structure which makes the data encryption easy, fully secure and time efficient. We devise a method that relies on Earned Value Management (EVM) to solve management questions for efficient forecasting that can be used to control the problem of under budget or over budget and predictive accuracy of each model was calculated. Evaluating this method on Science and Technology Education at the Post-Basic Level (STEP-B) project of the Federal University of Technology Akure (FUTA), we demonstrated its effectiveness with different interfaces which cover all sections and activities with functions to perform. The result obtained shows that the predictive accuracy is good with low error rate in under budget within the data present in our database. Also, with the result generated there is a need to keep control on the project schedule in order to control under budget or over budget rate. The system was implemented using C++ and visual studio 2008.

KEYWORDS: Project management, STEP-B, Budget, Earn Value Management

1. INTRODUCTION

Many of software projects fail to fulfill customers' quality expectation or fail to deliver the project within budget and on schedule. Though, the major cause of project failure is not the specifics of what went wrong, but rather the lack of procedure, methodology and standards for managing the project [15]. FUTA STEP-B project which is Nigeria project is not left out of these challenges. The purpose of this research is to model project management system for FUTA STEP-B and other management work and to implement the system designed. As FUTA STEP-B project grows and its benefits become widespread, there is need to improve on their operations and proper monitoring of projects which is time consuming and very tedious. To alleviate the challenges faced by FUTA STEP –B center of excellence on food security project and other management work, the research developed a model by using non-learning data structure which make the data encryption easy, fully secure and time efficient, for proper procurement, monitoring and evaluation in order to promote operation efficiency and free flow of management information. Then we use the features associated with Earned Value Management (EVM) to improve on the project management system and to model accurate forecasts of project performance problems and how project can be delivered on scheduled and within budget. The predictive accuracy of each model is calculated and it shows a great deal of the prediction of the model and how it is possible for budget to be predicted. The result obtained showed that the predictive accuracy is good with low error rate in under budget within the data present in the data base. The model was tested with FUTA STEP-B Center of Excellence on Food Security project which really improved the performance and assisted in the area of procurement, monitoring and evaluation. Finally, the research has contributed to knowledge by providing a robust system for management work in order to guide against project failure and for free flow of management information.

2. RELATED WORKS

What is Project Management? Several researchers gave meaning of Project Management such as; Kim 2000, Duncan 2000, Sanket *et al.*, 2017, Darko *et al*., (2005), Nilton Takagi and João Varajão 2019, Uday 2019, Vittal 2020 and Eliane *et al.*, (2019). According to Kim 2000 [6], Project Management is the application of knowledge, skills, tools, and techniques for project activities to meet project requirements.

Sanket *et al.*, 2017 [12] define Project management as the process of planning, scheduling, resource management, requirement analysis, designing and testing to achieve project goals and objectives.

Darko *et al*., 2005 [2] describe Project Management (PM) as a set of activities which enables successful implementation of a project.
Nilton Takagi and João Varajão 2019 [8] define Project Management as a methodology developed by the European Commission.
Uday 2019 [13] defines Project Management as the application of skills and knowledge that allows a company to be competitive in its market.
Vittal 2020 [14] describes project management as the art and science of using experience, knowledge, skills, tools, and techniques efficiently and effectively to meet stakeholder expectations.
Eliane *et al.,* 2019 [4] describe Project management as a field that has been applied in organizations since ancient times, with the aim of getting the best results from projects through a more efficient and effective management.
Duncan 2000 [3] explains how project management is accomplished through the application and integration of the project management processes of initiating, planning, executing, monitoring, controlling and closing. According to Amos 2013 [1] describes project management as the discipline of planning, organizing, securing, and managing resources to achieve specific goals.
A more tangible (but less interesting) description is that project management is everything you need to make a project happen on time and within budget to deliver the needed scope and quality. Therefore, Project management involves planning, scheduling and controlling all of the project activities to achieve its objective. This research develops system for FUTA STEP-B Center of excellence on food security to improve their operations and proper monitoring of projects which are currently performed manually. This system will cover all sections and activities involves in FUTA STEP-B programme for proper procurement, monitoring and evaluation in order to promote operational efficiency and free flow of management information.

3 SYSTEM DESIGN

In our system, FUTA STEP-B project proposal document is use as a case study. We consider all the activities of management programmes including sections, methods and phases of FUTA STEP-B project. The system is designed into different interfaces with functions to perform. The following features that associated with Earned Value Management (EVM) were used as functional component of the system designed [9].

i. Budgeted Cost of Work (BCW): The estimated effort for each work task.
ii. Budgeted Cost of Work Scheduled (BCWS): The sum of the estimated effort for each work task that was scheduled to be completed by the specified time.
iii. Budget at Completion (BAC): The total of the BCWS and thus the estimate of the total effort for the project.
iv. Planned Value (PV)**:** The percentage of the total estimated effort that is assigned to a particular work task; PV = BCW/BAC.
v. Budgeted Cost of Work Performed (BCWP): The sum of the estimated efforts for the work tasks that have been completed by the specified time.
vi. Actual Cost of Work Performed (ACWP): The sum of the actual efforts for the work tasks that have been completed.

All these were computed to determine cost performance (over budget or under budget) and schedule performance (behind schedule or ahead of schedule).
In order to measure Earned Value, Schedule Performance Index, Schedule Variance, Cost Performance Index, and Cost Variance defined in equation 1-5, work of [10] was adopted.
(a) Earned Value (EV) = BCWP/BAC 1
= The sum of the PVs for all completed work tasks
= PC (Percent complete)
(b) Schedule Performance Index (SPI)
= BCWP/BCWS 2
(c) Schedule Variance (SV) = BCWP – BCW…….....3
(d) Cost Performance Index (CPI) = BCWP/ACWP 4
(e) Cost Variance (CV) = BCWP – ACWP……. 5
Cost Performance Index (CPI) was computed and compare with the Cost Variance (CV) to answer management questions that are critical to the success of FUTA STEP-B project, such as:
(a) Are we ahead of or behind schedule?
(b) How efficiently are we using our time?
(c) When is the project likely to be completed?
(d) Are we currently under or over our budget?
(e) How efficiently are we using our resources?
(f) What is the remaining work likely to cost?
(g) What is the entire project likely to cost?

(h) How much will we be under or over budget at the end?

If the system reveals that the project is behind schedule or over budget, the project manager can use the EVM methodology to help identify:

i. Where problems are occurring
ii. Whether the problems are critical or not
iii. What it will take to get the project back on track.

Microsoft Visual Studio 2008 was used for the program while C ++ was used as the programming language. The experiments was run on a machine with an Intel Core 2 Duo CPU at 1.66GHz of 1GB RAM.

3.1 Architecture of the System

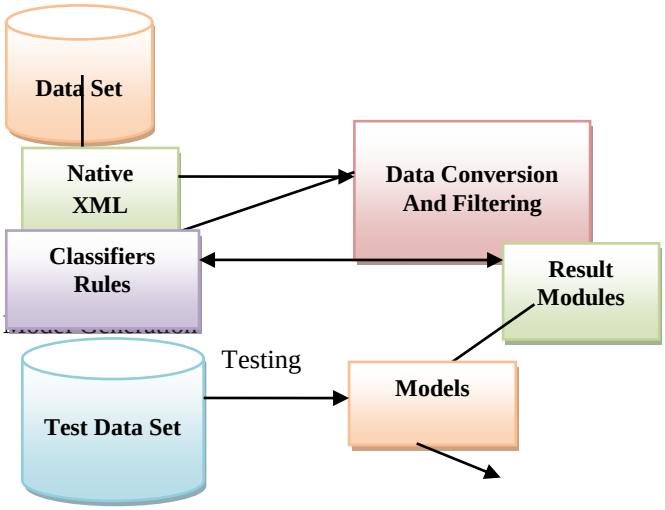

Figure 1: Architecture of the System

(1) Data Set: This consists of collected manual records from FUTA STEP-B proposal document. Consisting of 246 procurement list, 17 sections, and 13 activities with methods, phases, and processes of which some were used as trained data while 10 were used as test data. (Source from FUTA STEP B Project proposal document) [11]. Ms Excel package is used to enter the values of data.

(2) Data Conversion and Filtering: The excel format is converted to Rapid miner format in the module.
(3) Classifiers Rules: These are the generated rules from the algorithm of implementation in the form of IF…Then structures. Any algorithm which assigns a classification to unseen instances is called a classification.
(4) Result Module: This module represents the generated models for each of the classifiers used.
(5) Test Dataset: These are the simple of data which is to be tested or predicted over the generated model.
(6) Models: These are the algorithm used. These are Wekar-JRIP Algorithm, Wekar-Rep TREE, Rule Induction and ID3 Decision Tree algorithm.
(7) Output Analysis: This shows the various result generated from the models.

4 RESULT AND PERFORMANCE EVALUATION

A system is not useful unless implemented and tested to ensure the workability of its functionality and to be sure it meets the requirements for which it is intended. This section highlight the results obtained show its comparison with other management works to shows its effectiveness.

4.1 System Implementation

The program is divided into two, frontend (program interface) and backend (data ware house) or where data are stored. The system is designed into different interfaces which cover all sections and activities involve in management programme with functions to perform with FUTA STEP-B project as a case study. The interfaces include, Admin Login, Project Participant interface, Section form, Activity form, Method form, Project Work Breakdown Structure (WBS), Project Participant Registration, Project Procurement List, Project Execution Form, Project Monitoring and Evaluation System.

Users of this system are of two types, but the major users are the project team members. These types of users are termed as the project participant. Administrative users are the coordinators of the project. They have the capability to add more sections and activities, into the system and as well as capable of removing. The view of login is displayed in figure 2.

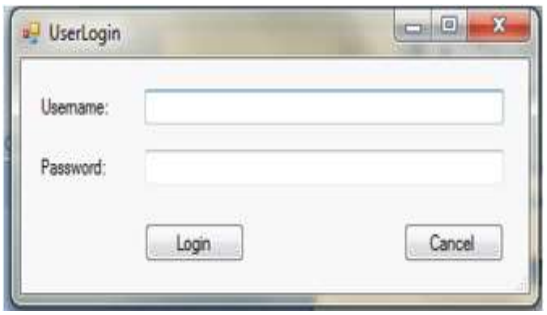

Figure 2: Display Login

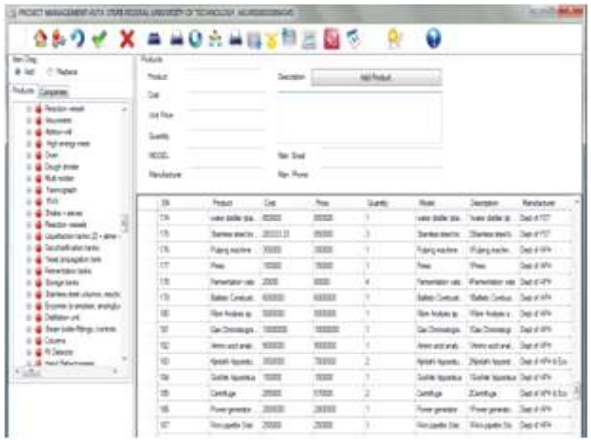

Figure 3: Display of Project Procurement Form

Figure 4: Display of Cost forecasting

4.2 Earn Value Management (EVM)- Measure and Results

Earn Value Management (EVM) consists of the following primary and derived data elements. Each data point value is based on the time or date an EVM measure is performed on the project.

Primary Data Points

Budget at Completion (BACs) =720days
Budgeted Cost for Work Scheduled (BCWS) = 320days
Budgeted Cost for Work Performed (BCWP) = 5I5days
Actual Cost of Work Performed (ACWP) =536days

Derived Data Points - Variances

a) Cost Variances (CV)

CV = BCWP-ACWP
=512days-536days

= -21days behind schedule

b) Schedule Variances (SV)

SV = BCWP-BCWS

=515days-320days

=195days ahead of schedule.

Performance Indices

a) Cost Performance Index

CPI =BCWP/ACWP

=515/536

=96%

b) Schedule Performance Index

SPI =BCWP/BCWS

=515/320

=160.9%

Since CV is -21days, the schedule variance (SV) is 195 days, the cost performance index (CPI) = 96%. This indicates the actual effort is lower than the estimated effort.

The cost variance (CV) is -21days. This also indicates more effort has been required than was estimated. Thus, the project is behind schedule but appears to be within budget.

Predictive Accuracy for the System

Predictive accuracy can be calculated as P_N^C where C is the Over budget and N is the number of instances in the test set. The standard error of prediction therefore can be given as

$$S_E = \sqrt{P(1-P)/N}$$

The more certain we wish to be, the greater the number of standard errors. The probability to this effect is called the confidence level, denoted by CL and the number of standard errors is usually written as Z_{CL}.

Table 1: The Standard Relation Table

Using this table the true predictive accuracy of the algorithm lies in the interval $P \pm Z_{CL} * S_E$

Therefore,

$$P = \frac{C}{N}$$

C = 0 .96, N = 10, P = 0.96/10 = 0.096

$$SE = \sqrt{P(1-P)/N}$$

$$SE = \sqrt{0.096(1-0.096)/10}$$

$$= \sqrt{\frac{0.096(0.904)}{10}}$$

$$= \sqrt{0.0086784}$$

$$= 0.09315$$

With the probability of 0.95

Pr (CL) = 0.95

The true predictive accuracy is 0.096 ± 1.96 x 0.009315

≈ 0.096 ± 0.0183

Between 0.0867 to 0.1143

0.0867x 0.1143/0.0867+0.1143

=.00990981/0.202

=0.0493

=4.9

The error rate = 5%

The predictive accuracy of each model is calculated above and shows a great deal of the prediction of the model and how it is possible for budget to be predicted. There is a very low error rate in under budget within the data present in our database. Therefore, there is need to keep control on the project schedule in order to control under budget or over budget rate.

4.3 Comparative Analysis with Existing System

The developed system was compared with the work of Makar 2012 [7] and illustrated in Figure 5.

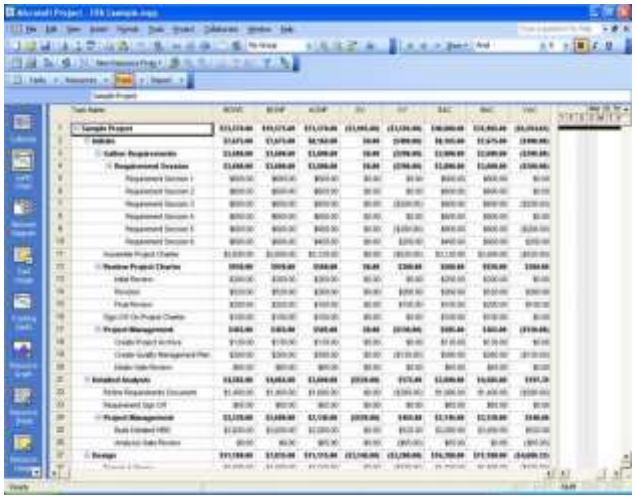

Figure 5: Display of Earned Value table of Microsoft Project (Makar, 2012).

The developed system is customize specifically for FUTA STEP-B project which allow direct use of functions design for the project this makes it more robust as compared to existing system which is design for multiple projects for different fields. The developed system uses non-learning data structure for data ware house which make the data encryption easy and fully secure as compared to existing system which uses ADO.Net (Microsoft Access Database) which can be manipulated by an outsider who has the knowledge. The developed system is directly used for number of activities involve in FUTA STEP-B project which makes staff time management possible. Hence, the customize application for the purpose of FUTA STEP-B project has better utility and handle direct activities.

5 CONCLUSION AND FUTURE WORK

The objective of this research was to devise a model for all management programmes, for proper monitoring and evaluation of project with different interfaces which covered all sections and activities of project management work with
functions to perform. The application uses non-learning data structure for data ware house which made the data encryption easy and fully secure. The application also allows direct use of function design for the project. This project was accomplished through the application of the Project Management processes of Initiating, Planning, Executing, Monitoring and Controlling, and Closing [5]. The model was tested with FUTA Step-B project and the predictive accuracy of each model was calculated which showed a great deal of the prediction of the model and how it is possible for budget to be predicted. The result obtained shows that the predictive accuracy is good with low error rate in under budget within the data present in our database. Also, with the result generated there is a need to keep control on the project schedule in order to control under budget or over budget rate.
In general, this model helps to check whether project appears to be on schedule or costing more than was planned. It also handled a greater and direct number of activities involve in management programme.
This research should be seen as a platform to satisfy that full scope of work is completed in a quality manner, within budget and on time. Finally, more study on the system should further be researched upon to better improve in the data for effective forecasting that can be used to control the problem of under budget and over budget.

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