Implementation of Review Technique and Critical Path Method on Academic Programs among Selected Tertiary Institutions in South-South, Nigeria

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ABSTRACT

The study was on the implementation of review technique and critical path method on academic programs among selected tertiary institutions in South-South states of Nigeria. The objectives of this study were to determine the commencement and completion of academic schedules using Critical Path Method forward and backward pass computation, to determine the critical path using Critical Path Method and Project Evaluation and Review Technique, to determine the total duration time for the academic programs among these three institutions in each semester using Critical Path Method and Project Evaluation and Review Technique and to determine the probability of completing academic programs within the stipulated time frame among the selected institutions in south-south states of Nigeria. Descriptive study was used in the description of the selected institutions. Also, accessible sampling was adopted due to the availability of the institutions' secondary data from the institutions' portal and academic calendar during the period under review. Analyses were performed on the accessible secondary data. The findings showed that total completion days of School A academic schedule using Critical Path Method and Project Evaluation and Review Technique were 84 and 83 days with the probability of 70%. School B total academic schedule completion days using Critical Path Method and Project Evaluation and Review Technique were 91 and 87 days with the probability of 100% approximately. Also, School C total academic schedule completion days using Critical Path Method and Project Evaluation and Review Technique were 91 and 85 with the probability of 83%. Hence, the implementation of Critical Path Method and Project Evaluation and Review Technique in the scheduling of academic programs is very significant on the academic schedule completion time since their probabilities of program completion were 70% and above. In pursuit of the goals outlined in this seminar project, calculations involving both forward and backward pass were executed in the context of Critical Path Method. This process helped ascertain the earliest event, the latest commencement and completion times for activities across the three institutions. Slack values were also calculated to determine the critical part in the three institutions under study. However, the study recommended that school management and staff should implement Critical Path Method and Project Evaluation and Review Technique in scheduling, planning, coordinating and executing all academic activities to ensure timely and effective completion.

INTRODUCTION

Implementation of review techniques and critical path method on academic programs involves the management of academic schedules, tasks or activities to meet up the scheme of work throughout the academic sessions of that institution. Every academic program regardless of their schedules, curriculum, syllabus, its size, duration or budget, has some core tasks or activities that are crucial to its successful completion. Planning, scheduling, allocating and controlling of scheduled academic activities determines the duration of completion of program in each academic session.

However, these scheduled tasks or activities must be performed in a specific order such that the scheme cannot begin work on one task until the previous scheduled task is completed. Project Evaluation Review Technique (PERT) and Critical Path Method (CPM) assist school management in identifying duration through a network of tasks or activities as a basis for planning, executing and controlling the academic programs in order to minimize the total academic program cost and time.

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The value of PERT/CPM is not however, limited to educational academic programs but tutors and school administrators benefit from applying this technique in planning, organizing academic program and coordinating students. Curriculum planning is no longer just the collection of a set of individuals and virtually independent courses. Professional associations urge their local chapters to arrange annual meetings and to conduct seminars to educate them on the application of PERT and CPM for project and academic activities. Managing academic programs needs coordination of multiple tasks or activities across the institutions while setting a realistic schedule in monitoring the program/project progress.

PERT and CPM are important tools used in academic programs in scheduling various academic tasks to ensure that the deadlines of programs completion are achieved or met. Since academic program is a combination of courses and related activities organized for the achievement of specific learning outcome, CPM and PERT become very useful in meeting targets and achieving the desired goals. These two operations research approaches, PERT and CPM are used in this seminar work to evaluate their implementation in fulfilling all the obligations and academic operations till their completion within the stipulated time frame.

It is as a result of this, that this seminar work is embarked upon to examine the implementation of PERT and CPM on academic programs among some selected tertiary institutions in South-South States of Nigeria. Tertiary institutions are all post-secondary schools, public and private universities, colleges, polytechnics, technical training institutes and vocational schools.

Aim and Objectives of The Study

The aim of this study is to apply PERT and CPM on academic programs among selected tertiary institutions in south-south states of Nigeria and the objectives are to determine the;

1. Commencement and completion of academic schedules in school A, school B and school C using CPM forward and backward pass computation.

2. Critical path using CPM and PERT in school A, school B and school C as the selected institutions in south-south states of Nigeria.

3. Total duration time for the academic programs among these three institutions in each semester during the period under review using CPM and PERT.

4. Probability of completing academic programs within the stipulated time frame among the selected institutions in south-south states of Nigeria.

Research Questions

1. What are the commencement and completion times of academic schedule in school A, school B and school C using CPM forward and backward pass computation?

2. Is there any difference between the slack variables determined using CPM and the slack values using CPM and the critical path using PERT in three selected tertiary institution?

3. What are the differences between the total duration times for academic programs among these three institutions originally and using CPM and PERT?

4. Does the probability of the completing academic programs within the stipulated time frame proven CPM and PERT as effective tools in scheduling academic programs?

LITERATURE REVIEW

At the core of PERT/CPM lies the fundamental idea of breaking down a complex project into a series of tasks or activities. Each activity is then linked to particular events that signify its initiation and completion. To incorporate sequencing constraints, it is essential to recognize that the commencement of an activity depends on

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the successful conclusion of specific preceding activities. The field of project management has garnered significant interest, particularly in the planning and creation of new curriculum. Often, a collaborative group of individuals, many of whom are actively involved in teaching or have additional responsibilities, undertakes these tasks, especially in the initial stages.

Cook (2020) gave examples of many such project according to the monograph on application in education. He emphasized that individuals engaged in these endeavors are situated in various schools or institutions, amplifying the challenges of coordination. Project management, as defined by PMI (2014), involves applying knowledge, skills, and techniques to execute projects with efficacy and efficiency. Both the earliest and latest times for task initiation, as well as the earliest and latest times for task completion, can be determined using algorithms. Additionally, the concept of slack time is integral to this process.

Niazi and Painting (2014) in their study identified the following reasons for the delay in constructed management problems: difficulties in financing the project by contractor, natural calamities, strikes by labourers, etc. Li and Carter (2005) asserted that projects with a problematic start typically struggle to recover. Once a collective sense of direction is lost, considerable time and effort are dedicated to rectifying errors rather than advancing the project according to schedule. The effective implementation of review techniques and critical path methods necessitates meticulous planning, scheduling, and coordination of interrelated activities.

The establishment of schedules is essential for illustrating the connections between activities throughout the entire project, providing a tangible representation of accurate cost and time estimates for each task. Over time, PERT and CPM have emerged as extensively employed Operations Research techniques. As a result, professionals often interchangeably use the two terms or amalgamate them into a singular acronym, referred to as PERT and CPM. Hence, expecting that each of the technique has its own most appropriate areas of application

According to Bennet (2020), a civil engineer, the critical path method serves a dual purpose in project management. Firstly, it generates a structured schedule to direct the project team, and secondly, it serves as the foundation for monitoring project schedule performance by assessing the actual progress against the planned tasks. Bennet further clarified that the critical path method essentially addresses the question of "how long" each task takes before the entire project can be completed.

CPM is designed to plan and regulate a multitude of activities characterized by intricate dependencies related to design and sequencing. Functioning as a project scheduling tool, CPM incorporates time and cost functions. The estimates utilized in CPM exclusively represent the normal time, serving the purpose of identifying activities in the network diagram and distinguishing between critical and non-critical ones. Additionally, CPM is employed for analysis, with Kelly and Walker (2011) proposing that project managers use it as a fundamental tool linked to the trade-off between completion time and project cost. Kim et al. (2013) asserted that CPM is well-suited for determining normal conditions rather than probabilistic ones. Lin (2013) supported the perspective that the critical path sequence signifies the minimum time required to complete the project and emphasized that any delay in a task or activity on the critical path directly impacts the planned completion date.

PERT is a methodology that incorporates time as a variable in the processes of planning, scheduling, organizing, coordinating, and controlling activities that entail uncertainties, coupled with performance specifications. According to Salas-Morera et al. (2013), the Navy launched a project known as PERT in the 1950s to manage extensive defence projects, and it has been consistently applied for such purposes ever since.

Yang et al. (2014) observed that PERT serves as a method for assessing the project completion time, specifically tailored for projects characterized by uncertain activity durations. This approach involves assigning parametric probabilities to task completion times based on optimistic, pessimistic, and likely estimates, as suggested by Sharon et al. (2010). Yang et al. (2014) emphasized the practical utility of PERT in effectively managing large-scale projects. Philip et al. (2006) proposed that PERT calculates a weighted average estimate for each activity or task, incorporating optimistic, pessimistic, and most likely times, and determines variance or standard deviation to establish the total project duration within a given confidence range.

Yang, et al (2014) concluded that with respect to the PERT method, calculating the probability time frame

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support the project completed within a given time frame. However, as with all aspect of business, PERT becomes a very powerful tool in scheduling of project program and activation or task within a given time frame.

CPM and PERT have found widespread applications in various sectors, including construction, manufacturing, defence organizations, and academic institutions. For instance, Lee et al. (2017) employed Program Evaluation and Review Technique (PERT) to identify critical activities during the construction of a plant and to calculate the total project cost and duration under normal conditions. Meyers (2020) utilized this methodology for a unique school addition planning, focusing less on physical construction and more on contracting for staffing and equipping the new addition. The key benefit associated with the PERT and CPM were the identification of slack time in numerous activities, facilitating improved planning for personnel responsibilities and the timely completion of academic tasks.

The objective of academic program review is to continuously guide the development and seamless operation of academic progress. Program review is intricately linked to strategic planning, resource allocation, and decision-making at the department, college, and university levels, as highlighted by Venn and Smith (2021). Across the globe, colleges are tasked with periodically reviewing curricula and programs, leading to significant restructuring of tertiary education systems to improve their reach and effectiveness in scheduling, organizing, coordinating, and controlling academic activities within specified time frames. Network diagrams serve multiple purposes, providing a manageable framework for users in project management. These diagrams, integral to PERT and CPM techniques, are notably emphasized by Bennett (2020), who notes the original critical path method's use of arrows to represent tasks, connecting them at nodes to establish proper sequencing.

In a paper by Fondahl (2010), a Professor of Construction Management at Stanford University, it was suggested that each task should be depicted as a node and connected with lines or arrows indicating the sequence between tasks. The network diagram serves to illustrate the relationships among the activities of a project, enhancing comprehension. Additionally, the durations of certain activities are provided, and their start and end times (nodes) can be identified on the network diagram for clarity.

In the realm of academic programs and activities, completion requires a definite amount of time. Events, conversely, serve as specific points in time and dates. Once the foundational network is established, it becomes essential to estimate the completion times for various academic activities. Time estimates are incorporated along the sequence of arrows, aiding in the assignment of dates to an event. The critical path, identified as the sequence of activities requiring the longest time, dictates the overall project completion time. Both the time and dates, along with the critical path, can be documented on the network diagram and its accompanying table. Each academic activity should be allocated a scheduled time and date for execution, and this information is recorded in the PERT and CPM activity table. Consequently, the finalized network and table serve as a comprehensive summary of essential information for coordinating and controlling academic programs.

MATERIALS AND METHODS

The case study of this seminar work is on academic programs among the selected institutions in South-south states of Nigeria. Out of the six (6) States in South-South, three tertiary institutions were selected using accessible sampling method and they are below:

1. School A
2. School B
3. School C

School A is located in Calabar, Cross River State.

School B is located in Uyo, Akwa Ibom State.

School C is located in Port Harcourt, Rivers State.

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There are activities stated down in their academic programs respectively, starting from their resumption till their examination is ended. The duration of each activity is assigned based on the secondary data representing each of their academic schedule in first semester 2022/2023 to align with the period under review. Data for this study are analyzed using CPM/PERT method. The academic activities are labelled with codes from A-O and from 1-15 depending on their activity description and duration.

Forward pass computation and backward pass computation are used to determine the critical path and slack values through the latest time and earliest times activity schedules.

The identification of the critical path through PERT analysis involves calculating slack using values referred to as floats. This process utilizes three time estimates, namely; optimistic, most likely, and pessimistic. The critical path is determined by assessing the floats, specifically through slack calculations, within the activities analyzed in PERT. The critical path is determined by the values of floats = 0 i.e. TF = 0 as shown below

$$TF = LC - ES - D \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots equation\ 1$$

After the critical values are determined, then the next step is to calculate the mean (t_e) and variance (*var*) with the formula stated below:

$$Mean,\ t_e = \frac{[a+4m+b]}{6} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots equation\ 2$$

$$Variance,\ var = \left(\frac{b-a}{6}\right)^2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots equation\ 3$$

The calculation of the likelihood of program completion involves employing the standard normal formula, depicted as follows:

$$Z = \frac{X - \sum_{te^{critical}}}{\sqrt{\sum_{v^{critical}}}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots equation\ 4$$

Where:

X = total project completion time using CPM

$\sum_{v^{critical}}$ = total sum of all the variances of critical activities.

$\sum_{te^{critical}}$ = total sum of all the expected critical activities.

Z = read from the normal distribution table, calculator.net

This includes secondary data collected from the institution's portal and academic calendars

Table 3.4.1 School A academic schedule first semester 2022/2023 academic session

S/N	ACTIVITY	DESCRIPTION	DURATION IN DAYS
1	A	Arrival of returning and new student	1
2	B	Registration for all students	9
3	C	Lectures Start for all	32
4	D	Solemn Assembly	1

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5	E	Supplementary Examination	5
6	F	Inaugural Lecture	4
7	G	Orientation of new students	2
8	H	Summer Exams	5
9	I	Continuous Assessments	5
10	J	Matriculation	1
11	K	Convocation	4
12	L	Special Senate Meeting	1
13	M	Revisions	7
14	N	Exams	28

Source: School A portal for 2022/2023 academic session

Table 3.4.3 School B Academic Schedule for First Semester 2022/2023 Academic Session

S/N	ACTIVITY	DESCRIPTION	DURATION IN DAYS
1	A	Resumption of old and new students	1
2	B	Students' week	5
3	C	Christmas break	17
4	D	Resumption from Christmas	1
5	E	Lectures	61
6	F	Revision	5
7	G	Exams	12

Source: School B Academic calendar for 2022/2023 First Semester

Table 3.4.3 School C academic schedule for first semester 2022/2023 academic session

S/N	ACTIVITY	DESCRIPTION	DURATION IN DAYS
1	A	Registrations	68
2	B	Lectures	86
3	C	First semester exams	12
4	D	First semester break	5

Source: School C Academic Schedule for First Semester 2022/2023 Academic Session

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RESULTS

Table 4.1.1 School A academic schedule for first semester 2022/2023 academic session

S/N	ACTIVITY	DESCRIPTION	DURATION IN DAYS	i - j
1	A	Arrival of returning and new student	1	1–2
2	B	Registration for all students	9	2 – 3
3	C	Lectures Start for all	32	2 – 4
4	D	Solemn Assembly	1	3 – 5
5	E	Supplementary Examination	5	4 – 6
6	F	Inaugural Lecture	4	5 – 7
7	G	Orientation of new students	2	6 – 8
8	H	Summer Exams	5	7 – 9
9	I	Continuous Assessments	5	8 – 10
10	J	Matriculation	1	9 –11
11	K	Convocation	4	10 – 12
12	L	Special Senate Meeting	1	11 – 13
13	M	Revisions	7	12 –13
14	N	Exams	28	13 – 14

Source: school A portal

Table 4.1.2 School A forward pass computation

S/N	**Immediate preceding event**	**Duration (in days)**	**Earliest activity time**	**MAX**
1	-	1		0
2	1	9	0 + 1	1
3	2	32	1 + 9	10
4	2	1	1 + 32	33
5	3	5	10 + 1	11
6	4	4	33 + 5	38
7	5	2	11 + 4	15
8	6	5	38 + 2	40

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9	7	5	15 +5	20
10	8	1	40 + 5	45
11	9	4	20 + 1	21
12	10	1	45 + 4	49
13	11, 12	7	21 + 1, 49 + 7	56
14	13	28	56 + 28	84

The table above demonstrates the computation of school A forward pass with CPM, where the initial event E_1 = 0 and the terminal event E_{14} = 84. Hence, the completion of academic schedule with CPM takes 84 days. Its network diagram is shown below:

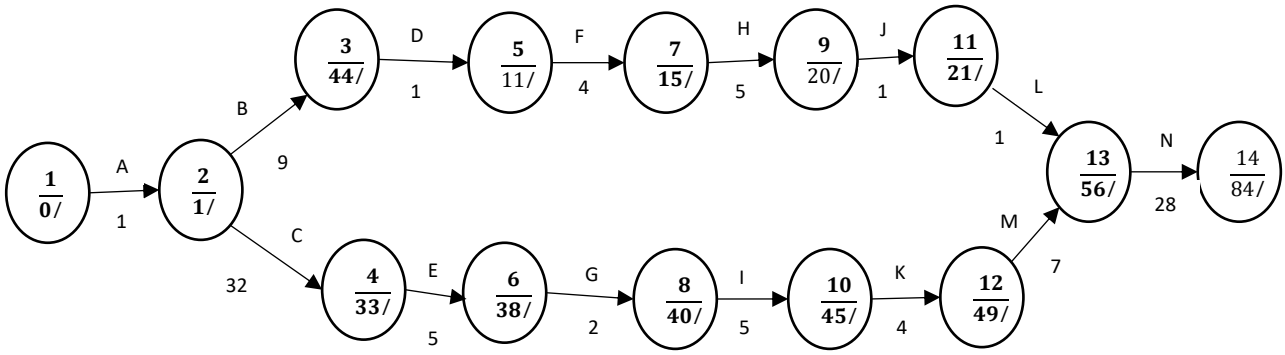

Figure 4.1.2 School A Forward Pass Network Diagram

Table 4.1.3 School A forward pass computation

S/N	Immediate preceding event	Duration (in days)	Largest activity time	MIN
14	–	28	84	84
13	14	7	84 – 28	56
12	13	1	56 – 7	49
11	13	4	56 – 1	55
10	12	1	49 – 4	45
9	11	5	55 – 1	54
8	10	5	45 – 5	40
7	9	2	54 – 5	49
6	8	4	40 – 2	38
5	7	5	49 – 4	45
4	6	1	38 – 5	33

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3	5	32	48 – 1	47
2	3, 4	9	44 – 9, 33 – 32	1
1	2	1	1 – 1	0

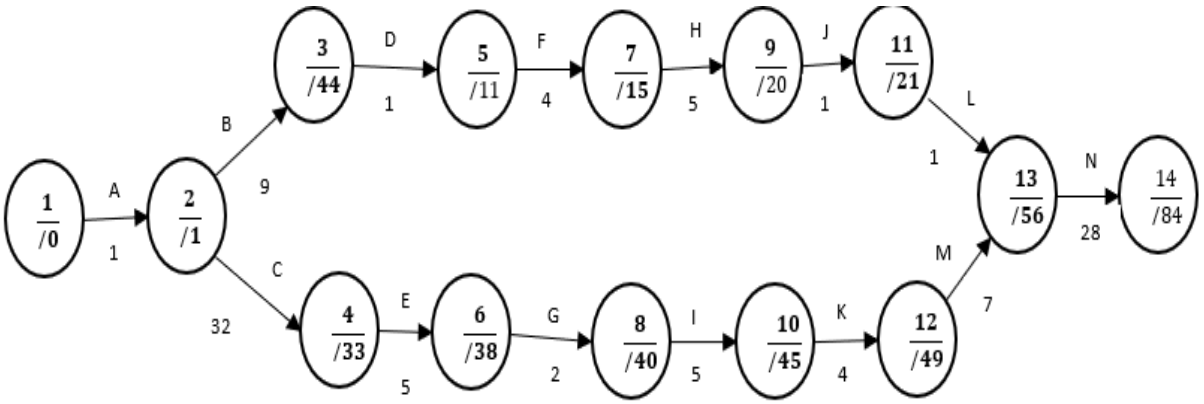

Figure 4.1.3 School A Backward Pass Network Diagram

To identify the critical path through the Critical Path Method (CPM), equation (4) from section 3.3.1 is utilized to calculate slack values, which are then consolidated and presented in the accompanying table. A visual representation, known as a network diagram, is created to illustrate the sequential order of activities along the critical path.

Table 4.1.2 School A Slack computation

Events	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Latest time	0	1	44	33	45	38	49	40	54	45	55	49	36	84
Earliest time	0	1	10	33	11	38	15	40	20	45	21	49	36	84
Slack	0	0	34	0	34	0	34	0	34	0	34	0	0	0

Therefore, the critical path is 1-2-4-6-8-10-12-13-14 representing a thick lines and arrows as shown in the network diagram below:

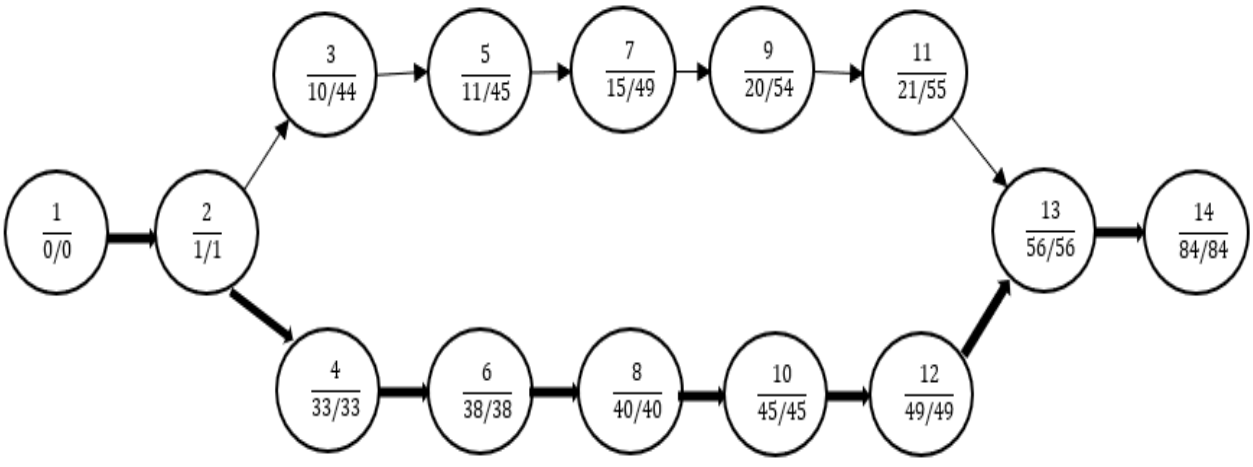

Figure 4.1.4: The Critical Path of school a Academic Schedule with CPM

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PERT three times estimates from the secondary data in table 3. Is used to calculate the mean using equation (2) and variance using equation (3) as summarized in the table below:

Table 4.1.5 School A PERT calculation

S/N	Activity	I – j	a (in days)	m (in days)	B (in days)	$te_{(mean)}$	Var
1	A	1 – 2	1	1	3	1	0.111
2	B	2 – 3	7	9	11	9	0.444
3	C	2 – 4	30	32	34	32	0.444
4	D	3 – 5	1	1	3	1	0.111
5	E	4 – 6	3	5	7	5	0.444
6	F	5 – 7	2	4	7	4	0.694
7	G	6 – 8	1	2	5	2	0.444
8	H	7 – 9	3	5	8	5	0.694
9	I	8 – 10	3	5	8	5	0.694
10	J	9 – 11	1	1	3	1	0.111
11	K	10 – 12	2	4	7	4	0.694
12	L	11 – 13	1	1	3	1	0.111
13	M	12 – 13	4	7	10	7	1.0
14	N	13 – 14	26	28	30	28	0.444

Applying equations (2) and (3), section 3.3.2

$\sum_{te^{critical}}$ = 1 + 9 + 1 + 4 + 5 + 1 + 1 + 7 + 28 = 57

$\sum_{v^{critical}}$ = 0.111 + 0.444 + 0.111 + 0.694 + 0.694 + 0.111 + 0.111 + 1 + 0.444 = 3.72

Also, applying equation (4), section 3.3.2

Probability $\left[Z \leq \frac{84-57}{\sqrt{3.72}} = \frac{27}{\sqrt{3.72}} = \frac{27}{1.93} = 14\right] = prob\,[Z \leq 14] = 1$

Therefore, the probability that school A academic schedule can be completed in 57 days is 1, implying approximately 100.

Table 4.2.1: School B academic schedule for 2022/2023 first semester academic session

S/N	Activity	Description	Predecessor	Duration	i – j
1	A	Resumption of old and new students	-	1	1 – 2
2	B	Students' week	-	5	1 – 3

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3	C	Christmas break	A	17	2 – 4
4	D	Resumption from Christmas	B	1	3 – 5
5	E	Lectures	C	61	4 – 6
6	F	Revision	D	5	5 – 6
7	G	Exams	E, F	12	6 – 7

Source: School B academic calendar for first semester 2022/2023 Academic Session

Table 4.2.2 Forward pass computation for school B

S/N	**Immediate preceding events**	**Duration in days**	**Latest activity time**	**MAX**
1	-	1	0	0
2	1	5	0 + 1	1
3	1	17	0 + 5	5
4	2	1	1 + 17	18
5	3	61	5 + 1	6
6	4, 5	5	18 + 61	79
7	6	12	79 + 12	91

The table above demonstrates the calculation of forward pass with CPM in which the initial event, $E_1 = 0$ and the terminal event, $E_2 = 91$. Also, the completion of the academic programs in school B takes the total duration of 91 days.

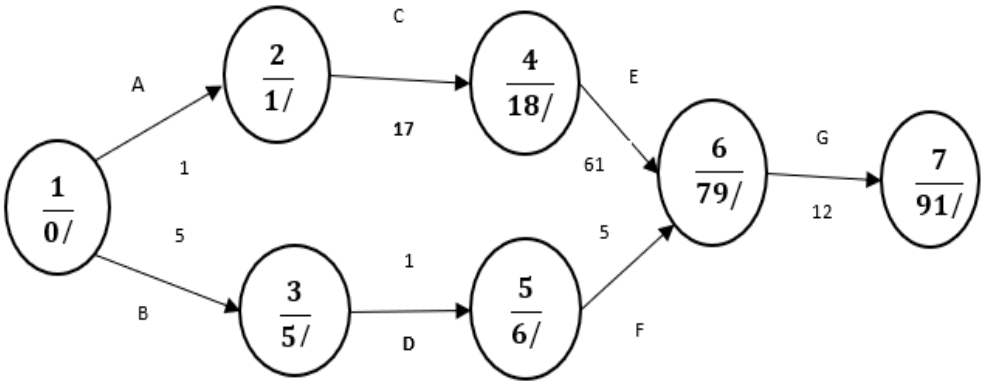

Figure 4.2.2 Forward pass network diagram with CPM

Table 4.2.3 Backward pass computation for school B

S/N	Immediate preceding events	Duration in days	Earliest activity time	MIN
7	-	12	91	91

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6	7	5	91 – 12	79
5	6	61	79 – 5	74
4	6	1	79 – 61	18
3	5	17	74 – 1	73
2	4	5	18 – 17	1
1	2, 3	1	1- 1, 73 – 5	0

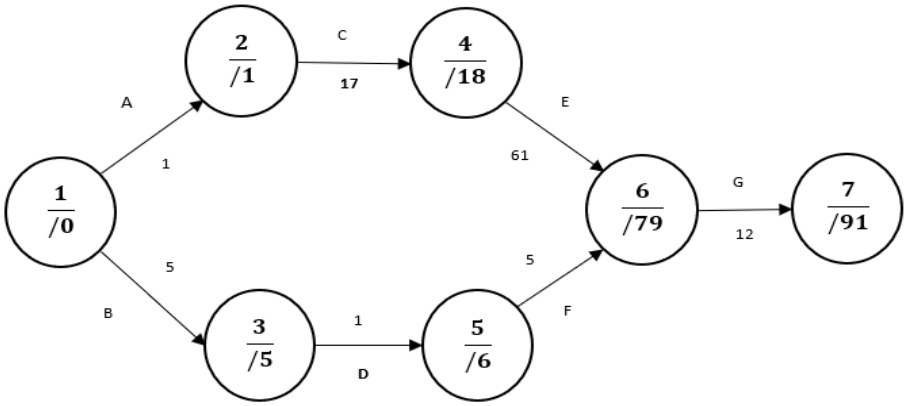

Figure 4.2.3 Backward computation diagram with CPM

To determine the critical path using CPM, the slack values are summarized in the table below

Table 4.2.4 School B slack computation

Events	1	2	3	4	5	6	7
Latest time	0	1	73	18	74	79	91
Earliest time	0	1	5	18	6	79	91
Slack	0	0	68	0	68	0	0

Therefore, the critical path is 1 – 2 – 4 – 6 – 7 and is representing the thick lines and across as shown in the network diagram below:

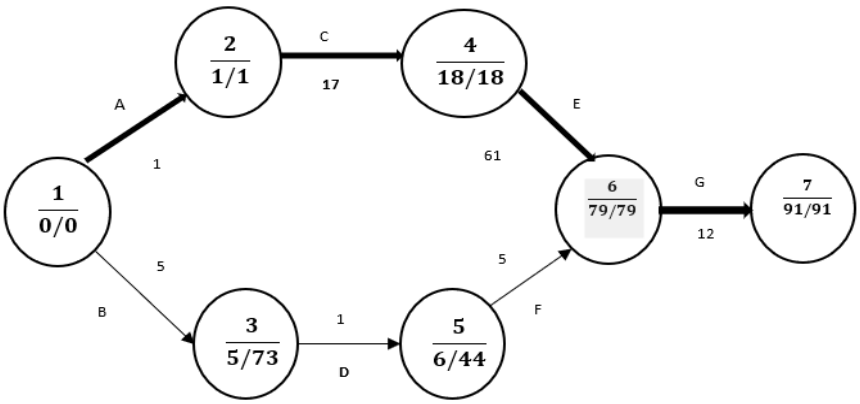

Figure 4.2.4 the critical path of school B Academic events

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Table 4. 2.4 Analysis of school B academic programs with PERT

S/N	Activity	i – j	a (in days)	m (in days)	B (in days)	e (mean)	Var
1	A	1 – 2	1	1	3	1	0.111
2	B	1 – 3	3	5	7	5	0.444
3	C	2 – 4	15	17	19	17	0.444
4	D	3 – 5	58	61	64	61	1.0
5	E	4 – 6	1	1	3	1	0.111
6	F	5 – 6	3	5	7	5	0.444
7	G	6 – 7	10	12	14	12	0.444

Applying equations (2) and (3), section 3.3.2

$\sum_{te^{critical}}$ = 1 + 5 + 61 + 5 + 12 = 84

$\sum_{v^{critical}}$ = 0.111 + 0.444 + 1.0 + 0.694 + 0.4444 + 0.444 = 2.443

Also applying equation (4), section 3.3.2

Probability $\left[Z \leq \frac{91-84}{\sqrt{2.443}} = \frac{7}{\sqrt{2.443}} = \frac{7}{1.53} = 4.48\right] = prob\ [Z \leq 4.48] = 0.9999$

Therefore, the probability that school B academic schedule can be completed in 85 days is 1, implying approximately 100%.

Table 4.3.1 School C academic schedule for first semester 2022/2023 academic SESSION

Events	Activity	Description	Predecessor	Duration (in days)	i – j
1	A	Registration	-	68	1 – 2
2	B	Lectures	A	86	1 – 3
3	C	1st semester exams	B	12	2 – 4
4	D	1st semester break	C, D	5	3 – 4

T able 4.3.2 School C forward pass computation

S/N	Immediate preceding events	Duration (in days)	Earliest activity time	MAX
1	-	68	0	0
2	1	86	0 + 68	68
3	1	12	0 + 86	86
4	2, 3	5	68 + 12, 86 + 5	91

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The above table demonstrates the computation of school C forward pass with CPM, where the earliest event, $E_1 = 0$ and the terminal event, $E_4 = 91$

Hence, the completion of the academic schedule in school C during the period under review takes a total duration of 171 days

Network diagram for forward pass is given below:

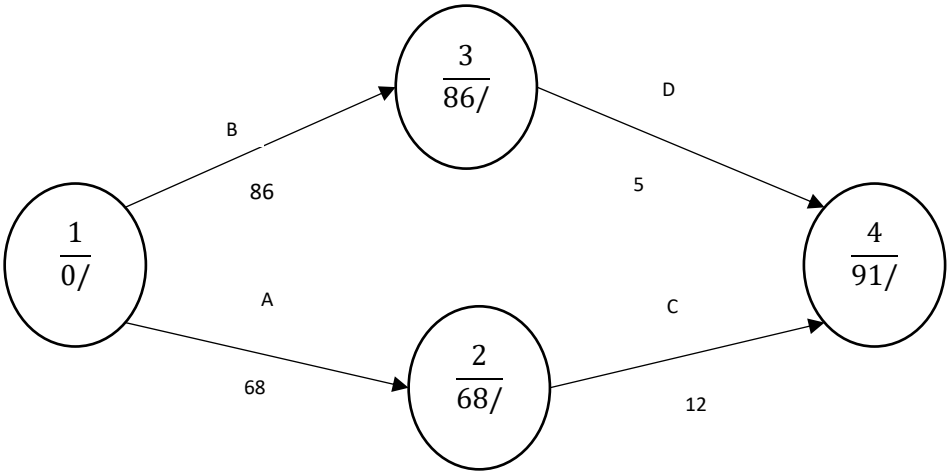

Figure 4.3.2 School C forward pass network diagram

Table 4.3.3 School C backward pass computation

Events	Immediate proceeding event	Duration (in days)	Latest activity time	MIN
4	-	5	91	91
3	4	12	91 – 5	86
2	4	86	91 – 12	79
1	2, 3	68	79 – 68, 86 – 86	0

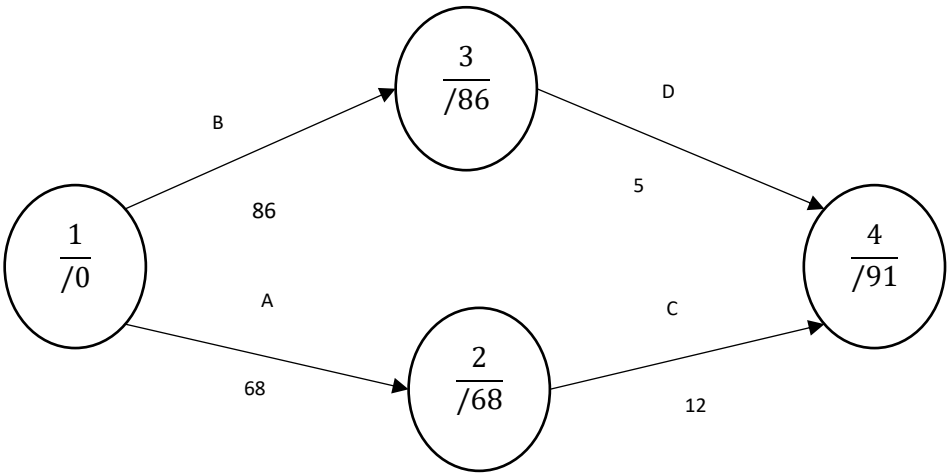

Figure 4.3.3 school C Backward Pass Computation

To determine the critical path using CPM, the slack values are summarized in the table below

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Table 4.3.4 School C Slack computation

Events	1	2	3	4
Latest time	0	79	86	91
Earliest time	0	68	86	91
Slack	0	11	0	0

Therefore, the critical path is 1 – 3 – 4 and its network diagram is shown below with thick lines and arrows

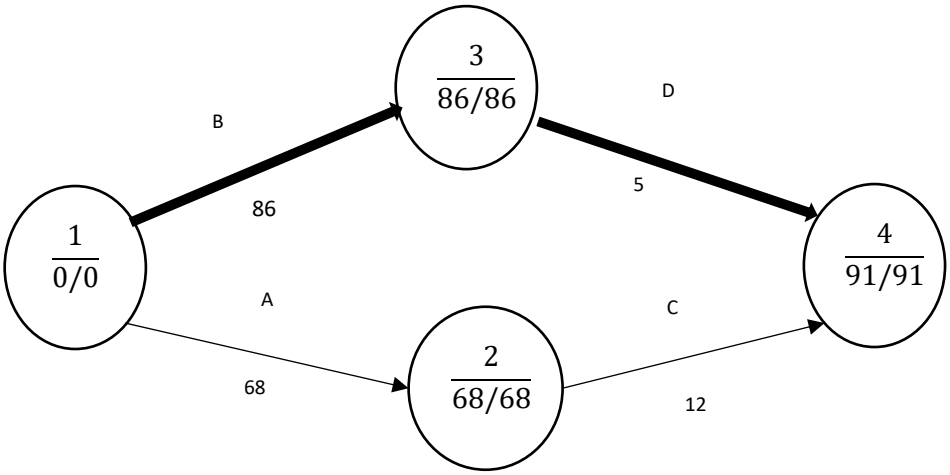

Table 4.3.5 Analysis of school C academic programs with PERT

S/N	**Activity**	**I – j**	**a (in days)**	**M (in days)**	**B (in days)**	**te (mean)**	**Var**
1	A	1 – 2	66	68	70	68	0.444
2	B	1 – 3	84	86	88	86	0.444
3	C	2 – 4	10	12	14	12	0.444
4	D	3 – 4	3	5	7	5	0.444

Applying equations (2) and (3), section 3.3.2

$\sum_{te^{critical}}$ = 68 +12+5 = 85

$\sum_{v^{critical}}$ = 0.444 +0.444 +0.444=1.322

Also applying equation (4), section 3.3.2

Probability $\left[Z \leq \frac{91-85}{\sqrt{1.332}} = \frac{6}{\sqrt{1.332}} = \frac{6}{1.154} = 5.20\right] = prob\ [Z \leq 5.20] = 1$

Therefore, the probability that school C academic schedule can be completed in 85 days is 1 implying approximately 100%.

DISCUSSION

Table 3.4.2 summarizes school A academic first semester schedule 2022/2023 academic session in 105 days

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originally. Then applying CPM is 84 days as shown in table 4.1.2 and applying PERT in completing the same academic activities in school A resulted in 57 days, as shown in table 4.1.5 with probability of 100%. Implying that PERT is more effective. Table 3.4.3 shows the total completion academic program for school B was originally 102 days. Table 4.2.2 summarizes school B forward pass computation using CPM in 91 days and table 4.2.5 for school B with PERT is 85 days. Table 4.3.1 shows school C forward pass computation in 171 days, and table 4.3.5 with PERT total completion of academic programs is 85 days. Furthermore, slack values were computed in determining the critical path in the three institutions under study.

RECOMMENDATIONS

1. School management and staff should implement Critical Path Method and Project Evaluation and Review Technique in scheduling, planning, coordinating and executing all academic activities to ensure timely and effective completion.

2. Academic staff should endeavour to work harder in order to cover the syllabus/curriculum so that every academic schedule can be completed within the stipulated time frame to align with the duration of total completion time based on CPM and PERT.

3. Academic and non-academic union should avoid strike actions in order to curtail delay in timely completion of academic programs /schedules.

4. Students should be well guided in executing their studies committed seriously, so that they can finish or complete their desired courses or academic programs within the stipulated time frame to correspond with CPM and PERT completion deadline

5. Government should ensure prompt provision of welfare, incentives and regular payments of salaries so that the staff that implement CPM and PERT can be encouraged to carry out their duties effectively in order to meet-up with the completion deadlines.

CONCLUSION

Drawing conclusions from the findings of this seminar project, it can be inferred that:

1. Utilizing CPM and PERT for scheduling academic programs holds immense importance in achieving timely completion of academic schedules, with their potential application evident in the three institutions.

2. In pursuit of the goals outlined in this seminar project, calculations involving both forward and backward pass were executed in the context of CPM. This process helped ascertain the earliest event, the latest commencement, and completion times for activities across the three institutions. Slack values were also calculated to determine the critical path in the three institutions under study.

3. The possibility of completing the academic schedules in the three institutions is very high since their probabilities of completion were 70% and above.

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