# Assessment of Central Tendency Measures and Network Techniques of Operations Research in Apparel Supply Chain Management

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## Abstract:

Any project is considered to involve integration of various activities and this is considered to be one of the challenging job of a manager. Many aspects must be examined on what to coordinate most of these tasks in order to develop a good plan and track the project plan. CPM and PERT, both close by related activity research methodology, are now ready to help the project leader fulfil these tasks.. These techniques are hugely useful for planning and demonstrating the integration of all methods. They typically use the software package to develop schedule information and then deal with all the data needed to monitor the progress of the project. Some general issues encountered in manufacturing of textiles are: how to calculate the length of any activity Calculation of order order placement identification of processes with 0 tolerance and those that need distinctive care and consideration for avoiding delay of final delivery, identification and rationalization of worker day off for giving a negligible influence on performance.To identify this, several operations research measures are available to do is provide scientifically sound solutions, and we used the CPM Critical Path Method (CPM) and PERT Program Evaluation and Review Techniques (PERT) with measures of Central Tendency methods to analyse and resolve issues that arise during various stages of textile manufacturing and production. and demonstrate how the average technique of central tendency assists and best duration to the supply chain in resolving challenges that arise during various stages of textile manufacture and production in this article.

**Keywords:** *Operational Research, Network Techniques, CPM, PERT, central tendency , Supply Chain Management, Apparel Industry*

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## Introduction

Many have cited that clothing manufacturing is not "rocket science" and that the textile industry does not need scientists or apply several principles that are scientific in nature such as. Operations Research (OR) is an mathematics branch that uses approaches such as scientific problems, figures, and processes (Algorithms) for making the right or better choices when it comes to maximizing (profit) on complex problems. Optimization assembly line, related to high produce, etc.) Or minimal (loss of cost, risk reduction, etc.) [1-3]. There are several intriguing mathematical theories in the OR field, that can be applied in textile manufacturing which can result in great increase in the profit [4].

Some general issues encountered in manufacturing of textiles are: how to estimate the duration of any activity; order lead time estimation, identification of processes with 0 tolerance and those that need distinctive care and consideration for avoiding delay of final delivery, identification and rationalization of worker day off for giving a negligible influence on performance. To solve all this, several measures in Operations Research are available to offer solutions that are scientific in nature and we have taken CPM Method of the Critical Path (CPM). PERT Program Evaluation and Review Techniques (PERT) are used to examine and resolve issues that arise during various stages of textile manufacture and production.

PERT was responsible for variability when evaluating the job's length. although it was not possible to schedule the project, although all operational details and duration were not known exactly, using the same estimate for operational time in CPM as they were known to have done or were convinced. Even though PERT is for extensive, intricate, non-monotonous tasks with potential period estimations, CPM on the other hand is best suited for enhancing task lead time in general iterative tasks with fixed time estimations [5].

## PERT and CPM

Sometimes any task or projects might take up a random and unplanned trend. PERT which is considered to be a substitute to CPM is an efficient technique besides allowing one to incorporate as many changes into your projects as you want [6]. This is applied for evaluating and estimating the required time completing project tasks, in addition to determining the least time required to completing the project. Sudden issues and several unplanned tasks can hinder particular tasks during any project undertaken and this completely changes the predecessors. This coincidence is a rather significant factor for task random systems. One could never manage any task as per the goals set at the project beginning. CPM was introduced in the year 1960 by Du Pont and emphasized the expense of a task versus the time required to finish it (it is possible to reduce your time by spending more money on certain activities - how does this amount make project time completed?) [7]. CPM generally gets applied in product management for avoiding repetitive jobs and so operational time could be estimated with substantial certainty because of previous knowledge. Today, When CPM is involved; one can find that something is amiss always. This is because the CPM employs a decisive model that simply has a stable time estimation done for every activity. Though, this is known for easy implementation, it is never suitable for big projects that could become more complex over time [8]. On the other hand, PERT was introduced by the U.S. Navy in 1958 to plan and regulate the Polaris missile program. The importance of this model is to complete the task in the least time amount. Additionally, PERT is capable of withstanding the full duration of an indefinite activity (e.g. full time for a specific activity is 4 weeks, yet it can be somewhere amid 3 weeks and 8 weeks to the maximum).

Project management makes use of PERT by calculating the time allotted (expected time) to complete a given activity [9]. The main difference is the approach to dealing with the PERT difference. Optimistic (at least), most likely, and



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pessimistic (long) - you are determined to successfully complete any activity three times in a row. Then, these time estimations are employed by subtracting the beta probability distribution from the weight average, and determining the time behind this weighting given average function [9–10].

**Table.1. Characteristics of CPM and PERT**

| CPM | PERT |
|---|---|
| Deterministic | Probabilistic |
| Historical data estimation | Estimates can be undefined. |
| Focuses on Time trade off | largely plan oriented |
| Scalable for minor tasks | known for its R&D suitability |
| Best known cost and time estimation | Consist of biasness, hinges on decision for positive/negative time estimations |

**Possible Application Areas in the Manufacturing of Textiles**

PERT maps represent information on events, activities, and duration and dependencies for completing a project [11–16]. Another node closes the other end of the activity line, similarly known as the event that marks the beginning of the next activity. For example an event with 'Fit Sample Making' will need an approval using a sample fit.

**Estimation time Calulation by Geometric Mean(G.M):**

Time required for completing a task and moving on to the next will be calculated using Optimistic time Average (O) and the maximum time needed (P-Pessimistic time) and this is known as Estimated time (TE). estimated will caluculated by geometric mean $=\sum \log a_i/N$ instead (TE = (O + 4M + P/6) [6]

Geometric Mean could be define as: Log GM $=1/n\log(a_1 x a_2 x a_3 x \ldots . a_{n)}$

geometric mean $=\sum \log a_i/N$

Therefore,Geometric Mean=Antilog($\sum \log a_i/N$)



**Table.2. Finding Estimation Time used by G.M**

| 2 | 4 | 6 | TOTAL | TOTAL/N | A.LOG) |
|---|---|---|---|---|---|
| 0.301029996 | 0.60206 | 0.778151 | 1.681241 | 0.560414 | 3.6 |
| 3 | 5 | 7 | | | |
| 0.477121255 | 0.69897 | 0.845098 | 2.021189 | 0.67373 | 4.7 |
| 4 | 5 | 9 | | | |
| 0.602059991 | 0.69897 | 0.954243 | 2.255273 | 0.751758 | 5.6 |
| 4 | 6 | 8 | | | |
| 0.602059991 | 0.778151 | 0.90309 | 2.283301 | 0.7611 | 5.8 |
| 4 | 5 | 9 | | | |
| 0.602059991 | 0.69897 | 0.954243 | 2.255273 | 0.751758 | 5.6 |
| 3 | 4 | 8 | | | |

| | | | | | |
|---|---|---|---|---|---|
| 0.477121255 | 0.60206 | 0.90309 | 1.982271 | 0.660757 | 4.6 |
| 3 | 5 | 7 | | | |
| 0.477121255 | 0.69897 | 0.845098 | 2.021189 | 0.67373 | 4.7 |

**Estimation Calulation by Harmonic Mean(G.M):**

The time taken to complete one activity and move on to the next is called estimated duration. It is computed using the Optimistic time Average (O) and the maximum time required (P-Pessimistic time) (TE). Instead, the Harmonic Mean will be used (TE = (O + 4M + P/6)).

Because the harmonic mean is equal to the inverse of the mean of inverses, the harmonic mean "HM" can be determined using the formula given:

If $m_{1,}$ $m_2$,$m_3$,..., $m_n$ are the individual items up to n terms, then HM = n / [(1/m1)+(1/m2)+(1/m3)+...+(1/$m_n$)].

**Table.3. Finding Estimation Time used by H.M**

| | | | | |
|---|---|---|---|---|
| 2 | 4 | 6 | | |
| 0.5 | 0.25 | 0.166666667 | 0.916666667 | 3.3 |
| 3 | 5 | 7 | | |
| 0.333333333 | 0.2 | 0.142857143 | 0.676190476 | 4.4 |
| 4 | 5 | 9 | | |
| 0.25 | 0.2 | 0.111111111 | 0.561111111 | 5.3 |
| 4 | 6 | 8 | | |
| 0.25 | 0.166666667 | 0.125 | 0.541666667 | 5.5 |
| 4 | 5 | 9 | | |
| 0.25 | 0.2 | 0.111111111 | 0.561111111 | 5.3 |
| 3 | 4 | 8 | | |
| 0.333333333 | 0.25 | 0.125 | 0.708333333 | 4.2 |
| 3 | 5 | 7 | | |
| 0.333333333 | 0.2 | 0.142857143 | 0.676190476 | 4.4 |



The time it takes to finish one activity and move on to the next is called estimated time. The Optimistic time Average (O) and the maximum time required (P-Pessimistic time) are used to calculate it (TE). Instead, (TE = (O + 4M + P/6)) will be employed

**Estimatime Calulation by Average(Mean)**

The arithmetic average of a data set is called the mean. This is calculated by multiplying tthe number of samples in a data set divided by total of the data collection's numbers

The Average =∑x/N

Here, X represents observations and represents the summation.

The number N denotes the number of observations.

**Table.4.Estimated Time By G.M,H,M,Average, Pert Formula :**

| Activity code | Activity description | Predecessor | Optimistic(a) | Most likely (m) | Pessimistic(b) | Duration G.M=Antilog(∑logai/N) | Duration MEAN | Duration HARMONIC MEAN | Duration Estimated time |
|---|---|---|---|---|---|---|---|---|---|
| **a** | **Measurement chart making** | **-** | **2** | **4** | **6** | **3.6** | 4 | 3.3 | 4 |
| **b** | **Sampling fabric sourcing** | **-** | **3** | **5** | **7** | **4.7** | 5 | 4.4 | 5 |
| **c** | **Pattern making** | a | **4** | **5** | **9** | **5.6** | 6 | 5.3 | 5.5 |
| **d** | **Marker making** | a | **4** | **6** | **8** | **5.8** | 6 | 5.5 | 6 |
| **e** | **Sample making** | **b,c** | **4** | **5** | **9** | **5.6** | 6 | 5.3 | 5.5 |
| **f** | **Labour costing** | **d** | **3** | **4** | **8** | **4.6** | 5 | 4.2 | 4.5 |
| **g** | **Material costing** | e | **3** | **5** | **7** | **4.7** | 5 | 4.4 | 5 |



Time required for completing a task and moving on to the next will be calculated using Optimistic time Average (O) and the maximum time needed (P-Pessimistic time) and this is known as Estimated time (TE). (TE = (O + 4M + P/6) [6].The time it takes to complete a preceding event in order to enable for activities to terminate early once they are completed is known as advanced notice.[18–20].

While we're on the subject, similar to some project management, Apparel manufacturing is likewise a system of actions which should be performed in series and in parallel as well. CPM and PERT can be used very efficiently at several phase in apparel manufacturing.

**Applying PERT and CPM in activities in pre-production**

Pre-production in textile industry involves a too many activities, although to shorten clarification, just certain activities of manufacturing of textiles are deliberated. Whether one is using a software application or manually analyzing the design, the following steps must be taken to use PERT:

- Breaking project into smaller tasks activities.
- Identify the dependences amid sequences and activities that are one activity could be started till the other is over.
- Estimation of TE for every activity should be done.
- PERT chart and indication the critical path should be done
- slack time count [21-24]

**Sequencing and identifying dependences among activities**

Every activity is indexed; the subsequent activity and the next. Then there is the relationship between them, i.e. one activity is not initiated until the other is completed. This is usually prepared in tabular form, where predecessors' codes will be given. Activities such as 'measurement chart preparation' display no antecedents; this shows that this activity usually will not be determined by completing another activity. At hand, there might be several activities in the previous column; e.g, the 'sampling' activity does not begin until the completion of (sampling material sourcing (b) and sample making (c), and so the two predecessors.

**Timescale Estimation for every activity**

Each activity in the process above must possess a previous and successor function. Second, it is important to estimate the time scale of each activity and calculate the time lag time using the principles described above. For example, a cycle can be studied to know the elapsed time for a 'sample preparation' task, to find out how long a person will take, or to ask for a specific activity within the predictable activity duration. Identify all required allowances that apply to allowances (it is the margin activity time provided) grounded on unnecessary and non-preventable allowances. When no allowances are added (O), cycle time can be considered a hopeful time, with more time (M) coming to add unavoidable allowance to cycle time and unavoidable. (P) Avoidable allowances in times of pessimism are associated with simultaneous cycle times. One can ask the job experts if they needed to know the average O, P and M as well as the Estimated Time, when situations are unfeasible to calculate time.

The subsequent case of a prototype plan consists of 7 operations, labeled by G. sourcing of materials or fabric may be simultaneously performed (A&B) by making measurement maps and sampling, while others cannot do so until their previous activity is completed (sampling cannot be started until the measurement chart is complete). In addition, there are three time estimates for each activity: A considered to be Time Estimate that is Optimistic while B is Pessimistic and M being the High Time estimate. Therefore, the time lag (TE) is calculated by the equation Geometric Mean=Antilog($\sum \log a_i$/N) instead (TE = (O + 4M + P/6) [6]

When reviewing activities, project review, approval, customer reviews and all of these are time consuming and should never be underestimated. [31] 1 to 2 weeks of review is not uncommon. Maintenance and user approval may take longer. When preparing plans, it is imperative for including writing of documents and reports for various purposes like editing.



**Fig.1. Timescale for each activity used by finding duration Geometric Mean(G.M):**

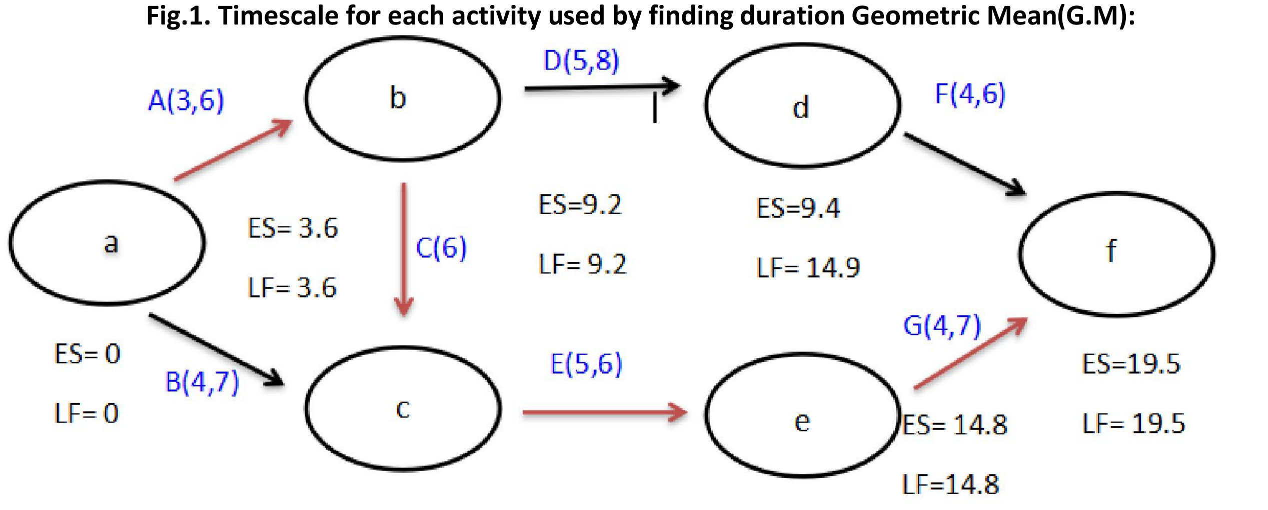


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**Fig.2. Timescale for each activity used by finding duration Harmonic Mean(H.M):**

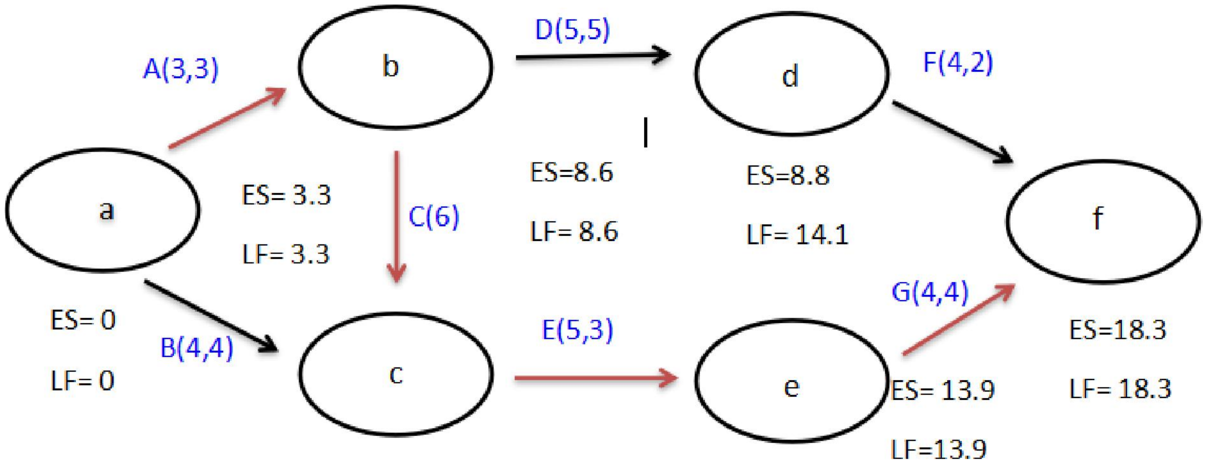




**Fig.3. Timescale for each activityused by finding duration Average (Mean):**

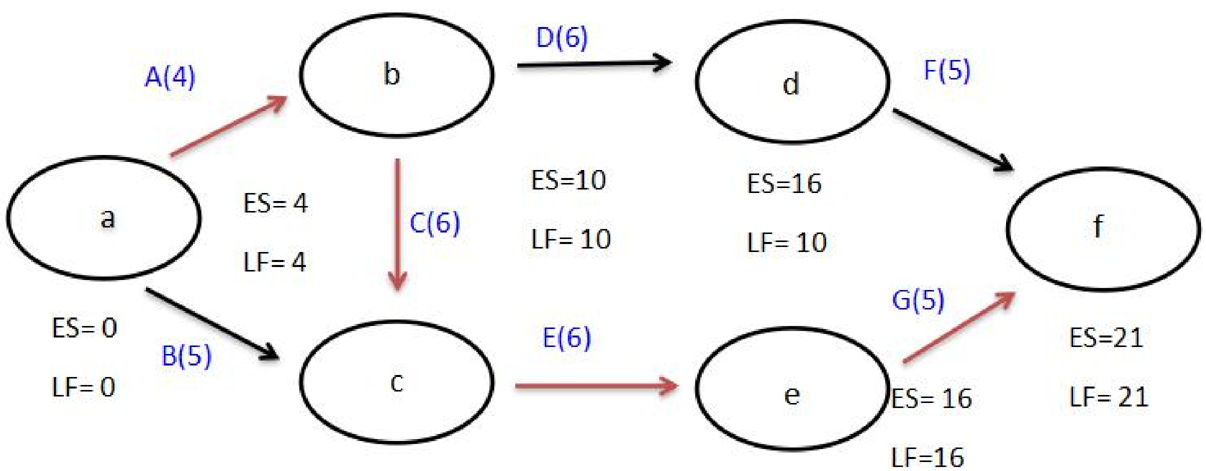


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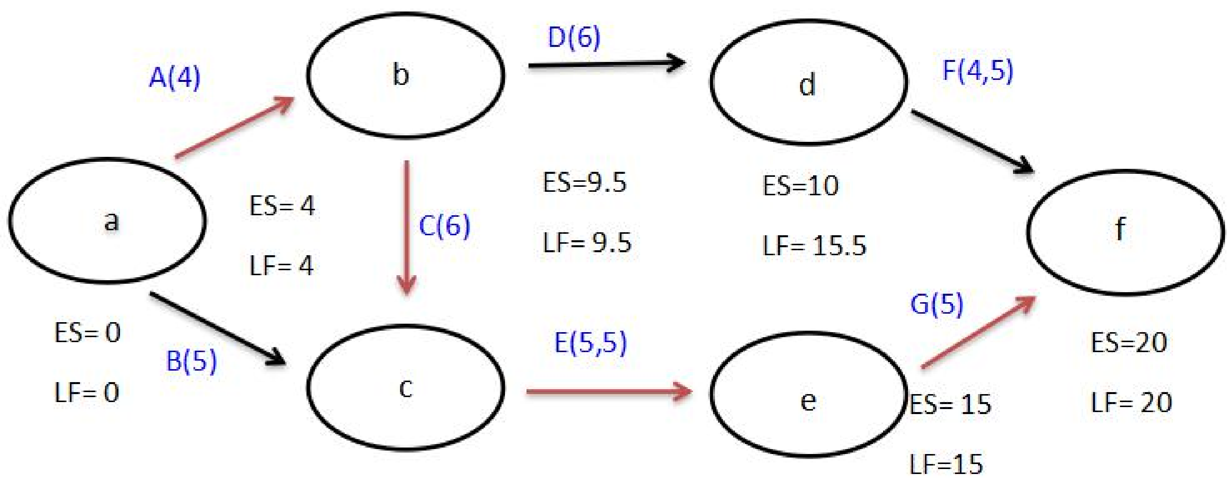
**Fig.4. Timescale for each activityiused by finding duration CPM AND PERT formula**






**Construct a PERT chart and highlight the Critical path.**

After completing these steps, a PERT chart can be created. The more difficult the path, the more time it takes for finishing. For setting the path time, one has to include the working duration for every accessible path.consider as $a_i$ where I - 1,2, 3…n and bate finish considers as $b_j$ j-1,2,3…m

**Determine Critical Path by finding duration Geomatric Mean:**

**Upward Approach: :**

**a1**=0,
a2=*a1*+*t*1,2 [*t*1,2=*A*=3.6]=0+3.6=3.6,,a3=*Max*{a*i*+*t i*,3}[*i*=1=*Max*{*a1*+*t*1,3;a2+*t*2,3}
=*Max*{0+4.7;3.6+5.6}=*Max*{4.7;9.2}=9.2,
a4=a2+*t*2,4 [*t*2,4=*D*=5.8]=3.6+5.8=9.4
a5=a3+*t*3,5 [*t*3,5=*E*=5.6]=9.2+5.6=14.8,
a6=*Max*{a*i*+*ti*,6}[*i*=45,]=*Max*{a4+*t*4,6;a5+*t*5,6}
=*Max*{9.4+4.6;14.8+4.7} =*Max*{14;19.5}=19.5

**Downward Approach :**

**b**6=b6=19.5 ,
b5=b6-*t*5,6 [*t*5,6=*G*=4.7]=19.5-4.7=14.8*b*4=*b*6-*t*4, 6 [*t*4,6=*F*=4.6]=19.5-4.6=14.9
*b*3=*b*5-*t*3,5 [*t*3,5=*E*=5.6]=14.8-5.6=9.2,
*b*2=Min{*bj*-*t*2,*j*}[*j*=43,]=Min{*b*4-*t*2,4;*b*3-*t*2,3}

=Min{14.9-5.8;9.2-5.6}, =Min{9.1;3.6} ,=3.6
*b*1=Min{*bj*-*t*1,*j*}[*j*=32,]
=Min{*b*3-*t*1,3;*b*2-*t*1,2}=Min{9.2-4.7;3.6-3.6}=Min{ 4.5;0}=0

The Path time of **ACEG is 19.5**

working days Consequent the critical path is the ACEG;If there may be more than one complicated path or the critical path may change.

**Determine** critical **Path by finding duration Harmonic Mean:**

**Upward Approach::**

***a1*=0,** *a*2=*a1*+*t*1,2 [*t*1,2=*A*=3.3]=0+3.3=3.3,

*a*3=*Max*{*ai*+*ti*,3}[*i*=12,]=*Max*{*a1*+*t*1,3;*a*2+*t*2,3}
=*Max*{0+4.4;3.3+5.3} =*Max*{4.4;8.6} =8.6
*a*4=*a*2+*t*2,4 [*t*2,4=*D*=5.5]=3.3+5.5=8.8
*a*5=*a*3+*t*3,5 [*t*3,5=*E*=5.3]=8.6+5.3=13.9
*a*6=*Max*{*ai*+*ti*,6}[*i*=45,] =*Max*{*a*4+*t*4,6;*E*5+*t*5,6}
=*Max*{8.8+4.2;13.9+4.4} =*Max*{13;18.3}

=18.3

**Downward Approach:**

*b*6=*a*6=18.3
*b*5b6-*t*5,6 [*t*5,6=*G*=4.4]=18.3-4.4=13.9
*b*4=*b*6-*t*4,6 [*t*4,6=*F*=4.2]=18.3-4.2=14.1
*b*3=*b*5-*t*3,5 [*t*3,5=*E*=5.3]=13.9-5.3=8.6
*b*2=Min{*bj*-*t*2,*j*}[*j*=43,] =Min{*b*4-*t*2,4;*b*3-*t*2,3}
=Min{14.1-5.5;8.6-5.3} =Min{8.6;3.3} =3.3
*b*1=Min{*bj*-*t*1,*j*}[*j*=32,] =Min{*b*3-*t*1,3b2-*t*1,2}
=Min{8.6-4.4;3.3-3.3} =Min{4.2;0}=0

The critical path of the project is : a-b-c-e-f and critical activities are **ACEG The totab project time is 18.3**

**Determine** critical **Path by finding duration Mean:**

**Upward Approach:**

*a1*=0 *a*2=*a1*+*t*1,2 [*t*1,2=*A*=4]=0+4=4
a3=*Max*{*ai*+*ti*,3}[*i*=12,]
=*Max*{*a1*+*t*1,3;*a*2+*t*2,3} =*Max*{0+5;4+6}
=*Max*{5;10} =10
*a*4=*a*2+*t*2,4 [*t*2,4=*D*=6]=4+6=10
*E*5=*a*3+*t*3,5 [*t*3,5=*E*=6]=10+6=16
*a*6=*Max*{*Ei*+*ti*,6}[*i*=45,]
=*Max*{*a*4+*t*4,6;*a*5+*t*5,6} =*Max*{10+5;16+5}
=*Max*{15;21} =21

**Downward Approach :**

*b*6=*a*6=21 *b*5=*b*6-*t*5,6 [*t*5,6=*G*=5]=21-5=16
*b*4=*b*6-*t*4,6 [*t*4,6=*F*=5]=21-5=16
*b*3=*b*5-*t*3,5 [*t*3,5=*E*=6]=16-6=10
*b*2=Min{*bj*-*t*2,*j*}[*j*=43,]=Min{*b*4-*t*2,4;*b*3-*t*2,3}
=Min{16-6;10-6} =Min{10;4}=4
b1=Min{*bj*-*t*1,*j*}[*j*=32,]
=Min{*b*3-*t*1,3b2-*t*1,2}=Min{10-5;4-4}
=Min{5;0} =0

The critical path of the project is : a-b-c-e-f and critical activities are *ACEG= 21*

**Upward Approach for PERT**

*a1*=0 *a*2=*a1*+*t*1,2 [*t*1,2=*A*=4]=0+4=4
*a*3=*Max*{*ai*+*ti*,3}[*i*=12,]\
=*Max*{*a1*+*t*1,3;*a*2+*t*2,3}=*Max*{0+5;4+5.5}=*Max*{5; 9.5}=9.5\
*a*4=*a*2+*t*2,4 [*t*2,4=*D*=6]=4+6=10
*a*5=*E*3+*t*3,5 [*t*3,5=*E*=5.5]=9.5+5.5=15
*a*6=*Max*{*ai*+*ti*,6}[*i*=45,]
=*Max*{*a*4+*t*4,6;*a*5+*t*5,6}=*Max*{10+4.5;15+5}=*Max*{ 14.5;20}=20

**Downward Approach for PERT**

*b*6=*a*6=20 *b*5=*b*6-*t*5,6 [*t*5,6=*G*=5]=20-5=15
*b*4=*b*6-*t*4,6 [*t*4,6=*F*=4.5]=20-4.5=15.5
*b*3=*b*5-*t*3,5 [*t*3,5=*E*=5.5]=15-5.5=9.5
*b*2=Min{*bj*-*t*2,*j*}[*j*=43,]
=Min{*b*4-*t*2,4;*b*3-*t*2,3}=Min{15.5-6;9.5-5.5}=Min{ 9.5;4}=4
*b*1=Min{*bj*-*t*1,*j*}[*j*=32,]=Min{*b*3-*t*1,3;*b*2-*t*1,2}=Min{ 9.5-5;4-4}=Min{4.5;0}=0

The critical path of the project is : a-b-c-e-f and critical activities are *A*,*C*,*E*,*G*

**The totab project time is 20**



**Table.5.** Slack time calculation

| Activity | Duration | Early Start | Late Finish | Early Finish | Late Start | Total Float |
|---|---|---|---|---|---|---|
| a-c | 4.7 | 0 | 9.2 | 4.7 | 4.5 | 4.5 |
| b-d | 5.8 | 3.6 | 14.9 | 9.4 | 9.1 | 5.5 |

| | | | | | | |
|---|---|---|---|---|---|---|
| d-f | 4.6 | 9.4 | 19.5 | 14 | 14.9 | 5.5 |

**Table.6.Slack time calculation**

| Activity | Duration | Early Start | Late Finish | Early Finish | Late Start | Total Float |
|---|---|---|---|---|---|---|
| a-c | 4.4 | 0 | 8.6 | 4.4 | 4.2 | 4.2 |
| b-d | 5.5 | 3.3 | 14.1 | 8.8 | 8.6 | 5.3 |
| d-f | 4.2 | 8.8 | 18.3 | 13 | 14.1 | 5.3 |

**Table.7.Slack time calculation**

| Activity | Duration | Early Start | Late Finish | Early Finish | Late Start | Total Float |
|---|---|---|---|---|---|---|
| a-c | 5 | 0 | 10 | 5 | 5 | 5 |
| b-d | 6 | 4 | 16 | 10 | 10 | 6 |
| d-f | 5 | 10 | 21 | 15 | 16 | 6 |

**Table.8.Slack time calculation**

| Activity | Duration | Early Start | Late Finish | Early Finish | Late Start | Total Float |
|---|---|---|---|---|---|---|
| a-c | 5 | 0 | 9.5 | 5 | 4.5 | 4.5 |
| b-d | 6 | 4 | 15.5 | 10 | 9.5 | 5.5 |
| d-f | 4.5 | 10 | 20 | 14.5 | 15.5 | 5.5 |



Slowing down is a measurement of the extra resources and time available to accomplish one task. Positive dull (+) signal is being in advance of agenda; Negative slowdown indicates behindhand the schedule; and indicates zero in the slack time. Start and end indicators and no duration in description; therefore they may possess zero error [30–34]. from Table 5 Lack of zero in activity in a critical way by definition; Like LF - EF= 4 - 4 = 0.

In the activity b ,LF is known to 9.2 and an EF has 4.7 days, the slack is 4.5 working days. Likewise, the d and f can be slowed down by 5.5 working days. So, Activity B could be deferred up to 4.5 working days without delay in the plan. Similarly, Without delay, activity d or f could be postponed by 5.5 working days This has a major impact on the decisions made by traders whose work is critical. Individuals who engage in B, D, or F activities can take a 19.5-day rest period. without any opposing effect on the sample time.

From Table 6 Lack of zero in activity in a critical way by definition; Like LF - EF= 10- 10 = 0.In the activity a-c ,LF is known to 10 , an EF has 5 days, the slack is 5working days. Likewise, the d and f can be slowed down by 6 working days. So, Activity B could be deferred up to55 working days without delay in the plan. This has a very significant impact on the decision of traders, whose work is important. Individuals performing B, D, or F activity may take an equivalent rest period of **18.3** days without any opposing effect on the sample time.

From Table7 Lack of zero in activity in a critical way by definition; Like LF - EF= 5 - 5 = 0.In the activity a-c ,LF is known to 8.6 and an EF has 4.4days, the slack is 4.2 working days. Likewise, the d and f can be slowed down by 5.3 working days. So, Activity B could be deferred up to 4.5 working days without delay in the plan. This has a very significant impact on the decision of traders, whose work is important. Individuals performing B, D, or F activity may take an equivalent rest period of **21** days without any opposing effect on the sample time.

From Table 8 LF is known to 9.5 and an EF has 5 days, consequently the slack is 4.5 working days. Likewise, the d and f can be slowed down by 5.5 working days. So, Activity B could be deferred up to 4.5 working days without delay in the plan. Similarly, activity d or f could be delayed by 5.5 working days without delay (alternatively, d and f may be 2.75 working days delayed). This has a very significant impact on the decision of traders, whose work is important. Individuals performing B, D, or F activity may take an equivalent rest period of 20 days without any opposing effect on the sample time. If any person, A, C, E or G becomes ill for any half day, the total sample time will be prolonged by 1/2 day.

## CPM and PERT software platforms:

PERT maps are typically drawn along a horizontal axis indicating the division of time into periods, weeks, months, and so on [35]. Software applications are to be commended for their assistance in manual calculations [36]. Although the PERT application is built-in with numerous textile industry-related ERPs or software planning, the use of desktop apps and web-based applications that are open sourced, especially for CPM and PERT applications, is quite independent [37–41]. Free. They are usable and optimized for greater user friendliness. Most software such as Concept Draw, KPlato, TaskJuggler, Oplan, etc. for desktop apps and ProjectPier [41-43] for DotProject, Event, Project.net, OpenProject Database et.,

## Conclusion

The critical route and project duration were investigated in this study and completion time were computed using various measures of central tendency and pert,cpm estimated time formula, and the critical path network diagram given in each approach estimation time. Harmonic mean is the greatest strategy to utilise to find the length of each activity offered out of all those measures we employed. Table 5 shows how to accomplish a project in 19.5 days using geometric mean, table 6 shows how to finish a project in 18.3 days using harmonic mean, table7 shows how to finish a project in 21 days using average and table 8shows how to finish a project in 20 days using the pert,cpm formula.The amount of outcomes exceeds the capacity of manual management, necessitating the use of sophisticated software tools. The use of these devices results in a large reduction in departure time, which greatly enhances the industry's ability to respond quickly. It's vital to recall that utilising the Harmonic Mean to find duration in Table 2 does not lessen the content of any task; rather, it efficiently manages resources.

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