COMPARATIVE ANALYSIS OF RISK REDUCTION USING PERT & CPM TECHNIQUE

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Abstract—The PERT/CPM produce begins with the hardwork of developing an estimate of the cost each activity when it is performed in the planning way (including any crashing). A various of details must be considered in planning how to coordinate all these activities, in developing a realistic schedule, and then in monitoring the progress of the project.

Fortunately, two closely related operations research techniques, PERT (program evaluation and review techniques) and CPM (critical path method) were developed in the 50's, within different contexts: the CPM was developed for planning and control of DuPont engineering projects and the PERT was developed for the management of the production cycle of the Polar is missile.

The usual PERT procedure may lead to overly optimistic results as many path which are not critical but slightly shorter than critical on the basis of estimated activity duration or average durations. This paper analyzed the traditional probability analysis method for duration risk in program evaluation and review technique(PERT) and Critical Path Method (CPM). On the basis of that it simulates the project's duration and analyzes the risk by Monte Carlo simulation method.

They share the same objectives such as defining the project duration and the critical task. The PERT/CPM technique is based on two straight steps; a forward propagation to define the earliest start and finish dates (and subsequently the project duration and the free floats), and a backward promulgation for the latest start and finish dates (and the total floats). Initially, the activity times are static with in the CPM technique and probabilistic with in the PERT technique. In a software project, predicting the likelihood of duration may play a key role to wards project success.

Index Terms—PERT, CPM, Monte Carlo simulation technique.

I. INTRODUCTION

Our life we all depend on management such that business world management, organizations management and institutions management and many more are highly using project management techniques for effective results. Constant change and complexity have become two consecutive aspects. We are all working in a similar environment which is constantly changing very fast and with the increase in complexity we need to be focused, profitable and productive for our environment. Project management is the process for time-limited, focused, nonrepetitive, activities with some degree of risk and usually scope of operational activities for the company is responsible.

Project Management is the process of obtaining goals of the project from a defined set of activities which reducing the probability of failure and confirm the completion with quantifiable and quality dealing. Project management is a process but also a collection of processes to be used to meet the project requirements. An effective Project Manager must manage the four basic factors of a project that are cost, resources, scope, and time. Each factor must be managed very carefully for a good project. All these factors are interrelated to each other and must be standy together if the project, and the project manager, both want to be a success.

A. Managing Resources

This is very important to manage resources for making an effective project. A successful Project Manager can carefully manage the resources that are assigned to the project. This includes time, cost and cost of labor of the project team. Project manager can managed project resources frequently and also involves more than people management. It also includes vendor cost, in which managing labor subcontracts and vendors.

In resource managing also manage the people resources that mean having the right people, with proper knowledge of tools and the good skills, in the right quantity used at the right time. The project manager also manages the tools which is used to making a project and the material that are assigned to the project.

B. PERT (Project Evaluation and Review Technique)

PERT is stands for “Project Evaluation and Review Technique. It was invented initially to clarify the planning and scheduling of big and complex projects. PERT was developed for the U.S. Navy Special Projects Office in 1957 to support the U.S. Navy’s Polaris nuclear submarine project.

It is a tool for project management which is used to plan and track schedule to analyze risks in the project and to organize activities within the project. The project evaluation
and survey technique, commonly known as PERT, is a statistical tool it is used in project management, which was developed for analysis and represents the tasks for completing a given project.

The main goal of PERT computations is to approximate the total time proceed from the start to the end of the project and also defined the same as getting that end date across with the calculation of risk.

**C. CPM (Critical Path Method)**

The Critical Path Method (CPM) is a way of minimizing the series of scheduled activities, or tasks, in this project. This is a tool of management designed to ensure a project’s complete on the time. Since it’s invented in the 1950s, CPM has been adapted to the Theory of Constraints and Critical Chain concepts idea devised by Israeli physicist Eliyahu Goldratt.

The basics of CPM were traced by “Du Pont” when he was working on project management for planning and scheduling on the UNIVAC machine in middle 1959. The variation in the value is quantity of time that all the activities can be late without increasing the all project execution time.

It is a project management method which covers all the critical and non-critical tasks throughout the critical path are recognized. It helps us to complete the project under a given timeframe without any delays.

Therefore we list all the activities in the project with their execution times and the preference among them. After that a network flow chart figure is maintaining with calculation earliest and latest start and finish times. A floaters lack value is calculated.

Hence, the critical path will always contain of activities which have zero slack.

\[
\text{Slack or float} = \text{latest (start or finish)} - \text{earliest (start or finish)} \text{ time}
\]

In which the activities having no slack or slack value 0 shown as the critical activities. Those activities defined the critical path which is the largest path for the finishing of the project. However, the tasks in the critical path can’t be delayed because a small delay in these can affect the result and in overall delay of the project.

CPM is often used to compute the earliest and latest possible start time for every activity. Here we identify the critical activities is that, if one are activity is delay, it will affect the whole process to suffer without a reason. Hence, it is named as Critical Path Method.

In this approach, a list is create consisting of all the activities required to complete a project, shown by the computation of time needed to complete each activity. Therefore the dependency between the activities is evaluated. Hence, ‘path’ is defined as a sequence of activities in a network system. Therefore we found that the critical path is the path with the longest length.

II. ANALYSIS OF PREVIOUS RESEARCH

Through the previous year research paper survey has been done for the improving knowledgebase for the PERT/CPM techniques and to study all the demerits which are found through the previously used several types of strategy, methods and algorithms.

From the basis of (D.G. Malcolm, C.E. Clark and W. Fazzar, 1959) are derive the concept of PERT originally for the clarification of schedule of projects, which are very complex or large. That was identified in 1957, for the office of U.S navy to support the Polaris nuclear submarine project of navy(U.S.).[1] That was an efficient for including variation, with probability to schedule the activities with the knowledge of the exact details and duration for the described activities.

(Aravind.M, Aravindhababu.V, Balamurugan.K, 2015), are given the new simulation approach to be determine the accurate value of the time of completion. Here the mean project time crashed notify by the traditional PERT analysis is always gives to us an underestimate of the original completion time for the project. [2] This paper advises an improved methodology to calculate the mean project time for completing using simulation. For Simulation, ARENA simulation software is preferred.

The attributes can be represented in graphical notation form in two different ways, first either by explain the activities by the nodes i.e; AoN dag or activities with the edges / arcs i.e; AoA dag. In the paper [4], (Nasser Eddine Mouhoub, Abdelhamid Benhocine, 2012) a new algorithm is introduced to get an Activity starting from the (Node as activity) dag uses the line graphs notation. The general idea is taken from the paper [17], (Nasser Eddine Mouhoub, HoucineBelouadah,2011). It is very simple to apply this new method.

(Wayne A. Haga, Tim O’keefe,2001) presented a simulation approach [5] to defined the order of erasing activities along with the optimized erasing technique for a network of PERT to lessen the regional value of cost adding crash and overrun for a given maintainable penalty function for delay project completion.

The activity time of the project are distributed as distributions in beta sampling and the approximated project duration as in the original Normal distribution. It is better than suppose as to be constant, but the redefine notions are specifically possibility. The approach in this paper[10] (Le
Roy F. Simmons, 2002) illustrate how the simulation with Process Model can found this unrequited limitation.

This paper [11] (Wanan Cui, Jiajun Qin and Chaoyuan Yue, 2006) is systematically found the drawbacks of a some indexes to calculate the task’s criticality in the network of PERT, which have some factors as, the critical activity index (CAI), the significance index (SI), cruciality index (CI) and the sensitivity analysis. After the survey of these problems, (ACCI) that is; activity critical comprehensive index was derived. Solve the example proved that the (ACCI) notify the deficiencies of all three adding sensitive analysis for some level.

In the study we found [12](Chen-Tung Chen and Sue-Fen Huang, 2007), Fuzzy PERT approach was used for solving this problem. In the activity time were represented by the triangular fuzzy numbers in the project network system. For each and every activity, fuzzy limits were calculated for the initiating and completing times.

III. PROPOSED METHODS

In which the proposed approach construct use of the Monte Carlo simulation across with the triangular division for random variant generation is used to finding the three activity time aspects used in the PERT/CPM technique. PERT considers the variability in activity time by considering approximate of time. Although of this the results achieve from PERT have a divergence from practical project completion time. The forecasting of the completion times in the project management is one of them ost challenging tools for the project managers.

The schemes overruns are very general to appear due to the uncertainty in approximate the amount of time and need of an activity. The main complication with Pert is that it consistently under estimates the schedule of risk and the most appropriate solution to this problem is known as Monte Carlo Simulation. Monte Carlo Simulation is the modern way to estimate the risk of the project schedule along random sets of activities duration that gives the various number of different critical paths and results into the minimization of risk under the project scheduling.

A. Monte Carlo Simulation

Monte Carlo Simulation, in which each input, is varied inside a predefined range hundreds of times and to produce a set of outputs across with the frequency of occurrence. Hence, the frequency is translated into the possibility of the respective output’s occurrence. When we use Monte Carlo simulation, we can produce a mathematical distribution and the likely range of out comes. Monte Carlo simulation was initiated in 1940’s, and that time the scientists were working on the atomic bombs. It is a type of probabilistic simulation and it is used to understand the risk effect and variability in the project management system and further type of financial models. Figure-3 showsthemethodologythatis used in this study.

B. Mathematical functions

Monte Carlo Simulation method is the fundamental procedure for measuring the uncertainty of any system contains of basic steps.

1) Design a model holds the conditional probabilistic attributes.
2) Produce the random set of inputs.
3) Evaluate and store the results
4) Repeat the steps bands for required number of iterations
5) Evaluate the results with the information.

There is process of inputs and outputs are defined across with the probabilistic distribution. After that we run the simulation to the number of the described iterations and calculate the outputs correctly. In the previous work are related, at the different places it has been express that how to find the criticality indication of discrete activity times. Throughout my work, a method is identified to find the criticality indexes of the project with the priority of relationships included between them. In which with the criticality index of the activity, we can show a percentage value between 0 and 1 which is represent how many times the activity goes critical for the specific number of iterations.
ALGORITHM 1: Activity Criticality index along with preference

Input: In a project, each and every activity Ai, the three time attributes optimistic ‘ai’, most likely ‘bi’ and pessimistic ‘ci’ will be the inputs, the dependencies, Count, and number of iterations.

Step 1: For all the activities in the project, the a, m and b attributes are passed to the triangular distributed random variant function defined for the random variable ‘R’

a) If R=m-a/b-a then return m;

b) If R<m-a/b-a then return a + √ R*(b-a)*(m-a)

c) If R>m-a/b-a then return b-√(1-R)*(b-a)*(b-m)

Step 2: The minimum activity time mini from the triangular function is obtained.

Step 3: For all activity Ai, Check for dependencies,

Step 4: If there is no dependency Check

If mini > bi Count ++Else

Add the mini value of the dependency to all the activity time attributes and for more than one dependencies select the one which has greater value and repeat the same process.

Step 5: Return the count value for all the activities.

Step 6: The criticality index for an activity Aii calculated as CI=total no.of iterations−count value

Total no.of iterations.

Step 7: Repeat the process for all the activities in the project.
ALGORITHM1: Risk optimization of the algorithm

**Input:** In a project, each activity Ai, the 3 time of a attributes optimistic ai, most likely bi and pessimistic ci will give as the dependencies, the inputs, and number of iterations.

**Step 1:** For all the activities in the project, the a, m and b attributes are passed to the triangular distributed random variant function defined for the random variable ‘R’

- d) If R=m-a/b-a then return m;
- e) If R<m-a/b-a then return a + \( \sqrt{R}(b-a)*(m-a) \)
- f) If R>m-a/b-a then return b- \( \sqrt{(1-R)}(b-a)*(b-m) \)

**Step 2:** The minimum activity time \( \text{mini} \) from the triangular function is found.

**Step 3:** With the activity times for each activity, finish time, the earliest and latest start is calculated.

**Step 4:** Slack or float values are calculated to find the critical activities.

**Step 5:** Completion time \( \text{Te} \) inform of critical path length is obtained.

**Step 6:** The completion time probability is calculated through z-score formula, \( Z = Td - \text{Te} SD \)

Here, SD is the standard deviation and Td is the deadline.

**Step 7:** Calculate the risk percentage.

**Step 8:** Repeat steps 1-5 for the different simulation runs for the defined known iterations.

IV. ANALYSIS AND RESULTS

The results acquire were more reliable than the common method of PERT/CPM. The probability of obtaining the project to be completed on a definite expected date is enhanced, with this new approach which was calculated through the z-score and hence the risk for the project is minimized or decreased which was our essential objective. The initial model has been tested on five distinct project datasets and it’s taken from different project management based on research papers or websites for different the accuracy of the completion times and also reduces the schedule risk in the project. In this chapter we analysis about the results is done with all the factual examples with the previously described methods in research papers.

**Project Data Set-1:**

Inside the data set project is obtained for the network analysis, it’s based on case study document in all the PERT/CPM methodology is used for the complete knowledge of project.
Table 1: Project data set1

| Activities | Predecessor | Optimistic time | Most likely time | Pessimistic time |
|------------|-------------|-----------------|------------------|-----------------|
| A          | -           | 3               | 6                | 12              |
| B          | -           | 1               | 2                | 4               |
| C          | A           | 1.5             | 3                | 6               |
| D          | B           | 1               | 2                | 4               |
| E          | C           | 2               | 4                | 8               |
| F          | D           | 0.5             | 1                | 2               |
| G          | E,F         | 0.5             | 1                | 2               |
| H          | G           | 3               | 6                | 12              |
| I          | H           | 1.5             | 3                | 6               |
| J          | H           | 0.5             | 1                | 2               |
| K          | I,J         | 0.5             | 1                | 2               |

Activity Criticality Index: The result of critical index is defined in the figure below that illustrates the criticality index of the activities are shown in the project dataset1.

Figure 3: 1st data set activity and criticality index
Figure 4: 1st data set Criticality Index with included precedence

Comparative Analysis:

From the above both of figure in dataset 1, we can decide the criticality indexes of the action in the project. But in our next figure the values shown are defined with the activities having their precedence’s. After these two set of results, it can be included that the criticality indexes are increased for several activities of the project due to the concluded dependencies among the activities. In the next two activities, we can be notice the values increased from 0.46 to 0.49 and 0.65 to 0.68.

4.1.2. Completion times: Here project manager are decided the deadlines of the project is 27 weeks.

Table 2: project data set-1

| Method            | Estimated Completion time | Critical path     |
|-------------------|---------------------------|-------------------|
| Pert/CPM method   | 26 weeks                  | A-C-E-G-H-I-K     |
| Proposed Method   |                           |                   |
| 1stSimulationrun | 24.24 weeks               | A-E-G-H-I-K       |
| 2ndSimulationrun | 29.58 weeks               | A-C-E-G-H-I       |
| 3rdSimulationrun | 25.63 weeks               | A-G-H             |
| 4thSimulationrun | 23.82 weeks               | A-C-E-I-K         |
| 5thSimulationrun | 21.56 weeks               | A-E-G-H-I-K       |
Comparative Analysis:
The above table defined the completion times of the project explained through the original PERT/CPM approach and the time with the given proposed algorithm with many type of simulation runs. In which we observed that completion times acquire from the proposed algorithm are more reliable and for each and every simulation run the critical paths change for the project activities. Hence, we can be seen along the above table that 26 week time is vary to 24.24 and many other values.

| Task | ES | EF | LS | LF | Slack | Critical? |
|------|----|----|----|----|-------|-----------|
| Start | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | Yes |
| A    | 0.0 | 0.0 | 6.0 | 6.0 | 0.0 | Yes |
| B    | 0.0 | 2.1667 | 0.6666666666666666 | 10.0 | 10.0 | No |
| C    | 6.5 | 9.75 | 6.5 | 9.75 | 0.0 | Yes |
| D    | 2.1667 | 4.3333 | 10.0 | 10.0 | 0.0 | Yes |
| E    | 9.75 | 14.0838 | 9.75 | 14.0838 | 0.0 | Yes |
| F    | 4.3334 | 6.4167 | 0.0 | 0.0 | 0.0 | Yes |
| G    | 12.0 | 12.0 | 0.0 | 0.0 | 0.0 | Yes |
| H    | 14.0838 | 15.0 | 15.0 | 0.0 | Yes |
| I    | 21.6667 | 21.6667 | 0.0 | 0.0 | 0.0 | Yes |
| J    | 21.6667 | 21.6667 | 0.0 | 0.0 | 0.0 | Yes |
| K    | 24.1667 | 24.1667 | 0.0 | 0.0 | 0.0 | Yes |
| End  | 28.9999 | 28.9999 | 28.9999 | 28.9999 | 0.0 | Yes |

Figure 5: PERT/CPM output for project dataset-1

| Task | ES | EF | LS | LF | Slack | Critical? |
|------|----|----|----|----|-------|-----------|
| Start | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | Yes |
| A    | 0.0 | 0.0 | 6.0 | 6.0 | 0.0 | Yes |
| B    | 0.0 | 2.5047 | 0.0 | 0.0 | 0.0 | Yes |
| C    | 6.0325 | 6.4167 | 0.0 | 0.0 | 0.0 | Yes |
| D    | 2.5047 | 2.0 | 2.0 | 2.0 | 0.0 | Yes |
| E    | 10.5701 | 10.5701 | 0.0 | 0.0 | 0.0 | Yes |
| F    | 5.2384 | 5.2384 | 0.0 | 0.0 | 0.0 | Yes |
| G    | 10.5701 | 10.5701 | 0.0 | 0.0 | 0.0 | Yes |
| H    | 18.1139 | 18.1139 | 0.0 | 0.0 | 0.0 | Yes |
| I    | 19.5790 | 19.5790 | 0.0 | 0.0 | 0.0 | Yes |
| J    | 19.5790 | 19.5790 | 0.0 | 0.0 | 0.0 | Yes |
| K    | 23.0369 | 23.0369 | 0.0 | 0.0 | 0.0 | Yes |
| End  | 24.2441 | 24.2441 | 0.0 | 0.0 | 0.0 | Yes |

Figure 5: 1st simulation output for project data set-1
| Task | ES | EF | LS | LF | Slack | Critical? |
|------|----|----|----|----|-------|-----------|
| A    | 0.0| 6.24215614971577| 6.24215614971577| 0.0 | Yes    |           |
| B    | 0.0| 2.0023559515599992| 11.446161976761259| 13.446161976761259| 11.446161976761259| No |
| C    | 6.24215614971577| 5.37200061492428| 6.24215614971577| 5.37200061492428| 8.81876197001252E-16| No |
| D    | 2.0023559515599992| 3.4756271067496| 13.46925708311938| 14.93746686862192| 11.46161976761259| No |
| E    | 3.4756271067496| 16.094601500222647| 9.37200061492428| 16.094601500222647| 1.776558839402505E-16| No |
| F    | 3.4756271067496| 4.6392817149510159| 14.93746686862192| 16.094601500222647| 11.46161976761259| No |
| G    | 16.094601500222647| 17.302032477500845| 16.094601500222647| 17.302032477500845| 0.0 | Yes |
| H    | 17.302032477500845| 21.52490966674621| 17.302032477500845| 21.52490966674621| 0.0 | Yes |
| I    | 21.52490966674621| 24.373910076836484| 21.52490966674621| 24.373910076836484| 3.525713768809518E-16| No |
| J    | 24.373910076836484| 4.313834792363899| 23.579475951047713| 24.373910076836484| 2.045468283409202| No |
| K    | 24.373910076836484| 25.639679470967664| 24.373910076836484| 25.639679470967664| 7.10542735761002E-15| No |
| End  | 25.639679470967664| 26.69679470967664| 25.639679470967664| 26.69679470967664| 7.10542735761002E-15| No |

**Figure 5.2 : 2nd simulation output for project dataset-1**

| Task | ES | EF | LS | LF | Slack | Critical? |
|------|----|----|----|----|-------|-----------|
| A    | 0.0| 9.04531012652734| 9.04531012652734| 0.0 | Yes    |           |
| B    | 0.0| 2.1130949340714197| 9.95076959062688| 12.06388463130477| 9.95076959062688| No |
| C    | 9.04531012652734| 3.4756271067496| 13.46925708311938| 14.93746686862192| 11.46161976761259| No |
| D    | 2.1130949340714197| 4.7517316663217624| 12.06388463130477| 14.702501253822028| 9.95076959062688| No |
| E    | 4.7517316663217624| 16.094601500222647| 16.06129003055225| 17.52912166479056| 16.06129003055225| No |
| F    | 16.094601500222647| 17.302032477500845| 16.06129003055225| 17.52912166479056| 16.06129003055225| No |
| G    | 17.52912166479056| 24.91509713098797| 17.52912166479056| 24.91509713098797| 23.93565871764| 0.0 | Yes |
| H    | 24.91509713098797| 25.85860060572962| 24.91509713098797| 25.85860060572962| 3.072742790581333| No |
| I    | 25.85860060572962| 28.95656871764| 25.85860060572962| 28.95656871764| 28.58526005072962| 3.525713768809518| No |
| J    | 28.58526005072962| 29.58500600507296| 28.58526005072962| 29.58500600507296| 29.58500600507296| 3.525713768809518| No |
| K    | 29.58500600507296| 29.58500600507296| 29.58500600507296| 29.58500600507296| 29.58500600507296| 3.525713768809518| No |

**Figure 5.3 : 3rd simulation output for project dataset-1**
Critical path length (cost): 21.564472516143155
Initial nodes: Start

| Task | ES | EF | LS | LF | Slack Critical? |
|------|----|----|----|----|-----------------|
| Start | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 Yes |
| A | 0.0 | 4.143836492469435 | 0.0 | 4.143836492469435 | 0.0 Yes |
| B | 0.0 | 2.3884293030467985 | 4.3884293030467985 | 4.3884293030467985 | 0.0 Yes |
| C | 4.149926492469435 | 7.3110897611228 | 4.149926492469435 | 7.3110897611228 | -1.776249299102588E-15 No |
| D | 2.3884293030467985 | 4.618056492156644 | 4.618056492156644 | 6.752808020766276 | 9.01210321002227 | 4.092408210069520 No |
| E | 7.3110897611228 | 10.20572717761355 | 7.3110897611228 | 10.20572717761355 | 0.0 Yes |
| F | 4.618056492156644 | 5.81168387188582 | 8.011182283029337 | 10.20572717761355 | 4.39404284048588888 No |
| G | 10.20572717761355 | 12.91712736594627 | 10.20572717761355 | 12.91712736594627 | 0.0 Yes |
| H | 0.0 | 10.91712736594627 | 10.91712736594627 | 10.91712736594627 | 0.0 Yes |
| I | 0.0 | 17.477150767307565 | 17.477150767307565 | 17.477150767307565 | 0.0 Yes |
| J | 0.0 | 20.5759484326213398 | 20.5759484326213398 | 20.5759484326213398 | 0.0 Yes |
| K | 0.0 | 21.564472516143155 | 21.564472516143155 | 21.564472516143155 | 0.0 Yes |

Figure 5.4.: 4th simulation output for project dataset-1

Critical path length (cost): 23.82212522447359
Initial nodes: Start

| Task | ES | EF | LS | LF | Slack Critical? |
|------|----|----|----|----|-----------------|
| Start | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 Yes |
| A | 0.0 | 5.70572725147407 | 0.0 | 5.70572725147407 | 0.0 Yes |
| B | 0.0 | 2.027971198678 | 6.33502609392294 | 6.33502609392294 | 0.0 No |
| C | 5.70572725147407 | 8.083876432050315 | 8.083876432050315 | 8.083876432050315 | 0.0 Yes |
| D | 0.0 | 0.0 | 5.027971198678 | 5.027971198678 | 0.0 No |
| E | 8.083876432050315 | 11.700762022261707 | 9.083876432050315 | 11.700762022261707 | 0.0 Yes |
| F | 4.77687669144962 | 5.81664614428281 | 10.616974135637877 | 11.700762022261707 | 5.839096637832895 No |
| G | 11.700762022261707 | 12.636811615783696 | 11.700762022261707 | 12.636811615783696 | -1.776356839402588E-15 No |
| H | 12.636811615783696 | 15.396878720594944 | 12.636811615783696 | 15.396878720594944 | -1.776356839402588E-15 No |
| I | 19.3588787825059444 | 22.844999803984656 | 19.3588787825059444 | 22.844999803984656 | 0.0 Yes |
| J | 19.3588787825059444 | 20.6964015632474766 | 21.5054725149944 | 22.844999803984656 | 2.14959634539013 No |
| K | 22.844999803984656 | 23.82212522447359 | 22.844999803984656 | 23.82212522447359 | 0.0 Yes |

Figure 5.5.: 5th simulation output for project dataset-1
Table 3: Risk percentage of dataset 1

| Method                  | Z-score | Probability | Percentage | Risk    |
|-------------------------|---------|-------------|------------|---------|
| Pert/CPM method         | 0.16    | 0.5668      | 56.68%     | 43.32%  |
| Proposed Method         |         |             |            |         |
| 1st Simulation run      | 0.5257  | 0.7004      | 70.04%     | 29.96%  |
| 2nd Simulation run      | 0.4486  | 0.6741      | 67.41%     | 32.59%  |
| 3rd Simulation run      | 0.4215  | 0.6631      | 63.31%     | 36.69%  |
| 4th Simulation run      | 0.7482  | 0.7728      | 77.28%     | 22.72%  |
| 5th Simulation run      | 1.0361  | 0.8499      | 84.99%     | 15.01%  |

Comparative Analysis:
We found the results shown in the above table defined the probability and the output of schedule risk for the project dataset 1. It can be simply determined that the completion time and accuracy is refining with the proposed technique in comparison of regular PERT/CPM method. With the early method the probability value attained is 0.56 and with this technique, it is enhance to 0.67 and the risk value is optimized similarly to 43.32 per to 32.59 per. Hence, it is proved that the describe algorithm provides more exact results in comparison of last one. All the results are produces in java on net beans.

V. CONCLUSION AND FUTURE WORK
We found that PERT/CPM method is widely used in project scheduling for a better project. The project scheduling is of the major step of the project management procedure. Different type of project management methods are currently being used by many industries and organizations. We have executed a small survey on this topic and establish that it has been used with several methodologies which perform effectively under certain circumstances. We evaluate that this technique has its main restriction that is underestimation or above estimation of completion times of the project in project management.

This paper present a new improved method and its uses the concept of Monte Carlo simulation with triangular distribution to discover throughout the activity time attributes of the project. Here we proposed the algorithm results to the expand rate of probability of the project. The project is completed under the certain defined deadline.

In future work may include increasing the proposed algorithm or a new approach with some different modifications for the better results. The resource limitation can also be included in the analysis to improve the performance of the method.

After the experimentation results have proven that the initiate method illustrates them or accurate values of the completion times for the better project which lead to the increased prospects for the predefined deadlines of the projects that are given by project manager. We also discover that risk in project is reduced with this new method and this was the main objective of this research work. Hence, the proposed approach gives the improving the results comparison between the PERT/CPM approach.

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