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Determining an Accurate Estimate of a Project Completion Time Using Simulation

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ABSTRACT: The mean project completion time determined by the traditional PERT analysis is always an underestimate of the actual project completion time. This paper suggests an improved methodology to estimate the mean project completion time using simulation

KEYWORDS: PERT, Simulation

I. INTRODUCTION

Project evaluation and review technique (PERT) has been increasingly used as a technique for planning and controlling large projects[1]. It is used to estimate the completion time of a project by identifying activities that can be delayed without lengthening the project completion time. PERT underestimates the actual completion time as it considers only the critical path activities. The possibility of simulating the PERT network in order to develop a more accurate estimate of the project completion times is very difficult and simulation of real world sized PERT networks which have high number of samples is often considered cost prohibitive. This paper suggests an improved methodology to identify the critical path of a PERT network. It uses a digital simulation to get an accurate approximations of a project's completion time than the standard PERT analysis and is computationally significant than the crude simulation of PERT networks

Methodology

The methodology that is used to get an accurate estimate of the project completion time is based on the assumption that the activity times are normally distributed. The following flowchart briefly explains the methodology used in this paper. Simulation is done using the ARENA simulation software.

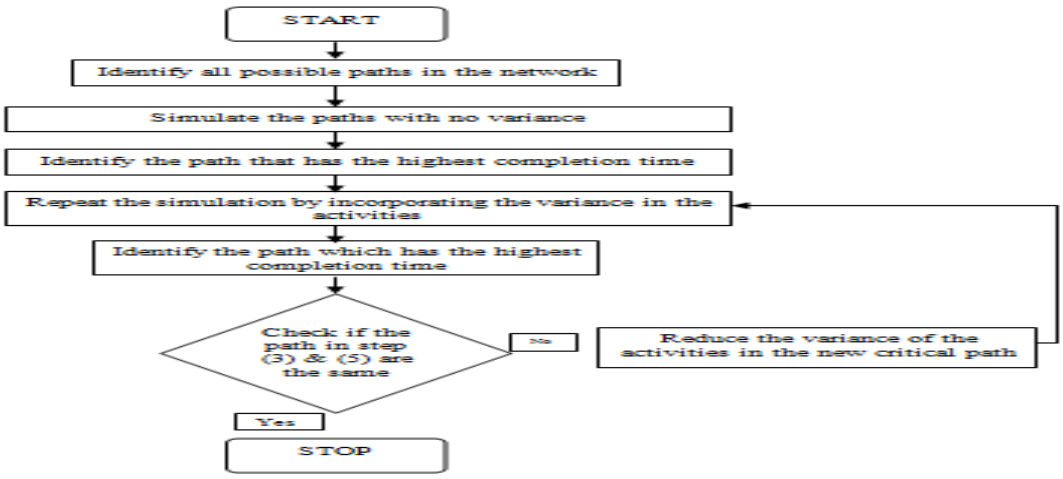

Figure 1: Methodology to estimate project completion

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Case study

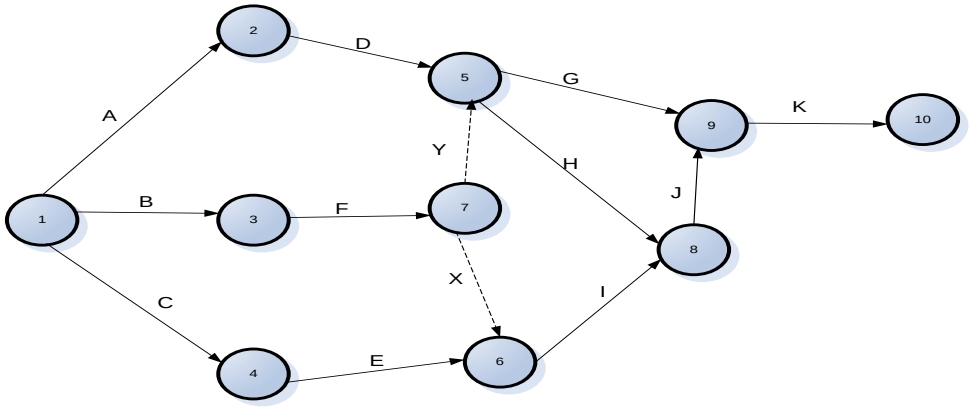

Figure 2. A simple Pert Network of the Space Module Assembly

The possible paths of the above network are,

i. A-D-G-K
ii. B-F-G-K
iii. A-D-H-J-K
iv. B-F-H-J-K
v. B-F-I-J-K
vi. C-E-I-J-K

Note: The duration time of the activities in the network are given in Appendix 1

II. RESULTS

Table 1 Simulation results of the paths in the network

S. No	Possible Paths	Completion time with no variance (Hours)	Critical Path	Completion time with variance (Hours)	Critical Path	Completion time with reduced variance (Hours)	Critical Path
1	A-D-G-K	49		47.7		47.7	
2	B-F-G-K	30		35.96		35.96	
3	A-D-H-J-K	56.33		55.77	*	56.404	*
4	B-F-H-J-K	37.33		36.13		36.13	
5	B-F-I-J-K	39.5		35.21		35.21	
6	C-E-I-J-K	56.83	*	54.42		54.42	

Note: The simulation model is given in Appendix 2

From the results it can be concluded that by simulating all the paths with variance has generated a new critical path. Since this path is different from the path that resulted form the simulation run with no variance, the paths are again

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simulated by reducing the variation in the new critical path activities by 50%. Since no more new critical paths are generated the process is stopped and the path 3 (A-D-H-J-K) is considered to be the critical path of the project and the project completion time is estimated to be 56.404 hours.

III.CONCLUSION

The traditional PERT analysis only the activities in the critical path. As a consequence it underestimates the actual project completion time. A new critical path may be generated due to the variations in the critical path activities. The methodology discussed in this paper gives an accurate estimation of the project completion time by incorporating the variances in the activities. Apart from the completion time, the simulation can also reveal other valuable information such as wait time, percent utilized, value added time which is not available in crude simulation.

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