Research article Available online www.ijsrr.org ISSN: 2279-0543

International Journal of Scientific Research and Reviews

Critical Path Method inDesigning Feasible Solutions

Rashmi Agarwal*, Dr. Nisha agarwal, Sanjeev Kumar

D. A. V. College, Bulandshahar, Meerut, U. P. , INDIA

ABSTRACT

To maintain Project Planning & Control two techniques of Operations Research namely Critical Path Method (CPM) &ProgrammeEvaluation& Review Techniques (PERT) if employed for planning, scheduling, controlling and implementing may minimize the troubles, delays and interruptions by determining certain critical factor and coordinating various activities and may thus maintain synergy of overall project management system, Informally CPM is logical sequencing of a series of events arranged in such a manner that the most efficient route to some culmination point can be calculated PERT allows for some random variations on time durations. In the present paper, the authors attempted to focus on applications of CPM and PERT that may efficiently be applied in designing the most feasible solutions.

*Corresponding Author

Rashmi Agarwal, Lecturer
D. A. V. College, Bulandshahar,
Meerut, U. P. India

INTRODUCTION

Network scheduling is a technique used for planning, and scheduling large projects in the field of construction, maintenance, fabrication, purchasing computer system etc. The technique is a method of minimizing the trouble spots such as production, delays and interruptions, by determining critical factors and coordinating various parts of the overall job. There are two basic planning and control technique that utilize a network to complete a predetermined project or schedule. These are Programme Evaluation Review Technique (PERT) and Critical Path Method (CPM). [i]

A project is defined as a combination of interrelated activities all of which must be executed in a certain order for its completion. An activity is said to be critical if a delay in its start will cause a further delay in the completion of the entire project. The sequence of critical activities in a network is called the critical path. It is the longest path in the network from the starting event to the ending event and defines the minimum time required to complete the project.

The procedure of determining the critical path is; List all the jobs and then draw network diagram. Each job is indicated by an arrow with the direction of the arrow showing the sequence of jobs. Indicate the normal time for each activity and calculate the earliest start time and the earliest finish time for each event and write the earliest time for each event and also calculate the latest finish and latest start time, from this we calculate the latest time for each event and write. Identify the critical activities and connect them with the beginning event and the ending event in the network diagram by double lines. Which give the critical path and calculate the total project duration?

REVIEW OF LITERATURE

***Roger Hiemstra*,** inCritical Path Analysis:A Planning/Time Management Tool for Managing Research,usedof Critical Path Analysis (CPA) in formulating, scheduling, and managing the various milestones or activities involved in a research or any other type of project that requires advanced and careful planning.

W. S. Abeli and D. P. Dykstra, Department of Forest Engineering, Sokoine University of Agriculture Morogoro, Tanzania, definedCritical Path Method (CPM) is one of the network techniques which has been developed to assist in planning and control of such undertakings. The method whose aim is to improve work efficiency first identifies critical and non-critical activities within the project. By overlapping these activities and putting the greatest efforts on critical activities, total project

duration is cut down quite considerably. Theirpaper illustrates the methodology and time saved when a CPM is applied on a project dealing with the installation of culverts.

Mosaic's Published Papers: 5-STEPS, Five Steps To Ensure Project Success - The '5 Steps To Ensure Project Success' methodology is a proven process designed to focus the thinking of the key Stakeholders onto the parameters required to achieve a successful project outcome.

A Brief History of Scheduling - Back to the Future - A Brief History of the first 50 years of 'Critical Path' Scheduling; and arguably the evolution of modern project management. The suggestion is that the growth of modern project management is a direct consequence of the need to make effective use of the data generated by the schedulers in an attempt to manage the 'project' and control the 'critical path'.[ii]

Beyond Reporting - The Communication Strategy - Communication is a science and an art. Communicating effectively with the project's important stakeholders, so that their expectations can be both managed and met, is central to achieving a successful outcome. Reports are not enough! Communication is a complex two way process within the overall relationship between the project and the stakeholder. This paper identifies the key processes involved in developing and implementing an effective communication strategy. [iii]

Calculating and Using Float - This paper argues that the lack of defined calculations for most of the float values in a PDM schedule must reduce the overall value of the schedule model compared to more rigorous approaches but also recognizes that if scheduling is a modeling process designed to affect the future behaviors of people working on the project other factors may be more important.[iv]

Communication in organizations: making the schedule effective - There is no point working hard to develop a schedule that is not used! Once the schedule has been created or updated, it is its role as a communication medium that can have the most powerful influence on the successful delivery of a project and the skills outlined in this presentation become critical to realizing the value embedded inthe scheduling tool.[v]

(The) Cost of Time - or who's duration is it anyway? - Probably the most common action undertaken by schedulers everywhere is assigning a duration to a task. This paper outlines the factors

influencing the choice of an optimum duration. Considers the factors that can cause the duration to be modified during the planning phase and then outlines some of the likely costs associated with accelerating the project.[vi]

(The) Effective Management of Time in the 21st century -

This paper overviews a range of ideas to assistin the effective management of time including:

*The need for effective planning ahead of scheduling and the different objective of these two processes.

*The concept of 'schedule density' and the need to schedule at an appropriate level of detail based on the contemporary knowledge available to the project team.

*The need for on-going dynamic scheduling to manage time.

*The need to contemporaneously assess the impact of delaying events in real time based on accurate and current schedules to allow effective mitigation.

*The need for effective training and credentialing of planners and schedulers.[vii]

(The) Effective Management of Time in Complex Projects - an ICT perspective - The IT industry's inability to effectively manage time has been widely documented, other industries fare no better! In response to this challenge, the CIOB assembled an international team of project planning and scheduling experts to develop a ***Guide to Good Practice in the Management of Time in Complex Projects*** (the Guide). This paper will identify the key elements within the Guide that proactively contribute to the successful delivery of complex projects and offer a way forward to improve time management.[viii]

(The) Effective Management of Time on Mega Projects - Why there are so many problems and how to solve them? - The construction industry's ability to effectively manage time is getting worse. In response to this challenge, the CIOB assembled an international team of project planning and scheduling experts to develop a ***Guide to Good Practice in the Management of Time in Complex Projects*** (the Guide). This paper will identify the key elements within the Guide that proactively contribute to the successful delivery of mega projects, relate these ideas to practical examples of their use on mega-projects and offer a way forward to improve time management[ix]

Float - Is It Real? - The existence of a 'critical path' and non-critical activities (with their associated 'float') grew out of the science of 'scheduling' as defined by Critical Path Analysis (CPA) and are barely 50 years old! This paper analyses the factors creating the 'critical path' and 'float' within a schedule and then look at ways of resolving the conflicting views of float encountered in the literature. Potential solutions include the UK 'Delay and Disruption Protocol', client led integrated teams and the use of alternative planning methods such as location based scheduling, trend analysis and earned schedule. [x]

Improving Schedule Management - This paper describes the changing role of scheduling within the complex dynamic environment of modern projects and programs. PMI's contributions including the SEI, standards and credentials are identified. The attributes needed for an effective schedule and the skills needed by an effective scheduler are described and linked to the emerging paradigms of complexity theory. [xi]

Managing for Success - The power of regular updates - Critical path scheduling techniques, supported by efficient scheduling software have long been recognised as a standard component in the overall project management process. This paper looks at the interaction between the analytical and psychological processes involved in schedule development and control systems to identify ways to deliver major enhancements in the planning / scheduling process. [xii]

Project Controls in the C21 – What works / What's fiction- This paper takes a controversial look at the relevance of project control systems and suggests the changes in skills, attitudes and practices needed to keep scheduling, cost control and EV relevant in the coming years.[xiii]

Project management vs Project scheduling - This presentation focuses on the differences between successful schedulers and successful project managers and how together they can create successful project outcomes.[xiv]

Resource optimisation - a new paradigm for project scheduling - A resource optimisation approach would involve changing the underlying philosophical approach embedded in CPM from a belief that the pre-determined duration and sequencing of activities takes precedence, to one that recognises the real objective of scheduling is to keep the resources working effectively. This paper looks at two alternative approaches to achiving this objective.[xv]

Scheduling in a Defence Environment - The primary purpose of any schedule should be to help the project manager and project team optimise the overall strategy for the delivery of the project, coordinate workflows and assist in the decision making processes needed to resolve dilemmas and issues on a day-to-day basis. This paper identifies some of the symptoms of scheduling failure and then addresses three topics; a discussion of the real purpose and usefulness of scheduling. the current 'state of play' in the development of scheduling and some emerging trends that may re-focus scheduling.[xvi]

Scheduling in the Age of Complexity - This paper suggests that a radically different approach is needed to make scheduling relevant and useful in the 21st Century. Starting with the ideas derived from Complexity Theory, Complex Responsive Processes of Relating (CRPR) and the concept of the project team as a 'Temporary Knowledge Organization (TKO) one can see the delivery of the project being crafted by thousands of individual decisions and actions taken by people who are 'actors' within the social network of the project team and its immediate surrounds. The role of 'project management' is to motivate, coordinate and lead the team towards the common objective of a successful project outcome. The project scheduler has a key role in this complex environment provided the right attitudes, skills and scheduling techniques are used in the optimum way.[xvii]

Seeing the Road Ahead - the challenge of communicating schedule data - The successful delivery of projects requires a broad understanding of what is required to be achieved, by whom and when. However, one of the key challenges facing schedulers has been to convert the rich data contained in their schedules into useful information that the project team can actually use. This paper outlines the evolution of the graphical presentation of time related data from 1765 through to the current time.[xviii]

Should your schedulers be certified? - This paper focuses on initiatives to revitalise our industry by creating a career path for planners and schedulers as well as clearly identifying the benefits of certification for organizations that employ planners and schedulers. New initiatives by the CIOB and Planning Planet are designed to deliver a career framework for professional 'Time Managers', taking people from novice, to a practitioner skilled in the art of planning and scheduling. [xix]

Standardizing Quality in Project Scheduling - The publication by PMI of its Practice Standard for Scheduling in May 2007 followed by the CIOB Guide to Good Practice in the Management of

Time in Complex Projects go a long way towards defining 'good scheduling practice'and providing tools that for the first time allows the unambiguous assessment of the technical competence of any schedule. The definition of planning and scheduling and the certification of schedulers has also been the subject of much attention. This paper provides an overview of the *Practice Standard*, *The Guide* and the emerging credential framework for schedulers.[xx]

Time IS NOT Money- "Time is not money; with money you can put it on the table and you can see it, and if you leave it, it may even accumulate - whereas with time, you can't see it or touch it. It expires at a regular and consistent rate whether you use it or not." [xxi]

Time management -v- Contract administration- This paper defines the standards by which project schedules should be prepared, quality controlled, updated, reviewed and revised in practice to effectively manage time. And then describes the standards of performance which should reasonably be required of a project scheduler.[xxii]

Why Critical Path Scheduling (CPM) is Wildly Optimistic - CPM tends towards an optimistic representation of the project's completion date. Used appropriately, this can be a performance motivator. However, prudent management also requires an accurate prediction of the completion date. This paper will describe how both processes can be used in combination for the effective management of time.[xxiii]

An International Conference on Operations and Supply Chain Management in china (2007) [ ],was assumed that an activity can always begin when all of its immediate preceding activities have been completed, however, this assumption may not be adequate enough to describe some practical applications in project management. Therefore, this paper validates an amended two-phase algorithm, which has been presented in the author's published paper to investigate activity networks with this special time-switch constraints. The analysis shows that the critical path and float times in this case are differ from those of traditional activity networks.

PROPER METHOD TO TEACH MATHEMATICS AND PHYSICS:

The policy on education has emphasized the need for qualitative improvement of education, particularly in the areas of science and mathematics. Generally a science or physics student is also

studying mathematics. We are taking these two important subjects mathematics and physics at senior secondary stage to relate them. First we introduce these subjects in brief:

MATHEMATICS: Mathematics has been an inseparable part of education since the beginning of formal education and it has played a predominant role not only in the advancement of civilisation but also in the development of physical sciences and other disciplines. The objectives of teaching mathematics at senior secondary stage intend to help the pupil to acquire knowledge and critical understanding of basic concepts, terms, principles and symbols.

PHYSICS: Physics is a fundamental science concerned with understanding the natural phenomena that occurs in our universe. Natural phenomena such as flow of water, heating of objects, sound of waterfalls, rainbow, energy coming from nucleus etc. The main objective of physics is to use the limited number of fundamental laws that governs natural phenomena to develop theories that can predict the results of future experiments. The fundamental laws used in developing theories are expressed in the language of mathematics.

Now we are making balance in between these two subjects as they are the vital areas of the curriculum. The topics related to these subjects are as follows:

Topics in Mathematics:

1. Arithmetic, 2. Geometry, 3.Algebra, 4.Trigonometry, 5.Number system, Mathematical logic and Boolean algebra, 6. Coordinate Geometry, 7. Differential Calculus, 8.Integral Calculus, 9.Vectors, 10.Dynamics,11.Statics, 12.Mensuration.

Topics in Physics:

1. Mechanics, 2. Kinematics, 3.Gravitation, 4.Work, Energy and Power, 5. Properties of Bulk matter, 6. Oscillations and Waves, 7.Electronic Devices, 8.Motion of system of particles and rigid body, 9.Electrostatics.

Laws of material sciences, particularly those of physics, are quantitative. They are expressed as mathematical relationship between physical quantities.

Now we divide the above topics into the subtopics, with appropriate sessions of about 40 minutes each, like this:

MATHEMATICS:

1. Arithmetic (7 sessions): Numbers, conversion of units, percentage, square and square- roots, cube and cube- roots, exponents and logarithms'.
2. Geometry (3 sessions): Triangles and their properties, circles and their properties, polygons and their properties.
3. Algebra (20 sessions): Factorization, polynomials, algebraic identities, linear and quadratic equations, graphs, A.P, G.P, H.P, set theory, binomial theorem, exponential and logarithmic series.
4. Trigonometry (20 sessions): Degrees and radians, relation between arc, radius and angle subtended by arc at the centre in a circle, trigonometric ratios and their signs, formulae based on trigonometric ratios and inverse trigonometric functions with their applications, trigonometric equations, expansions of $\sin x$, $\cos x$, $\tan x$.
5. Number system, Mathematical logic and Boolean algebra (8 sessions): Decimal number system, binary number system and their conversions, logic and truth table, Boolean algebra and its properties.
6. Coordinate Geometry (9 sessions): Coordinate systems, distance and section formulae, graphs, lines, circles and conic sections.
7. Differential Calculus (18 sessions): Functions, limits & continuity, differentiation, maxima and minima.
8. Integral Calculus (20 sessions): Integration & definite integrals.
9. Vectors (10 sessions): Scalars and vectors, vector algebra, dot and cross product of vectors, components of vectors in three dimensions.
10. Dynamics (8 sessions): Equations of motion, motion under gravity, projectile, impulse and momentum.
11. Statics (8 sessions): Three dimensional geometry.
12. Mensuration (2 sessions): Revision of all formulae and their applications.

PHYSICS:

1. Mechanics (5 sessions): Need for measurement, percentage error, dimensional analysis.
2. Kinematics (10 sessions): Vector analysis, equation of motion, projectile motion and circular motion.
3. Gravitation (2 sessions): Universal gravity.
4. Work, Energy and Power (2 sessions): Work done by a constant force and a variable force.

5. Properties of Bulk matter (10 sessions): General properties of matter in Bulk state, elasticity, surface tension, flow of liquids.
6. Oscillations and waves (3 sessions): Simple harmonic motion.
7. Electronic Devices (6 sessions): Digital circuits and logic gates.
8. Motion of system of particles and rigid body (2 sessions): Centre of mass.
9. Electrostatics (10 sessions): Electricity, Gauss' Theorem, electrical capacitance and conduction.

The contents included have been organized to impart knowledge and develop skills and attitudes. In addition to further enhancing the capacity of the pupils, a systematic study of subjects efforts have been made to suggest activities to suit the diverse needs. The proper arrangement of the above topics of mathematics and physics should be like this:

MATHEMATICS:

A. Arithmetic
B. Geometry
C. Algebra
D. Trigonometry
E. Mensuration
F. Differential Calculus
G. Coordinate Geometry
H. Integral Calculus
I. Vectors
J. Dynamics
K. Statics
L. Number system, Mathematical logic, Boolean algebra.

PHYSICS:

1. Mechanics and Properties of Bulk matter
2. Gravitation, Oscillation and waves, Motion of system of particles and rigid body
3. Kinematics and Work, energy and power
4. Electrostatics
5. Electronic devices.

Now we make a network diagram for this, separate for each of these two subjects:

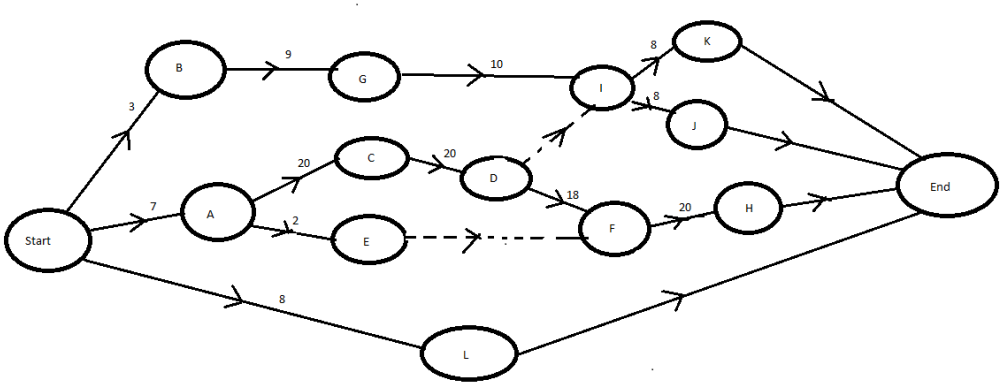
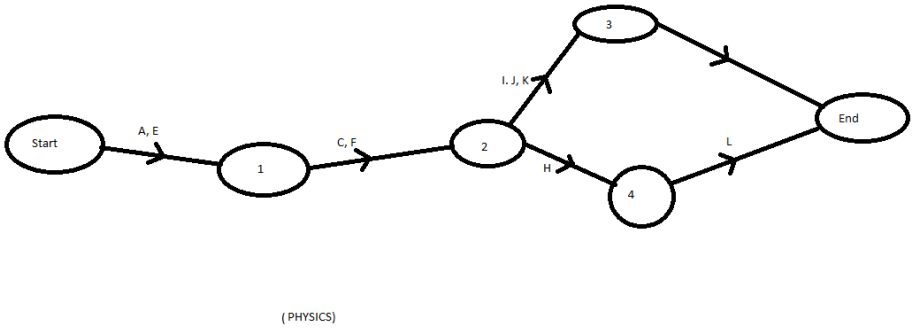


Figure 1: Network Diagram for Mathematics



(PHYSICS)

Figure 2: Network Diagram for Physics

REFERENCES

1. Antonio Prensa, "The Critical Path Method" in Management (2002).
2. G W F Hegel, 'A Brief History of Scheduling - Back to the Future', Introduction to Philosophy of History, 1770-1831, P042.
3. Dr. Lynda Bourne PMP, FAIM, Director, Stakeholder Management Pty Ltd, 'Beyond reporting - The Communication Strategy', PMI global congress, Asia Pacific 2010, Melbourne Convention Centre, Melbourne, Australia, 22-24 February 2010, Speaker: Lynda M. Bourne, DPM, PMP, FAIM, Wednesday, 24 February, 13.30–14.45, 1 hour, 15 minutes.
4. Patrick Weaver, 'Calculating and Using Float', Published, PM World Today, November 2009, P110.

5. Lynda Bourne., 'Communication in organizations: making the schedule effective', Presented at PMOZ, August 2009, P090.
6. Patrick Weaver, '(The) Cost of Time - or who's duration is it anyway?', P009.
7. Patrick Weaver, '(The) Effective Management of Time in the 21st century', Presented at: Project Scheduling 2011, CQ Functions, Melbourne, VIC, by IQPC, 25-26 May 2011, P148.
8. Patrick Weaver, '(The) Effective Management of Time in Complex Projects - an ICT perspective',The development of a *Guide to Good Practice in the Management of Time in Complex Projects* (the Guide). This work has been completed and the Guide will be published in early 2011, MSCPMP Circle - QF4, 14th October, Kuala Lumpur, Malaysia, P130.
9. Patrick Weaver, Denis Waitley, '(The) Effective Management of Time on Mega Projects - Why there are so many problems and how to solve them?', International Construction Conference 2010 (ICC2010), Legend Hotel, Kuala Lumpur, Malaysia, 12 to 13 October 2010, P126.
10. Patrick Weaver. FAICD, FCIOB, PMP. Director, Mosaic Project Services Pty Ltd. 'Float - Is It Real?',Presented at: Ninth Australian International performance Management Symposium, 1-3 March 2006, P043.
11. Patrick Weaver. FAICD, FCIOB, PMP. Director, Mosaic Project Services Pty Ltd., 'Improving Schedule Management', PMI Global Congress, Asia Pacific 2009, Kuala Lumpur, Malaysia, 9-11 February 2009, P081.
12. Patrick Weaver. FAICD, FCIOB, PMP. Director, Mosaic Project Services Pty Ltd., 'Managing for Success - The power of regular updates - Critical path scheduling techniques, supported by efficient scheduling software', Presented at: Primavera Australia 2002 User conference, Melbourne, 5th -6th August 2002, P002.
13. Patrick Weaver, 'Project Controls in the C21 – What works / What's fiction', Melbourne University, 25th August 2008, P083.
14. Patrick Weaver, 'Project management vs Project scheduling', Project Scheduling, Brisbane, QLD, Australia, 25 - 27th November 2009, P107.
15. Patrick Weaver, 'Resource optimisation - a new paradigm for project scheduling',Construction CPM Conference, Walt Disney World, Florida, January 21-25th, 2012, P152.
16. Patrick Weaver, 'Scheduling in a Defence Environment', Presented at: D+I07Defence + Industry 2007 Conference, Adelaide, P069.

17. Patrick Weaver, 'Scheduling in the Age of Complexity', Sixth Annual PMI College of Scheduling Conference, Boston, MA, USA, Sunday, May 17 - Wednesday, May 20, 2009, P089.
18. Patrick Weaver, 'Seeing the Road Ahead - the challenge of communicating schedule data', PMOZ, Brisbane, 23 - 26 August 2010, P106.
19. Patrick Weaver, 'Should your schedulers be certified?',Presented at: Construction CPM Conference, Walt Disney World, Florida, January 21-25th, 2012, P149.
20. Patrick Weaver, 'Standardizing Quality in Project Scheduling', Top Link Conference & Event Management, Presented at: Successful Project Management, Energy, Power and Utilities Industry, Corus Hotel, Kuala Lumpur - Sept. 2010, P071.
21. Read the interview 'Time is NOT money', a conversation with Keith Pickavance' for some background on Keith's assertion the 21st Century will be 'The Age of Time'. [View PDF] - Or you can view the broadcast of his keynote presentation at PM Asia by clicking on: http://www.multichanneltv.com/ciob/cio004/
22. Patrick Weaver, 'Time management -v- Contract administration', PMOZ [Project Management at the Speed of Light], Novotel Sydney Brighton Beach, New South Wales, Australia, 2-5 August 2011, P146.
23. Patrick Weaver, 'Why Critical Path Scheduling (CPM) is Wildly Optimistic', Presented at:
24. Eighth Annual PMI College of Scheduling Conference, Sunday, May 1 - Wednesday, May 4, 2011, P117.