



Optimization of Construction Project Scheduling by Using Linear Programming

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Abstract: Planning, scheduling of construction projects are affected by unpredictable factors such as cash flow, design changes etc. Conventionally project scheduling by using critical path method has been used. Of late project scheduling using softwares like ms-project, primavera are used. However optimized project scheduling using linear programming and softwares are being attempted. In these project work optimized project scheduling using linear programming and LINDO software are proposed to be used. Procedures to solve these various problems are cited and the final solution is obtained using LINDO program. It could be used by construction managers in planning stage to explore various possible solution. Linear programming shows that algorithm is very promising in practice on a wide variety of problems. This method is simple, applicable to a large network, and generates shorter computational time at low cost, along with an increase in robustness. A sample optimized project scheduling for a residential building G+2 both by conventional method of scheduling and by using software like ms-project, primavera and LINDO are

compared and simulated values will be projected.

Keywords: Project management, linear programming.

Introduction:

Construction projects is high-rise buildings, highways, power stations, pipelines etc are involving thousands of activities. Planning, Scheduling of such projects using traditional network techniques like CPM/PERT have many disadvantages due to large number of activities. Alternate methods using to model such as graphical methods, linear scheduling methods, line of balance methods. The advantages of these graphical approaches are simplicity and visualize whole project. The disadvantage of these graphical methods attempt to finish the project at the earliest with a fixed production rate for each crew and therefore a known cost of the project. This cost may not be the minimum cost. In order to include production rate as a decision variables to find a schedule with a minimum cost a graphical model and



analytical techniques are used. Linear programming is a method to achieve the best outcome in a mathematical model, whose requirements are represented by a linear relationships. Linear programming can be applied to various fields of study. It is widely used in construction project, business and economics, and is also utilized for some engineering problems.

Objective of the project:

To develop a project network by establishing activity work break down structure with duration and the sequence of their execution. To formulate linear programming model. To identify the project minimum direct cost for a specified feasible project duration.

Literature review:

Hanssmann and W.Hess(1960) used a linear programming. Linear programming mathematical method for determining a way to achieve the best outcome like maximum profit with lowest cost in given model. Linear programming is a specific case of mathematical optimization.

Issac (1995) They has been done to analyse the amount of savings that could have been achieved by proper construction management techniques with reference to a 12-unit housing construction. Even a small amount of saving without sacrificing the quality or quantity of work will be extremely beneficial to a country like India.

AI-Momani (2000) some concepts of linear programming and critical path method are reviewed to describe recent modelling structures that have been of great value in analyzing planning project time-cost problem. The model development represents many restrictions

and management considerations of this project.

Tarek Hegay (2001) : A practical approach is presented for the model and optimization of construction scheduling. To simplify a spreadsheet model is developed to easily usable. This model integrates CPM with time-cost trade-off, resource levelling, cash flow management. This model used to minimize the project cost .

Hesham (2002) : An efficient optimum solution is presented for a real-life dayoff scheduling problem with a three-week cycle. The two different objective is labour demands for each day of the week to minimize the number of workers. The another objective is to reduce transportation cost by minimizing the number of active day-off pattern. The solution technique utilizes the linear programming solution to determine the minimum number of workers. This solution is simple techniques to use scheduling problems.

Michael Benisch (2004) They use two combine approaches to handle uncertainty. They use this techniques for finding optimal solutions in the expected to solve combinational optimization problem. This problem is formulate as a stochastic problem, and to solve the sample average approximation method.

Issam M.Srou (2006) address the issues of workforce training and allocation on construction project. Christo Ananth et al. [9] discussed about creating Obstacles to Screened networks. In today's technological world, millions of individuals are subject to privacy threats. Companies are hired not only to watch what you visit online, but to infiltrate the information and send advertising based on your browsing history. People set up accounts for facebook, enter bank and



credit card information to various websites. Those concerned about Internet privacy often cite a number of privacy risks events that can compromise privacy which may be encountered through Internet use. These methods of compromise can range from the gathering of statistics on users, to more malicious acts such as the spreading of spyware and various forms of bugs (software errors) exploitation. The objective of this proposed model is to minimize the labour costs with satisfying project labour demand.

Ahmed B Senouci (2006) presents a computerized system for the scheduling and cost optimization of linear projects. This system which use a genetic algorithm model, minimizes the project cost and indirect cost. The proposed system determines the optimum formations and interruption durations of the production activity that minimizes the project cost.

Uros (2008) the optimization was performed by the nonlinear programming approach. The nonlinear project cost objective function is subjected to the various system of the activity precedence relationship, activity duration constraints and the project duration constraints. The activity precedence relationship constraints was defined to comprise the project duration. Finish –start, start-start, start-finish, finish – finish precedence relationship between activity. The project duration constraints define the maximum various project duration..

Li, Heng and Chan (2009) describes the use of prototyping to optimize construction planning scheduling by analyse resource allocation and planning with construction model, resource model.

M.Kong (2009) the process of generating optimized schedules for construction projects is a time-consuming. This uses to a

multiple of possible execution orders and consequently to a optimization problem.

Samel L Baker (2010) critical path method is one of several related techniques for doing project planning and scheduling. If some of the activities requires other activities to finish before they can start, then the project becomes a complex web of activities.

Miriqbal Faheem (2010) planning, scheduling are affected by various factors such as climatic condition, design change, etc are results the project duration and cost maximization. Identification of least cost scheduling traditional network techniques are used by bar charts, line of balance, CPM, PERT are used. These techniques have many disadvantages in planning, scheduling due to large number of interacting activities. Linear programming model is used to eliminate this disadvantages. This model is simple, apply to large network and minimize the cost and duration of the project. For high rise building LINGO software is used.

Omar M. Elmabrouk (2011) in this CPM/PERT are two traditional research techniques are used. It is mainly provides a framework for crashing total project time by using linear programming techniques.

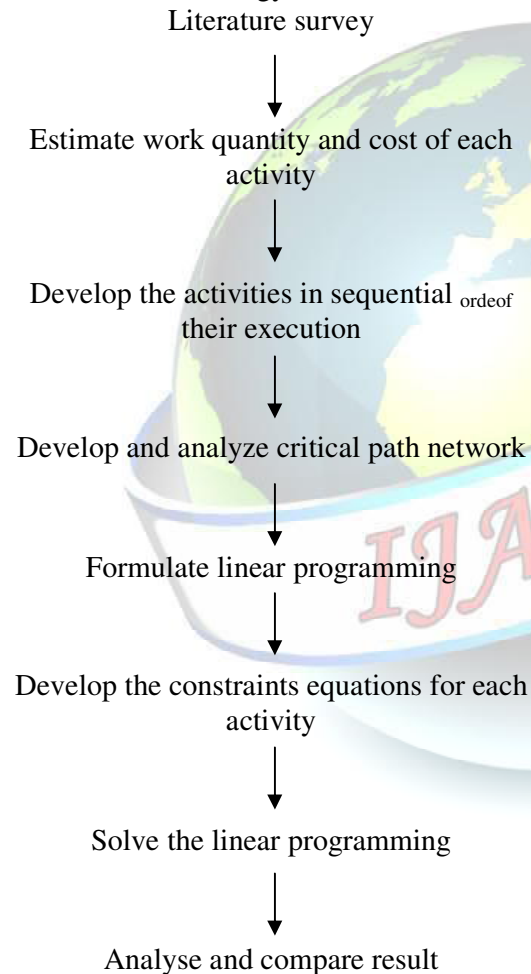
B.R.Kharde (2012) crashing technique is used to find optimum project duration to minimum project cost. In crashing the direct cost increase while indirect cost decrease. So it is beneficial to decrease the project duration and project cost.

Omar M. Elmabrouk (2012) some concepts of linear programming and critical path method were reviewed to describe recent modelling structures that have been of great value in analyzing extended planning horizon project time-cost crash problem. A simplified representation of a project and a linear



programming model was formed to represent this system. Procedures to solve these numerous problem formulation were cited and the final solution was obtained by using LINDO program. It could be used by construction managers in a planning stage to various possible opportunities to the contractor. This method is simple applicable to a large network, computational time at low cost.

Research methodology



Linear programming model :

Minimize : $Z = CX$

Subjected to: $AX < b, X > 0$

Where, $X = \langle x_1, x_2, x_3, \dots, x_n \rangle^T$ is a vector of variables, $A[a_{ij}]$, where $i \in N_m$ and $j \in N_n$ is a constraint matrix, and $b = \langle b_1, b_2, b_3, \dots, b_n \rangle^T$ is a right hand side vector.

Analysis :

The linear programming model will not only take into account the activities on the critical path. The LINDO solution report and output solution. It indicates that the project project can be completed with shorter duration. The linear programming analysis carried out to determine the optimal solution in extra resource. It is important for a project management to recognize the flexibility of the system that can be used to numerous possible opportunities. This approach allowsthe user to easily manipulate different project networks of various difficulty representing real world application and to study the effectiveness of the model. The proposed model is implemented and tested for linear programming.

Conclusion :

The algorithm is developed for the minimizing project duration and cost. It is simple to applicable and give numerous possible solutions. LINDO software are user friendly and comprehensive set of fast.

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