Scheduling techniques for Linear Highway Project - Review Paper

[1]Mr. Gaurang V. Bhadage, [2]Prof. Abhijit N. Bhirud

[1]PG Student, [2]Associate Professor, JSPM's Imperial College of Engineering & Research, Wagholi,

Pune, Maharashtra, India.

Abstract: Road Transportation is the backbone of developing countries. The network of the roads is most important and cost effective; it provides connectivity and access in urban and rural areas. Based on the time allocation for activities, there are various methods for Planning and scheduling of highway projects. It has been traditionally done with Project evaluation and review Technique, Critical Path method, Bar charts, Gantt chart. These methods are not sufficient for planning, monitoring and scheduling due to the relationships between activities and the execution method. This type of problems is occurring generally in linear projects. Linear projects consist of activities for entire stretch when the activities progressing with buffered time in the different stretches of alignment. LSM is used for scheduling in highway infrastructure development. It schedules the activities such that the effective use of resources is maximum at interruption minimum. The detailed analysis of progress of actual work done and production with respect to actual days required as per the calendar with work breaks and real time spent on the particular activity was carried out which is not possible with LSM and the duration of the project must maintain the quantity and quality of work in planning road project by using new innovative method with the different aspects such as productivity, site conditions and practices.

Keywords — Scheduling Techniques, Linear Highway Projects, Linear Scheduling Method, Activities

I. INTRODUCTION

Construction project scheduling and planning has always been a significant factor determining the successfully completion of highway projects due to competition, time, space and resource constraints, penalties and incentives that are predominant in this sector. Better planning and meticulously scheduled project invariably becomes a successful project and contributes indirectly or directly to the growth of any country. Planning, scheduling and monitoring of highway projects are carried out with bar charts, milestone charts and network techniques and software depends on these techniques. The practice of scheduling tools help to obtained the possible completion times available between activities and critical paths for action taking during implementation. Depend on this information, the scheduler (project manager) further manipulates and reschedules the activities to complete the project optimally. The important criteria in predicting the duration of highway project is by defining the probable output of activities involved to provide resources appropriately to these activities. The assign of duration for every activity is belongs to the productivity from employed men and machinery decides total overall project duration. Standard data book for examination of activity rates in implementation of projects provide us with guidelines which are help to determine production rates for various project activities.

II. LINEAR CONSTRUCTION OVERVIEW

Construction projects consist of activities which have a discrete or continuous relationship between them. The start or progress of project depends on completion of a previous activity in discrete systems whereas progress of activities is simultaneous in continuous systems. From the study of the schedule prepared by some leading road constructors, it has been observed that the usual order of activities in road construction are diversion, clearing, earthwork, embankment, sub base, sub grade, macadam, asphalting, kerbs and culverts. From this list of activities it is seen that road projects have a combination of distinct and linear activities. Discrete activities such as culverts, underpasses are similar to activities as in a building project and occur only at distinct locations on a road. Linear activities form the bulk of the activity types in road projects such as clearing earthwork base course macadam asphalt etc. which occur along the project and succeeding activities progress while the preceding activities are still ongoing. Moreover, road projects are executed in various sections depending on the availability of working space and resources with the same crew or with different crews for each of these sections. If the sections are comparatively long, then there is a possibility of crew allocations for the succeeding

activities while the preceding activities are still in progress. These types of projects are classified as linear projects and scheduling them with conventional methods shall not provide us with accurate results.

III. NEED OF STUDY

From the review on scheduling methods currently used in the construction industry, it is clearly understood that the compatibility of the scheduling tool is purely based on the type of project, its component tasks and their production rates and nature of relationship between them. Therefore it becomes mandatory for project scheduling to depict the reality of the construction process in a project. Linear scheduling method has been used as effective method in scheduling road and similar linear projects. The efficiency of linear scheduling to handle the rate of output of particular activity and incorporate uncertainty prevailing in project course of action needs to be investigated comprehensively and a more sort after scheduling approach need to be grow for linear construction. Moreover in a country like India, where infrastructure growth is constantly under stress due to more GDP that means GDP targets set every year, only constructors equipped with technology shall be capable to bring the project facilities on time. The transportation sector is vast and caters required to nearly 1.6 billion people. In 2016, the sector provides about 7.5 % to the GDP of country with road transportation contributing a lion's share.

IV. LITERATURE REVIEW

The approach of the study is possible only by an analysis of the earlier works done in this area and reviewing existing literature related to methods used for scheduling, the productive quality and cost overrun in the road projects.

A. Literature related to methods used for scheduling

[1] **Alexandros Kallantzis (2007)** The linear scheduling method is an alternative method for linear projects in which the same means the critical path has been found out like critical path method .The random project generator was introduced to produce a group of twenty five random linear projects and their equivalent networks to analyze and compare their critical paths. Aim to find out the differences and the relationships between the activities in linear projects. Also compared the critical path of the Kallantzis-Lambropoulos repetitive project model against network scheduling model of CPM.

[2] **Mattila and Park (2003)** have compared the two scheduling techniques and the results of the critical activities of the linear scheduling method and the repetitive scheduling method (RSM). They proposed the control points to determine the critical path with the help of RSM whereas controlling links were used for determination of critical path of LSM. The study of relationships has been carried out to identify the relationships between them for LSM and CPM and found the identical results for both the methods.

[3] **Rene A Yamin and Devid J Harmelink (2001)** found the alternative scheduling method used for linear type of project and that was more useful on field than CPM. The Linear scheduling method and CPM are used in higher level of management where critical factors identification needed. The adoption of right method highlights the essential requirements to be satisfied by scheduling, planning and management. They scheduled two different project examples with LSM and CPM methods and discussed the difference between them. Their conclusions could be one step ahead for the project management team and project.

B. Productivity

[4] **Kabeh Vaziri (2007)** Project scheduling is depends upon duration of task. But assigning task duration has lot of uncertainties and that effect on the assigning resources. To control this problem they evolved control policies. These policies are form of planned resource allocations to that task which are useful to capture the uncertainties of duration of task. They grew an algorithm by adopting simulation methods to find out the crew size. The main purpose of research is to allocate skilled labor to that project with consideration of duration and cost.

[5] **Han-Guk Ryu, Hyun-Soo Lee and Jung-Ho Yu (2003)** The model was introduced to examine the productivity of the project. When the productivity lost the project gets delayed. The actual completion period is varies due to loss in productivity. The required quantities and the resources are recorded and apply them to urban and rural projects. A simulation model was introduced to combine simultaneous work productivity and global productivity. The main outcome of the method is reduction of productivity due to loss of duration and model having information regarding loss of productivity.

[6] **McCabe 2003** Risk analyses with the duration have an influence on infrastructure projects. A model is introduced with the minimum and maximum duration was found with scheduled risk and formulated with MonteCarlo Method. There are steps involved in this model. Firstly with domain experts and study of literature variables are identifying from possibility of the huddles. In second stage the correlation of the variables was introduced with domains. In third step analyzation done by experts the probability is introduced gleaned from correlations. The final stage the model was apply throughout the analysis of threads in parallel with the group of managers having knowledge of Primavera. The Monte Carlo result found identical with probabilistic model.

C. Time cost overrun

[7] **Swapnil P Wanjari and Gaurav Dobaria (2016)** they prepared questionnaire with 15 activities are responsible for cost overrun and delayed in execution of project. This questionnaire was send to 190 construction experts across India. The responses were obtained and using

the statistic tool such as ANOVA and analysis tool such as SPSS. These analysis has three major factors are depending on availability of material, price escalation and activity planning. This content also provides suggestions of professional expert.

[8] **Arun and Rao (2007)** they developed decision making tool which can be used to predict the duration and the cost overrun and delay in activities related to highway projects. The activities are classified into controllable and uncontrollable delaying factors. With the help of opinions of senior officers or consultant or professionals they evaluate the risk factors in highway projects and developed Knowledge Based Decision Supporting Tool (KBDST) to evaluate the risk from the highway projects. These support tools monitor the activities and evaluate the risk. It was developed in Java. The overrun of cost from the activities was the output of the tool.

[9] **Iyer and Jha (2006)** In Indian construction industry the time and cost overrun varying from months to years; the researchers studied the remedial measures. They found 55 attributes which are generally affected on project. There are some failure attributes and some are successful. They arrange them in the form of questionnaire. After analyzing the performance of the project, they fount that there are few factors which are need to be focused to obtained optimum result.

V. OBSERVATION

The impressive management of project is focusing on objectives and the nature of activities and optimum resource allocations. There are different tools used in project management which are required proficiency in handling and must aware about the time – cost management to achieve the physical progress. The commonly used methods are CPM, PERT, which are activity oriented network. However, the development of new scheduling method is required for particular project generally depends on the nature of activities. Therefore the duration of the particular activity is differ from reality based on the factors such as availability of land , environmental clearances, political impact, resources of material etc. Particularly in linear projects, these aspects having more impact on highway construction because of different geological as well as environmental conditions. Since these aspects take more time to complete the project in stipulated period and in sanction cost. LSM is used for planning and scheduling of linear highway projects but it has limitations. When above said problems are more impacting then the scheduling method has failed. In LSM it always assume that production rates are linear but indirectly its limitation and making detailed network is complicated for large projects, so, it becomes necessary to find new method for accurate prediction of duration of the different activities as the existing approaches disregard these factors.

VI. CONCLUSION

The LSM developed in this work is restricted to analysis of single sections of road projects. For application in large linear highway projects activities are perform simultaneously at various locations, the visualization of network is difficult due to more detailing. The graphical representation is not clear in LSM. So there is need of the development of scheduling method as a comprehensive approach in highway project scheduling. The completion date must be maintain the quantity of work in planning road project. There is need of model incorporating engenderment rates through new method for a flexible implementation in road projects based on productivity, site practices and conditions, crews and work quantities.

REFERENCES

[1] Alexandros Kallantzis, John Soldatos and Sergios Lambropoulos, "Linear versus Network Scheduling: A Critical Path Comparison", Journal of Construction Engineering and Management, ASCE, Vol.124, No.3, pp.483-491, 2007.

[2] Kris G. Mattila & Amy Park "Comparison of Linear Scheduling Model and Repetitive Scheduling Method" Journal of Construction Engineering and Management 129(1) February 2003 DOI: 10.1061/(ASCE)0733-9364(2003)129:1(56)

[3] René A. Yamín and & David J. Harmelink "Comparison of Linear Scheduling Model (LSM) and Critical Path Method (CPM) " Journal of Construction Engineering and Management Vol. 127, Issue 5 (October 2001) https://doi.org/10.1061/(ASCE)0733-9364(2001)127:5(374)

[4] Kabeh Vaziri, Paul G. Carr and Linda K. Nozick "Project Planning for Construction under Uncertainty with Limited Resources" April 2007, Journal of Construction Engineering and Management 133(4), DOI: 10.1061/(ASCE)0733-9364(2007)133:4(268).

[5] Han-Guk Ryu, Hyun-Soo Lee and Jung-Ho Yu (2003) "A method for analysing delays duration considering lost productivity through construction productivity data model." In: Greenwood, D J (Ed.), 19th Annual ARCOM Conference, 3-5 September 2003, University of Brighton. Association of Researchers in Construction Management, Vol. 2, 735-43.

[6] B. McCabe "Monte Carlo simulation for schedule risks, " January 2004, Proceedings - Winter Simulation Conference 2:1561 - 1565 vol.2, DOI: 10.1109/WSC.2003.1261603, Source IEEE Xplore, Conference: Simulation Conference, 2003. Proceedings of the 2003 Winter, Volume: 2

[7] Swapnil P Wanjari and Gaurav Dobaria " Identifying factors causing cost overrun of the construction projects in India" Department of Civil Engineering, Visvesvaraya National Institute of Technology, Nagpur 440010, India Sadhana Vol. 41, No. 6, June 2016, pp. 679–693 DOI 10.1007/s12046-016-0498-3

[8] Arun, C. and Nagabhushana Rao Bh., "Knowledge Based Decision Support Tool for Duration and Cost Overrun Analysis of Highway Construction Projects", Journal of Civil Engineering, Institution Of Engineers (India), pp 27–33, August 2007.

[9] Iyer, K.C. and Jha, K.N. "Critical Factors Affecting Schedule Performance: Evidence from Indian Construction Projects", Journal of Construction Engineering and Management, ASCE, Vol.124, No.3, pp.871-880, 2006.

[10] Government of India Report (2005): National Road Transport Policy Document (2005) available on National Portal of India: Business; Infrastructure; Roadways.