Progress monitoring in a Real Time Infrastructure projects

Aishwarya S, Muthu D, Venkata Subramanian C

Abstract*: India is one of the countries where the infrastructure projects face delay. And progress monitoring for linear projects is one of the crucial parts in such projects. Progress monitoring should be done at every stage at daily basis to avoid delays, risk and cost overruns in a linear infrastructure project. This paper aims at reviewing causes and sources of delay in linear infrastructure projects and suggestions to overcome the difficulties in conventional progress monitoring techniques. The methodology followed in this research is review of literatures for understanding the causes and effects of delays and project management software for progress monitoring. From the findings through literature review and this research , the main factors which cause delay in infrastructure projects (based on ranking) mainly in railway projects namely land acquisition , Front availability , labor and material availability , unfavorable weather conditions , fund constraints , slow progress work , Change of scope , less granularity of information, Improper site management and some external factors. The decision making related to any activities can be made by using this project management software which will replace the traditional progress monitoring techniques in the future. This paper concluded by suggesting few recommendations to improve the efficiency of progress monitoring and ways to avoid delays in future projects.

***Index Terms*: Daily Progress Report, Delay analysis, Infrastructure Projects, Progress Monitoring, Project Management.**

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I. INTRODUCTION

Infrastructure projects are full of risk and uncertainties as it will take years to complete the projects, changes and schedule deviation are unavoidable in such situations. Due to certain changes, the project progress will go down and it will reflect on schedule and cost overrun which results in delay in a project that will affect the client's time and contractor's profit. To overcome the above problem, first way is to increase the resource and complete the work in a stipulated time; second way is to work with an existing resource and work rate which leads to time extension in a project**.** Construction projects are facing delay and it differs from project to project delays in project are linked to the project cost [2] [5]. Due to delay in project, the owner faces financial problem mainly because of loss of productivity [5]. The main effects of delay are time extension, cost overrun and loss of reputation to contractor .

Revised Manuscript Received on May 06, 2019

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And the main causes of delay are Payment clearance to contractor, bad weather conditions and unexpected site condition [1].The whole world faces delay during execution of infrastructure projects [14].

The percentage of infrastructure projects delivered late were around 72 % and only 28% of the whole projects were delivered on time. The Completion of the project within the stipulated time indicates the efficiency of the project [7]. Hence, the causes of delays in construction projects should be studied and analyzed. The most common problem in Indian Construction projects are delay in the execution time [17].

Delay is described as the schedule deviation in the project which results in schedule overrun and cost overrun [3]. The development in technology such as robotics and other techniques will improve the automation in infrastructure projects [8].A step by step photographs and its data will be more developed in the future and be used in the projects to measure the efficiency of the project[10].So , the traditional progress monitoring technique will not be suitable for the present modern construction projects.[18].Roads & highways are the mode of transportation through which the goods and people will navigate from one place to another. Hence, it has to be constructed and maintained properly to maintain the quality and increase the convenience of the public [19]. In infrastructure projects, the automated progress monitoring can improve the granularity of information and enhance the coordination between management and the other team members [20].

The findings related to this research from the past literatures are information availability in site and coordination between various stakeholders was very poor and it can be overcome by proper project management software. The main aim of this research is to monitor the progress of work in linear infrastructure projects and to analyze the factors which cause delay at initial stage of the linear infrastructure projects.

II. PROGRESS MONITORING

In this paper, nPulse (PMIS - Progress Monitoring Information System) is used for progress monitoring for a real time infrastructure projects especially for railway projects. This software is cloud based and it is not an open source software .Proper license has to be used to access this software. nPulse is a software which is useful for analytics and will act as a decision support for projects.

The following points are the main benefits of this software:

1. Past performance analysis.
2. Indicating alerts for delay / risk.
3. Maintaining proper co-ordination between management and other authorities involved in the project.
4. Progress can be monitored through various visual dashboards. The

following image represents the nPulse login page.

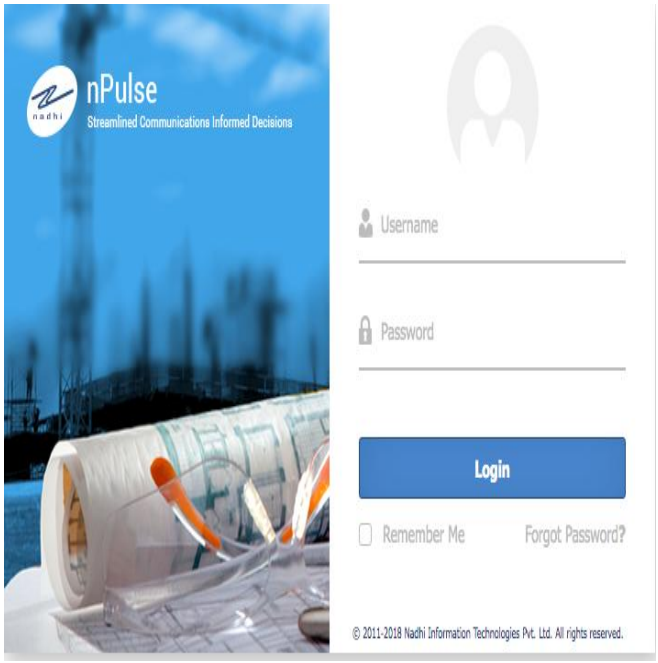

Figure 1 Login Page Of nPulse Software

This Software saves time and money by providing predictive analytics and data are collected through browser and mobile. Different type of access control and permission can be done by this software .only admin and the person who have access to that particular module can only be able to view/edit the change in that particular area. Daily Progress, Meetings, Issues and Document transmittal and approval can be tracked very effectively through this software.

Schedule can be imported from MSP (Microsoft Project) and it will be integrated with BOQ (Bill of Quantities). After integration process, DPR (Daily Progress Report) will be generated by the concerned authorities. The generated DPR can be seen in the form of various dashboards especially S- curve which represent the progress and delay in the project by method of CPM (Critical Path Method). During DPR generation, the delay reasons are captured. The delay reasons generated through this software are used in this research for delay analysis. Figure 2 represents the different modules in nPulse software.

III. DELAY

Infrastructure projects are full of risk and consist of unpredictable situations that will happen in such projects at any situation due to some unavoidable reasons. Delay in project will affect the reputation of the contractor and it will create some financial consequences .

The delay reasons are categorized as below:

I. Client Related Issues/Delays
   1. Delay in approving and issuing drawing
   2. Delay in making payment to the contractor where the work has completed
   3. Not solving the issues on a perfect time & Local problem such as environmental, political problems etc.,

II. Project Related Site Issues/Delays
   1. Front Availability Issues
   2. Unexpected Site condition
   3. Issues in accessing to the site

III. Execution Related Issues
   1. Availability of Resources
   2. Improper Coordination between management and site persons
   3. Delay in executing a particular work due to weather changes and changes in methodology

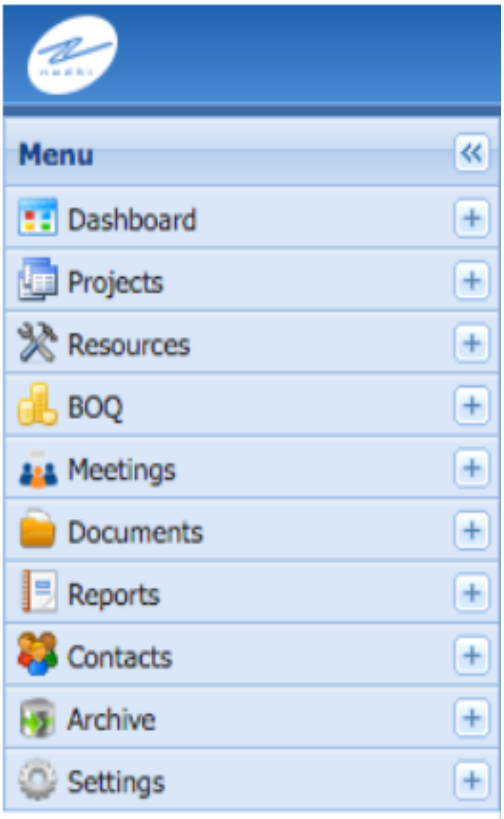

Figure 2 Different Modules In nPulse Software

S-curve can be analyzed to know the physical and financial progress of the project. The schedule deviation can also be analyzed and catch up plan can be done to overcome the delays. It can be done in two ways, either the resource can be increased, and work can be completed within time or the work can be continued with the existing work rate with extension in time but within the completion time of the project. Figure 4 represents the S- curve which indicated the physical progress of the project with sample values.

IV. METHODOLOGY

The methodology followed in this research consists of three sections. . First section consists of a detailed literature review which was carried out to know the causes and effects of delays in construction Projects and

the merits and demerits of conventional progress monitoring were studied.

Second section comprises of knowing the details of project management software which can be effectively useful for progress monitoring in a real - time infrastructure projects. Finally, the third section consists of delay analysis, conclusions and some recommendations for future research.

In the first section, past studies about this area was thoroughly studied and investigated. The investigated results such as causes and effects of delay in infrastructure projects were further used for analysis. It was prepared into a format according to the software template and it is used by the site engineers while raising DPR for delay in executing the particular activity. Points ranking from 1 to 5 were given to the response according to the importance level in the project. Figure 3 represents the methodology followed in this project

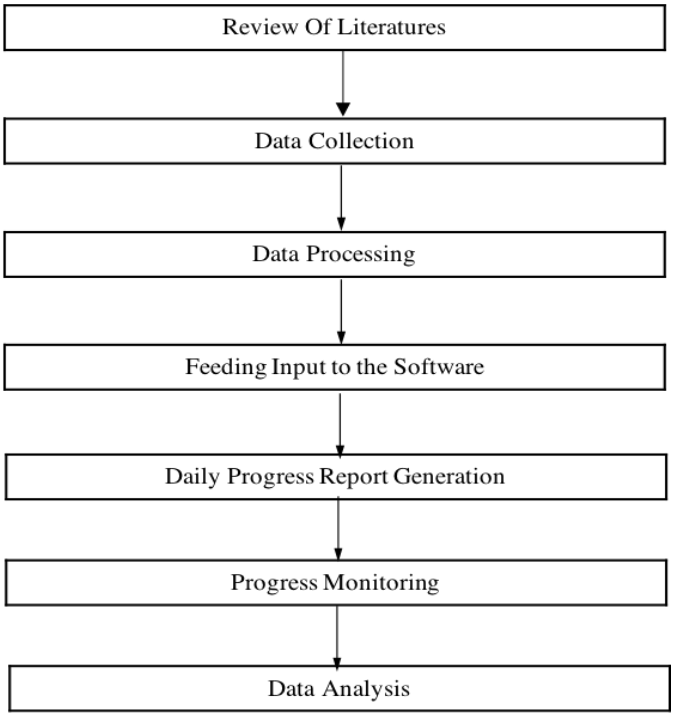

Figure 3 Flow Chart Representing the Methodology For Progress Monitoring And Delay Analysis

The data collected from the software is used for delay analysis in infrastructure projects. From the DPR generated by the site engineers, the daily progress will be monitored through Physical and financial progress. Only the admin can control the access of the users and settings in this project. The users cannot add contacts or make any changes without the access .If any changes needed to be made or any configuration need to be done, it can be done only by the admin of this project in nPulse software.

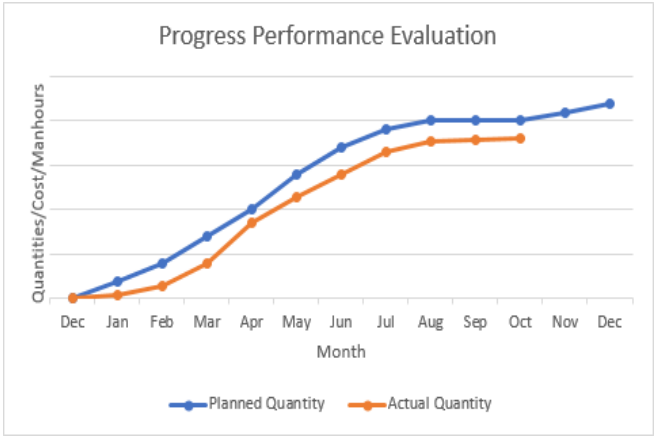

Figure 4 S-curve Representing progress of the Project

V.DATA ANALYSIS

Table 1 represents the results for the analysis carried out in this project which mainly includes delay analysis by monitoring the progress of the projects daily using nPulse software.

Due to many reasons that causes delay in a project, time extension, cost overrun, schedule overrun, poor productivity, claims and loss of profit are the effects of the delays. The delay effects eventually affect the contractor's reputation and client's money. Progress monitoring can be done at every stage using the DPR generated. The delay and catchup analysis can be done, and the delays can be avoided by increasing the work rate or by taking extension of time for the project within the stipulated time.

Using the project performance chart, percentage delay progress and percentage time delay can be analyzed, and necessary action can be carried out to catch up the delay in the project. Land Acquisition is the major delay reason for all infrastructure projects.

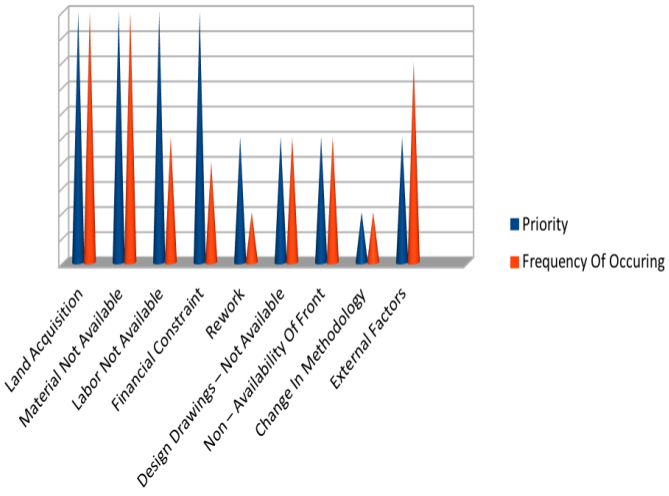

Figure 5 Delay Chart with Priorities And Frequency Of Occurrence

VI. RESULTS AND DISCUSSIONS

From this research, the delay occurs at an initial stage of the infrastructure projects were analyzed and

recommendations were given to avoid such delays which adversely affects the schedule and cost. Delays cannot be unavoidable in certain situation, but it can be reduced to a lowest level by knowing the consequence at a very early stage. From the findings of this paper , the major factors which causes delay in railway projects are land acquisition problem, Non - Availability of labor and machine , drawings and front end, Financial Constraints and change in methodology. Issues, documents (drawings) and risk involved in this project can be tracked through this software and can be closed at an early stage so such delays can be avoidable. Land acquisition problem is unavoidable, but the site can be chosen in such a way that it doesn't affect the green land or agricultural land. During feasibility study itself, this problem can be easily identified and sorted out at an early stage. In this software, alerts will be sent to the concerned authority about the project delay and risk so that it can be solved in an easy manner at an early stage of the problem itself.

Table 1 Delay Reasons With Priorities

SI.No	Delay Reason	Priority	Frequency Of Occurrence
1	Land Acquisition Problem	High	High(during initial stage)
2	Material Not Available	High	High
3	Labor Not Available	High	Medium
4	Financial Constraint	High	Low - Medium
5	Rework	Medium	Low
6	Design Drawings - Not Available	Medium	Medium
7	Non - Availability Of Front	Medium	Medium
8	Change In Methodology	Low	Low
9	External Factors	Medium	Medium - High

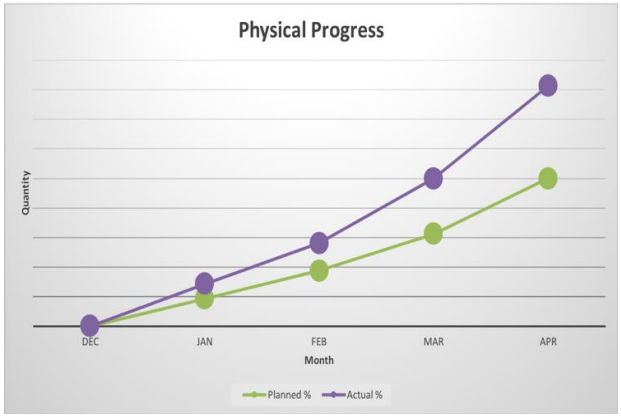

Figure 6 Physical Progress With Sample Values

VII. CONCLUSIONS AND RECOMMENDATIONS

Infrastructure projects are more likely to suffer from delay due to the long duration of the project; any uncertainties in such project will change the direction of the project. Thus, it will affect the schedule and cost of the entire project. Delays are unavoidable in certain situation, but it can be reduced to an acceptable level. This paper mainly focused on the progress monitoring and delay analysis at early stage of the projects. In such a long project, proper coordination is needed between management and the other team members. Proper planning during the initialization of the project is very necessary to avoid the above mentioned delays in the project the information about project such as issues, delay in project should to escalate to the high level to avoid problems in the future. Such escalation of information can be done through this software and high-level management can get the full detailed progress of the project at any stage. Thus, PMIS act as a decision making tool in critical situation. In this research, only few stretches are taken, and the future research can be focused on all modules of this software and analysis can be carried out for the entire duration of the project. Thus, the effectiveness of the software can be analyzed in a better way and it can be used for project management in infrastructure projects to avoid cost and schedule overrun.

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