

Optimization of Resources in Highway Construction

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ABSTRACT

The project is carried out to have a study about resource Management in highway constructions and its implementation. In recent years project management software systems like MS Project, Primavera etc. have been improving continuously and recent versions have exhibited better interfaces, integrated planning and control features, and Internet capabilities. Yet, basic project management functions such as resource allocation, resource leveling, and time cost trade-off analysis have been the least improved. The Construction projects, especially the highway construction projects, uses huge amount of resources on and off the field in various forms of resources viz., materials, plants, equipment's and human resources along with money, time and space.. Production and operation sequence management is the process of controlling production and services the main objective of which is to match efforts with application of resources and equipment's in order to best produce and serve. Effort is made to use available resource and time in a desirable way and prevent resource and equipment waste. Data collection is done by questionnaire survey and it is used to find Benefits of resource management, causes of failure of resource management and causes of resource fluctuation etc.. Project management software primavera is used in order to complete the project on time under budget.

Keywords— Resource Management, Resource Leveling, Scheduling of activities.

I. INTRODUCTION

The Construction projects, especially the highway construction projects, uses huge amount of resources on and off the field in various forms of resources viz., materials, plants, equipment's and human resources along with money, time and space. The uniqueness of the projects makes the resource planning a tedious job as the efficiency of each resource depends upon a huge number of working condition factors. Observing the trend in construction technology presents a very mix and ambiguous picture. On the one hand many of techniques

and materials used for construction are essentially unchanged since the introduction of mechanization in the early part of twentieth century. For example at the time of highway construction at the beginning of the nineteenth century most of the highway project report stated that the work could not have been done any faster or more efficiently in our days, despite all technological and mechanical advances in the time, since the reason being that no present system could possibly carry the spoil material away any faster or more efficiently than the system employed. No motor trucks were in the digging of soil everything ran on the rails for cutting and filling of soil at different chainage to reduce the wastage of human resources and achieve maximum productivity. And because of quantity of soil and rain, no other methods have work so well to achieve the desired output. In contrast to this view of one large project, it may also point to the continuous change and improvement occurring in traditional material and technique. This continuous improvement in techniques help to plan and distribute the resources as per the requirement and efficient distribution of all these resources helps in close monitoring and actual progress of the work which includes resources like man, material, machinery and money with respect to their productivity. The use of resources allocation in project control is not a new issue. It was proposed in 1950s. Most methods were first those which led to an optimal solution. Production and operation sequence management is the process of controlling production and services the main objective of which is to match efforts with application of resources and equipment's in order to best produce and serve. Effort is made to use available resource and time in a desirable way and prevent resource and equipment waste. Here, resource allocation is of great importance. It determines the type resource allocation and importance of various parameters based on the nature of a production system and amount, type and importance of resources. Developing a plan differs from developing a program in the issue of resource allocation in project control. A plan contains questions such as ,which activities are going to be

done or how these could be done. In addition, a plan estimates the time of performing a certain task in various methods and if the time is random, then it estimates time distribution. It also identifies required resources to perform tasks in various methods. Although it seems that plan is prior to program but. In fact, there is a close relationship between these two. A plan may lack a practical program and thus it must be revised. However, a plan and its related program aim to optimize one (or more) predetermined goal and the value of the objective function measures their efficiency.

RESOURCE MANAGEMENT

A resource is an entity that contributes to the accomplishment of project activities such as manpower, material, money, equipment, time or space.

RESOURCE PLANNING

Construction Work Force

The project man power planning primarily focuses on determining the size of project work force, its structuring into functional groups and workers teams, and scheduling the manpower recruitment to match the task requirement. This process chiefly involves identifying the trades or the skills required, establishing productivity standards to determine the number of worker needed to perform a given job in the specified time, data wise forecasting of workers requirements for accomplishing the project work and finally organizing the planned work force into operating work-teams having assigned programmed tasks.

Construction Materials

Efficient material management in project environments calls for an integrated approach covering numerous functions such as materials planning and programming, materials purchasing, inventory control, store-keeping and ware housing, materials transportation and handling at site, materials codification and standardization and the disposal of surpluses. The material planning and programming, which is the key function on materials management is closely linked with the project planning and control set-up. Both these work together to develop a plan to procurement and stocking of construction materials so as to provide at site, materials of right quantity, at right prices from right source and at the right time. The construction material planning involves identifying the materials required, estimating quantities, defining specifications, forecasting requirements, locating resources for procurement, getting material samples approved, designing material inventory and developing procurement plan to ensure a smooth flow of materials till the connected construction work are completed at the project site.

Construction Equipment

Production task needing equipment include excavating, handling, transporting, filling, compacting, grading, hoisting, concreting, pre-casting, plastering, finishing, trenching, and laying of pipes and cables. The

supporting equipment at project site consists of generators, transmission lines, pumping sets, other utility services equipment. Construction equipment is indispensable in execution of modern high-cost, time-bound massive construction projects. It produces output with an accelerated speed in a limited time. It saves manpower, which is becoming ever more costly and demanding. It improves productivity, quality and safety and also adds a sense of urgency. Acquisition of equipment mass involves initial heavy investment but, on the whole, its adds to profitability by reducing the overall costs, provided it is properly planned, economically procured and effectively managed. Equipment planning for a project aims at identifying construction task to be undertaken by mechanical equipment, assessing the equipment required, exploring the equipment procurement options and finally, participating in the decision making for selecting the equipment.

RESOURCE HANDLING

After considering the time or the schedule of activities and the determination of which activities control the project time, The availability or the most efficient usage of resources required to undertake the construction operation should be considered. It is usually assumed that the resources are available in doing the time calculations. When activities are conducted simultaneously, it leads to simultaneous demands for resources, producing peak resource demands at certain stages of the construction project. Peak demand of resource, particularly very short period of time, may be undesirable. For example this implies, if workers are the resources a hire and fire situation. Many resources in the construction industry tend to be expensive and limited in number. Skilled labour is often difficult to obtain and costly to hire. Resources not used effectively on site will lead to unnecessary wastage of capital. Generally, it is more desirable to have approximately uniform resource requirements. This means scheduling certain activities such the resource requirements are modified. The means for doing this scheduling are to utilize the available float in the network. A resource graph or resource profile which is a plot of resource requirement versus time is found useful for regulating the resource demands. The ideal situation is to have a level resource graph or a graph with few changes in level as possible. There are mainly two types of activities while scheduling a construction project, namely intermittent activities and continuous activities. With the former it is possible to break the operation and restart at a later date. Resource associated with such activities is easier to handle in the resource scheduling exercise than those associated than it associated with continuous activities. Continuous activities, once started must be carried on until completed. When beginning a resource scheduling exercise the engineer should be aware of the intermittent or continuous nature of project activities.

RESOURCE LEVELING

Resource levelling is process of assigning resources to the project activities in order to improve productivity and efficiency. In resource levelling, the same mode of approach is adopted for labour, materials and machinery. Once the network diagram has been analysed and all the activity floats should be established, the scheduling of all activities in the project is started. It is important to realize at this stage, that the individual activity durations used in the critical path calculation implies a commitment to working each activity with sufficient resource to ensure compatibility between the work volumes involved in the activity, productivity and production rate achievable by these resources. While developing the most up-to-date schedule, assume that company have unlimited supply of all resources needed for the task, but the real world situation may be very different. For example a single crane budgeted may be needed for two construction tasks at the same time, or the carpentry crew may be scheduled for work on two or more overlapping tasks, or painting crew will not be allowed to work alongside the electrician in a confined space.

RESOURCE OPTIMIZATION

Resource optimization is the set of processes and methods to match the available resources (human, machinery, financial) with the needs of the organization in order to achieve established goals. Optimization consists in achieving desired results within a set timeframe and budget with minimum usage of the resources themselves. The need to optimize resources is particularly evident when the organization's demands tend to saturate and/or exceed the resources currently available. Effective construction planning and scheduling is the first and crucial step towards a successful and efficient construction project. All succeeding tasks, or activities, should follow the planning stage. The planning and scheduling process is arduous, complex and time-consuming. Even experienced construction planners find it impossible to construct a comprehensive and faultless master construction plan, and during construction operations make reviews and updates as necessary. These reviews and updates bring waste and increase the project duration and cost.

II. METHODOLOGY

1. Collection of literature
2. Study of literature
3. Questionnaire survey
4. Analysis of questionnaire data
5. Case study
6. Listing out activities by primavera
7. Scheduling of activities
8. conclusion

III. DATA COLLECTION AND ANALYSIS

The use of computers requires that answers given by the respondents be coded into numbers before the actual data analysis. The coding process for closed ended questions consists of recording the number of response. The response categories must be mutually exclusive, so no answer can fit more than one of the categories. The returned questionnaire was numerically coded to enter the data systematically and efficiently. Data was entered using the statistical package for social sciences software. Double check, manually and by computer, was made to ensure data cleaning. Statistical analysis for the data was conducted using the statistical package for social sciences as follows

1. Defining and coding of variables.
2. Summarizing the data on raw data sheet.
3. Entering data.
4. Cleaning data (Double check).

After applying the above-mentioned steps, the descriptive statistic method has been used. The descriptive method is one of analysis method which provides a general overview of results. It gives an idea of what is happening. In this study, frequency distribution and percentage were used to describe aspects of data. The researcher uses this method because large amounts of data were gathered. It is often useful to distribute the data into categories and to determine the number of individuals or cases belonging to each category. This is called "category frequency". In this research, the data were presented in forms of tabulation, bar charts, and pie charts.

MEAN VALUE

The Mean value is defined as the average value of observed data. The mean for the data is obtained from the descriptive analysis. The questionnaire was designed by giving 5 options. They are

1. HIGH
2. MEDIUM
3. LOW
4. NEGLIGIBLE

Those factors having mean value less than 2.5 that relate themselves to positive statements are taken as the critical factors for each failure. On the other hand, the negative statements that have a mean value of 2.5 and above are taken as critical factors in certain cases.

ANALYSIS OF DATA

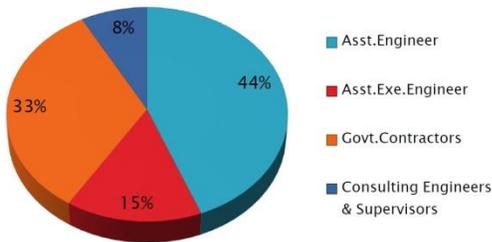
In this chapter, the results of the field survey are presented and discussed. The chapter illustrates and discusses the characteristics of the study population, application of construction resources management tools and techniques in construction projects, computer applications in resources management systems in construction projects, and Implementation of construction resources management systems.

Population Study Characteristics

The general characteristics of the study population were investigated. They include the field of work, experience of respondents, and the person in charge of managing construction resources

Respondents Designation

Figure shows that 35% of contracting companies respondents were 33% site engineers, 24% were projects managers, 18% were the officer manager, 15% owner and 10% contactors.



IV. CONSTRUCTION RESOURCE MANAGEMENT SYSTEMS

Implementation of construction resource management systems on construction projects provides the contracting company with many benefits and it can solve many problems that may face the contracting company. As table 6.1 indicates most of the contractors think that implementing systematic resource management can help them to determine the exact quantities required for a project, help to price tenders more accurately, help to finish the project successfully and to prepare accurate.

Material related factor or resource management

Materials are the essence in the construction industry which represents a substantial proportion of the total value of the project. Material related issue contributes to cost overrun. Hence, efficient material management is an important criterion for success of any project. A material management system includes the fundamental functions required in any construction project such as identifying, acquiring, storing, distributing and disposing of materials. Regular and adequate supply of the materials is very critical task as late or irregular delivery or wrong types of material delivered during construction affect the utilization of other resources like manpower and machinery. This leads to poor productivity, time delay and cost overrun.

Equipment related factor of resource management

Equipment Resources has an advantage over manpower resource as it can work under adverse circumstances continuously, requires less manpower and other facilities. The selection and utilization of equipment in a project must be an integral part of the total plan. The

type and number of the equipment's required in any project depends on the nature of the project. It affects significantly on construction cost.

Cost related factor of resources management

Cost is the first and foremost resource required for any construction work. The design and specifications of a project depend upon it, and without sufficient fund, any project cannot be completed. Hence, availability of sufficient funds and effective financial management are very important aspects in any project. Financial management is the use of financial or accounting information at all levels to assist in planning, making decisions and controlling the activities of an enterprise. Without proper management of the money or finance, the management of other resource becomes useless

Labour related factor of resource management

Manpower or human resource labour are very significant resources which play important role in success of any project. Good results certainly cannot be achieved without the adequate availability of skilled and unskilled manpower, most suitable allocation and management of human or manpower resource. Expected construction progress can be achieved only through the attainment of effective man-hour effort and the meeting of scheduled mile stone dates. Effective manpower management can reduce labour costs and thereby increase profits for company. In developing countries, poor labour productivity is a severe problem. Hence, effective manpower management and improvement in labour productivity is critical need for reducing labour costs and thereby increase profits for company

V. CASE STUDY

The use of resources allocation in project control is not a new issue. Most methods were first those which led to an optimal solution. Production and operation sequence management is the process of controlling production and services the main objective of which is to match efforts with application of resources and equipment's in order to best produce and serve. Effort is made to use available resource and time in a desirable way and prevent resource and equipment waste. Here, resource allocation is of great importance. It determines the type resource allocation and importance of various parameters based on the nature of a production system and amount, type and importance of resources. The Project Description 6 laning of Vadakanchery – Trissur section of NH 47, Km 240 to Km 270 under National Highway Phase 2 (SPV Trissur Expressway Pvt. Ltd.) in the state of Kerala to be executed as BOT (Toll) on Design Build, Finance, Operate & transfer (DBFOT) pattern under NHDP phase-II for NHAI.

A comparison between the planned progress of construction work and actual progress is performed in this study using project management software Primavera.

The software is usually used for timing and controlling various projects (Yasoobi,2001). It also can be used for timing and controlling and estimating costs of the project in all construction, industrial, software and many other types of projects. The process starts with entering project tasks into the software and specifying relationships between them while exerting resources available in projects on different tasks. The software then times tasks based on their relationship with resources so that the project finishes in the shortest time possible. Besides, if the resources consumption cost is given to the software, it can estimate the overall project expenditures. This study is mainly done using Oracle Primavera, project management software. All activities and their sequence of occurrence, duration, and resources required are studied. The organizational breakdown structure of company and work breakdown structure of the project are noted. Tacking of the completed activities and analysis are done. This gives an idea about the resources involved in the completed work

VI. CONCLUSION

The visit to highway project site and study of available database in the project site reveals that the construction companies in India have neither yet realize the necessity of detail study of their own resources nor have develop their accounting system for research and development purpose has evident from the lack of useful and relevant data from the site. The present construction practices in India is still adopt the methodology of as and when required,, resource management. Lack of professionalism leading to lack of detailed and meticulous planning and irrational decision making as per site management is concerned leading to underutilization of resources to a great extent. till now project resource planning is only limited to planning and scheduling with time but resource mobilization and usage planning according to their capacity and availability, ahead of time-in the planning stage, is still nobody's concern. Equipment cost for any project comprises of mainly 20-30% of project cost plus additional cost for maintenance, repair and operation. Cost of equipment has to be controlled properly by efficient allocation of equipment for different phases of work. So for using equipment effectively and efficiently equipment becomes necessary. Equipment procurement is done after measuring productivity of every equipment.

Material cost for any project which is more or less invariable, it depend mainly on type of project work to be performed. Material planning is done to achieve requirement of project at different phases of construction work and it also reduces excessive wastage of material.

Manpower Planning is the process by which an organization ensures that it has the right number and right kind of people, at the right place, at the right time, capable

of effectively and efficiently completing those tasks that will help the organization achieve its overall objectives. In any project, most of the activities are done —team-wise and productivity of individual labourers cannot be determined. Also teams productivity is depend on driving equipment such as grader, roller, paver etc. From the planning of highway project after allocating resources to various activities, we come to know if Equipment's and manpower is provided as per required data which is analyze by using Primavera as compare to actual used on site. It will help to complete project on time with specified duration as per contract

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