A Study of Effective Scheduling Techniques for Improving the Profitability of Construction Firms

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Abstract: *- Project scheduling is one of the most vital processes in Project Management. It is a widely dis-cussed topic in academic and practical circles due to its importance and complexity. Manpower, ma-chines, materials and equipment are used for the execution of project activities, but these mostly have limited availability, which can constrain project scheduling procedures. Within this context, a survey was carried out among the small scale con-tractors in India to see scheduling techniques used on small construction industries.*

Keywords: *- Project Management, Project Scheduling, Re-source Leveling, Multi-Attribute Decision Models*

I. INTRODUCTION

The efficient management of available resources is one of the greatest and most complex problems that Project managers (PMs) have to overcome. The Resource Leveling Problem (RLP) is a classic re-source management problem faced by practitioners, managers and researchers. Resource leveling aims to minimize peaks and valleys in the resource histogram without increasing the project duration be-yond the original critical path duration (Harris, 1990; Shtub et al., 2005). However, the problem can also come to bear in cases of limited resources, which often lead to extensions of the initial project duration (Hiyassat, 2001;Neumann & Zimmer-mann, 2000). During the past six decades, several different approaches have been developed for solv-ing the RLP. Exact algorithms have been proposed in the literature, including integer and dynamic programming techniques (Bandelloni et al., 1994; Neumann & Zimmermann, 2000). These approach-es are suitable for small-sized networks due to the so-called "combinatorial explosion"

Several heuristic procedures have also been developed to overcome the RLP; most of them are based on shifting heuristics or priority rule methods (Bur-gess & Killebrew, 1962; Neumann and Zimmer-mann, 2000). In addition, met heuristic approaches such as genetic algorithms (Leu et al., 2000; Ponz-Tienda et al., 2013; Kyriklidis et al., 2014; Kyri-klidis & Dounias, 2016; Li & Demeulemeester, 2016) and simulated annealing algorithms (Son & Skibniewski, 1999; Anagnostopoulos & Koulinas, 2010) have attempted to find an optimum solution to this problem. Recently, hyperheuristic algo-rithms proposed to treat the RLP and resource allocation problems (Anagnostopoulos and Koulinas, 2010; Koulinas & Anagnostopoulos, 2011; Kouli-nas et al. 2014) have offered some promising results. The basic idea of these approaches is to create a resource profile based on the early start schedule calculated from the Critical Path Method (CPM), and then shift noncritical activities according to fixed heuristic rules.

This paper describes the application of RPL methods to define the activity priorities to treat resource leveling under constraints when priority rule methods are implemented which will be useful for small construction firms

The proposed framework aims to optimize resource usage without exceeding a pre-determined resource limit. This goal is accomplished by allowing PMs' participation to the priorities determination phase of. A variety of well-established MADM models is implemented enabling the performance of a variety of decision attitudes.

II. LITERATURE REVIEW

Nawadi and Dangalazona, "An exploratory study into the challenges facing the emerging contractors in the construction of low cost housing in Nelson Mandela Metropole, South Africa," Published in xxxiii IAHS, Sept 2005 describes that The construction industry is an important player in the economy of South Africa. By survey they conclude in paper that the construction industry contributed approximately 35 % of the total gross domestic fixed investment and employed 230 000 employees. The South African government is the single biggest construction client, making up between 40 % and 50 % of the entire domestic construction expenditure. Furthermore this study has shown that in order for the government to achieve its goals in terms of the white paper on the construction industry, a lot of work is yet to be done amongst the emerging contractors and it can be achieved by effective scheduling.

V Srinivasa Raghavan1, Karthik Kumar V2 Problems faced by Small Scale Construction Contractors in India

In this paper study represents the survey carried out among small scale construction companies in India. The major problems faced by small scale construction contractors have been investigated through survey among the top level managers and the owners of the firms. Based on the result, Delayed payments by clients with rating 4.16, fluctuation in material cost with rating 4.05, owners involvement in construction phase with rating 3.91, cash flow management with rating 3.86 and in-creased competition in the construction field with rating 3.84 was perceived to be the top 5 major problems faced by small scale construction contractors in India.

Special training programs in construction business management, tendering processes and financial management are key areas in which the emerging contractors can be assisted.

III. RESOURCELEVELINGPROB LEM(RLP)

Resource leveling In project management, re-source leveling is defined by A Guide to the Project Management Body of Knowledge (PMBOK Guide) as "A technique in which start and finish dates are adjusted based on resource constraints with the goal of balancing demand for resources with the available supply."

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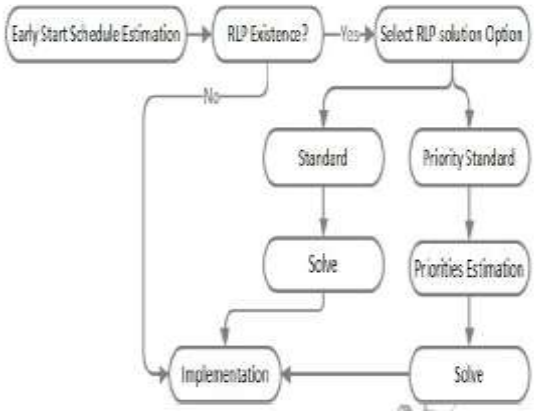
When performing project planning activities, the manager will attempt to schedule certain tasks simultaneously. When more resources such as ma-chines or people are needed than are available, or perhaps a specific person is needed in both tasks, the tasks will have to be rescheduled concurrently or even sequentially to manage the constraint. Project planning resource leveling is the process of resolving these conflicts. It can also be used to balance the workload of primary resources over the course of the project[s], usually at the expense of one of the traditional triple constraints (time, cost, scope).

When using specially designed project software, leveling typically means resolving conflicts or over allocations in the project plan by allowing the soft-ware to calculate delays and update tasks automatically. Project management software leveling re-quires delaying tasks until resources are available. In more complex environments, resources could be allocated across multiple, concurrent projects thus requiring the process of resource leveling to be performed at company level.

In either definition, leveling could result in a later project finish date if the tasks affected are in the critical path.

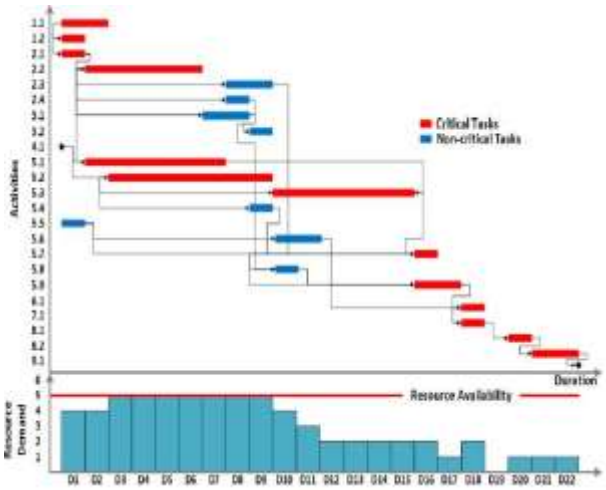
Resource leveling is also useful in the world of maintenance management. Many organizations have maintenance backlogs. These backlogs consist of work orders. In a "planned state" these work orders have estimates such as 2 electricians for 8 hours. These work orders have other attributes such as report date, priority, asset operational requirements, and safety concerns. These same organizations have a need to create weekly schedules. Re-source-leveling can take the "work demand" and balance it against the resource pool availability for the given week. The goal is to create this weekly schedule in advance of performing the work. With-out resource-leveling the organization (planner, scheduler, and supervisor) is most likely performing subjective selection. For the most part, when it comes to maintenance scheduling, there is less, if any, task interdependence, and therefore less need to calculate critical path and total float.



Decision Flowchart by RLP

IV. METHODOLOGICAL FRAMEWORK

The proposed framework aims to elicit priorities, when priority-rules heuristic procedures are implemented, in order to improve the shape of the resource usage histogram (Fig. 1). For example, MS-Project allows users to set priorities for specific tasks to control how they are leveled in relation to one another. Priorities are specified either as numbers (0 to 1000) or as linguistic values (lowest to highest) with the “highest” (or 1000) priority corresponding to "Do not level.” Because task priorities have an impact on the schedule, it is possible to affect leveling by altering assigned priorities. The final schedule of activities and CPM calculation is accomplished by MS-Project. However, the lack of coherent procedures for establishing priori-ties and the intuitional consideration of a variety of activities delay selection rules can result in the appearance of black boxes during the prioritization phase. Given that solutions to the RLP aim to rank a discrete set of alternatives (activities) under the consideration of a range of decision criteria (priority rules), this paper examines how a variety of MADM models perform in eliciting project activity priorities and providing flexibility during the re-source allocation resolution procedure. On the contrary standard heuristic approaches have no prior knowledge about the search space and the specific characteristics of each problem, and so they need to be run several times in order to achieve a near optimal solution.



V. CASE STUDIES:

Following case studies are conducted so far to study Implementation

Case study 1:

Jaitulja Bhawani Construction,Hadapsar,Pune

Discussion points:

- Materials
- Site locations
- Staff(skilled & unskilled)
- Equipments
- Cash flow important Management

Case study 2:

Mulani Construction Malawadi

Discussion points:

- Materials

- Site locations
- Staff(skilled & unskilled)
- Equipment's
- Cash flow important

Case study 3:

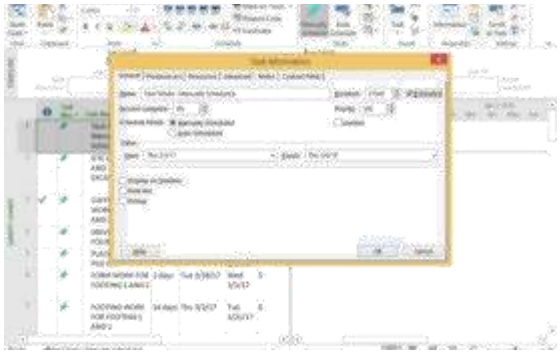
Anuja Construction, Pandharpur

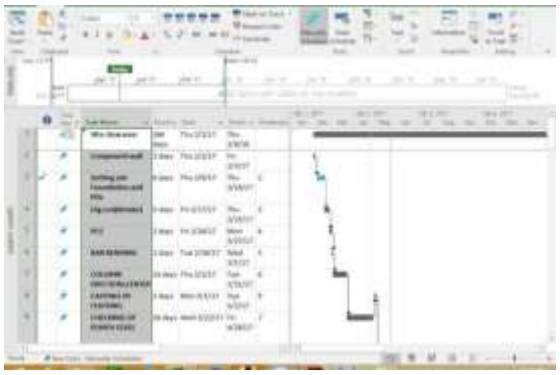
Discussion points:

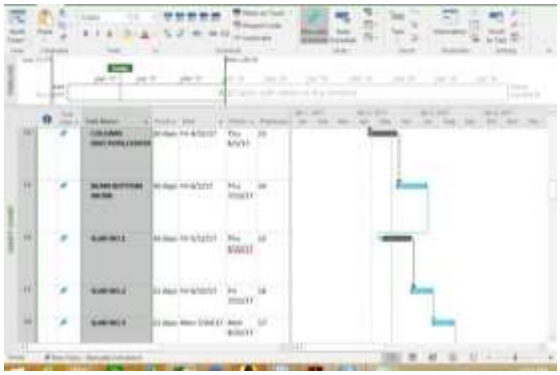
- Materials
- Site locations
- Staff(skilled & unskilled)
- Equipments
- Cash flow important
- Management.

SCHEDULING IN MSP FOR CASE STUDY 1

	266 days
Site clearance	2days
Compound wall	1days
Setting out Foundation and Pits	3days
Dig out(khodai)	1days
PCC	1days
BAR BENDING	2days
COLUMN EREC-TION,CENTERING,FORMWO RK	2days
CASTING OF FOOTING	4days
CHECKING OF PLINTH LEV-EL	1days
PLINTH BEAM	4days
MURUM FILL-ING,COMPACTION	4days
PCC LAYER	2days
COLUMN STARTER	1days
COLUMN EREC-TION,CENTERING,FORMWO RK	2days
BEAM BOTTOM WORK	2days
SLAB NO.1	21days
SLAB NO.2	21days
SLAB NO.3	21days
SLAB NO.4	21days
BRICK WORK	30 Days
PLASTERING	15Days
Electrification	15Days
Tiling ,Plumbing, water proofing	30 Days







VI. CONCLUSION

The framework presented discusses effective scheduling using RLP solutions. Several surveys are conducted for small construction industries and it has been observed that cost overruns occur due to poor planning and scheduling. One G+4 building is analyzed by using MS-projects to check effectiveness of RLP scheduling and it has been observed that no. of days can be less and it will in-crease profitability ,also reduce cost overruns

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