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CONSTRUCTION SCHEDULE MANAGEMENT OF BAGLINGA IRRIGATION PROJECT

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ABSTRACT
The construction industry is one of the most important activities that contribute towards the economic growth of any nation. However, the sector has been experiencing problems of cost and time overruns. Thus, the paper aims at developing an integrated scheduling approach for construction projects during the planning phase from a project owner's perspective. The study has shown that cost and time optimization model could yield impractical results unless double precedence relations are imposed between some activities such as excavation, Earthwork, Pitching and Concreting. It has also demonstrated that the cost and time budgeted during the planning phase would substantially deviate from actual if the planned construction start date slips from the plan, particularly for short period projects. The proposed approach demonstrated in the paper can sufficiently allow planning engineers to develop a comprehensive construction schedule so that the cost and time overruns in the lowest-bid awarded construction projects can be reduced. The paper provides empirical insights into how a robust construction schedule is developed from an owner's perspective. Cost-time optimization and risk analysis results obtained from manual computation might reduce the reasonable accuracy of the desired cost and schedule integration unless each activity is assigned its own calendar.

Keywords:
Construction Project Schedule, time overrun, Cost-time optimization

INTRODUCTION

The construction industry has now turned out to be one of the major driving forces behind economic development of developing countries. It contributes to high employment opportunity next to agriculture and to income creation for the population, and it also contributes to government revenue through generation of corporate profit tax and income tax from employees. Thus, a small improvement in the construction sector will certainly generate lots of benefits. Most design engineers of public construction projects do not provide a comprehensive design report comprising realistic schedules and accurate measurements of quantities; as a result, cost overrun and time overrun have become a growing concern in the construction industry of developing countries. Scheduling is highly dependent on optimization efforts and various types of uncertain variables; thus, it needs application of tools and techniques. The best approach to provide a robust schedule is a generate-and-test cycle for several alternatives until a satisfactory schedule is obtained. As a number of possible alternatives could be enormous, manual calculation of each alternative and iteration would be impossible.

The objective of the research is planning of construction of Baglinga Minor Irrigation Project situated in Chikhaldara tehsil of Amravati District. The planning of Baglinga Minor Irrigation Project involves each step from Preliminary Investigation to the completion of project. Many researches are carried out for the various projects for scheduling of

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the construction activities to take care of cost and time overrun. Irrigation project consist of various complex and tedious processes such as surveying and Investigation, Designing and estimating, administrative approval, land acquisition, forest clearance, environmental clearance, Central Water Commission clearance, Maharashtra Water Resources Regulatory Authority Clearance, Tendering, Execution, etc. Scheduling of such stages are being done in this study. For the study a case study is done on the Baglinga Minor Irrigation Project. Effective construction scheduling should involve the scheduling of not only scheduling of construction activities but also scheduling of pre-construction stages.

SCHEDULING

A construction schedule is a timeline for every task and event in a construction project. The construction schedule is a fundamental part of the project planning phase, as it also defines the resources needed and the teams responsible for each task in the construction process. A construction schedule is an entire blueprint of how a project will be executed and by when. A construction schedule outlines project timeframes/ milestones and tracks project progress to keep everything on time and on budget. It's the backbone of any thriving project management for construction. Creating a construction schedule is extremely important. Coordinating all tasks and personnel can be a tough job, and without a plan in place, it could become impossible. Schedules help track, communicate, and report progress for a particular project, keeping all stakeholders in the loop.

RESOURCES

In addition to assigning dates to project activities, project scheduling is intended to match the resources of equipment, materials and labor with project work tasks over time. Good scheduling can eliminate problems due to production bottlenecks, facilitate the timely procurement of necessary materials, and otherwise insure the completion of a project as soon as possible. In contrast, poor scheduling can result in considerable waste as laborers and equipment wait for the availability of needed resources or the completion of preceding tasks. Delays in the completion of an entire project due to poor scheduling can also create havoc for owners who are eager to start using the constructed facilities.

The construction business has its specific requirements and challenges similar to any other industry. Here is a rundown of all the essential resources needed for construction projects:

Human resources: The workforce is the most critical part of the construction resource pool. It is the people behind the project that make it a reality. The following are the vital roles required in the construction industry:

Estimator: The estimator is responsible for estimating the costs, materials, and labor needed to complete a project.

Designer: The Designer's job is to design the various components as per requirement and develop a creative solution in a blueprint.

Supervisor: The supervisor acts as an intermediary between the field workers and the management office. He/she ensures effective communication between the two parties.

Quantity Surveyor: The quantity surveyor provides the client with advice on building costs and contractual matters throughout the building process and acts as a consultant to the architect.

Engineer: Engineers are vital on a job site and may specialize in Earthwork, Concrete, mechanical, Structural work, etc. For example, civil engineers use computer software technology to create plans for their projects. Electrical engineers monitor the power requirements in the project and ensure all hazards are negated.

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Construction Worker: Construction workers are the driving force of every project. Once the project is planned, the workers get their hands dirty to make it a reality.

Equipment: Construction projects require heavy equipment. The selection of the equipment depends on the time and cost of the project. Some of the heavy equipment used in construction projects are bulldozers, excavators, cranes, Concrete Mixers, Compactors, etc.

Materials: Materials such as Earth, cement, metals, sand, Reinforcements, RCC Pipes, bricks, concrete, clay, etc., are the most common type of construction material used in construction of Irrigation Projects. Selection criteria such as cost-effectiveness and quality play a significant role.

Facilities: Facilities not only improve workers' welfare but also enhance efficiency. Construction sites must include the following facilities:

- Living accommodations for the workers.
- Sanitary and toilet facilities.
- Drinking water facilities.
- Changing rooms and lockers.
- Canteen.

Construction projects are subject to numerous constraints such as resourcing costs, price volatility, uncertain nature of the projects, and more. Due to these limitations, construction projects are vulnerable to budget and timeline overruns.

PROJECT CASE STUDY

In this study Baglinga Minor Irrigation Project of Water Resources Department of Maharashtra Government is carried out. The project is situated on Datpadi River of Purna Sub-Basin of Tapi Basin in Chikhaldara tehsil of Amravati District. The length of earthen dam is 730m and height is 31.30 m. The storage capacity of project is 7.285 Mm^3 and irrigation potential is 1324 Ha.

The following sub work breakdown Structure (W.B.S) were taken.

WBS is a grouping of different elements of the project with concerned to specific project and it organizes or impinges to determine the overall intent of the project.

1) Preliminary Survey and Site Investigation.
2) Designing of various components of Project.
3) Land Acquisition.
4) Estimating and Costing
5) Planning and Scheduling
6) Tendering
7) Execution
8) Controlling of resources and time management.

Steps involves in Scheduling and Resources allocation to the station work.

1) Creating an ideal schedule
   To create an ideal schedule for any project, first step is to collect data available for the project.
2) Enterprise Project Structure (EPS)

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Create the structure of a company with its branches which is executing the project. This is known as Enterprise Project Structure

3) Organizational breakdown structure (OBS)
After the EPS, OBS is created which is hierarchy that reflects the persons responsible for the project in the enterprise.
4) Calendar
The work is carried out in 6 days per week. So the standard 6 day workweek calendar is made with necessary holidays in it. A break of one hour is given in the afternoon.
5) Create a new project
A project is a set of activates and associated information that constitutes a plan for creating a product or service. The project is created under the respective division in the EPS and assigned in the person charged form OBS to it. The project can be given planned start and must finish dates. The project is assigned a calendar which can be global, resource or project calendar.
6) Work breakdown structure (WBS)
WBS is a hierarchy of work that must be accomplished to complete the project. Each project has its own hierarchy with top level WBS element begin equal to that EPS nodes or project. Each WBS element may contain more detailed WBS levels, activities, or both.
7) Define activities
Activities are the fundamental work elements of a project and form and from the lowest level of a WBS and, are the smallest subdivision of a project. An activity has the following characteristics like Activity ID, name, start and finish dates, activity calendar, activity type, activity codes, constrains, expense, successor
8) Relationship between activities
To form a network the activities should be connected to each other, which is done by assigning preceding and succeeding activities with significant relation to the activities.
    - Finish to start (FS) relationship.
    - Finish to finish (FF) relationship.
    - Start to start (SS) relationship.
    - Start to finish (SF) relationship.
9) Determining activity duration
When planning the work, the duration is entered in the original duration field. The actual duration can only be entered for the activities, which are completed.
10) Activity dates.
The following are the types of activity dates available in the primavera; actual start, actual finish, planned start, planned finish.
11) Activity cost.
The activity cost is the sum of all the cost incurred to complete the activity.
12) Creating baselines
A simple baseline plan is a complete copy of the original schedule which provides a target against which a project’s performance is tracked.
13) Updating schedule
If the project is progressing exactly as planned, then only needed to estimate progress. If the project is not progressing as planned many activities are starting out-of-sequence, actual resource use is exceeding planned use, and then update should be done for activities and resources individually. Most projects contain some activities that progress as planned and some which do not. In this case, the best method is to combine the two updating methods.
14) Tracking
Taking window is used for monitoring a project’s progress using different types of layouts such s labour costs, project cost, resource forecasting, and resource allocation unit wise and cost wise.
15) Earned value
Earned value is a technique for measuring project performance according to both project cost and schedule. The technique compares the budgeted cost of the work to the actual cost.
16) Claim digger

The claim digger is a schedule analysis tool that enables a company to generate a report that compares selected data fields in a revised project and a corresponding baseline.

17) Project thresholds
Project thresholds consist of parameters assigned to WBS elements; they are used to monitor projects and generate issues
18) Project issues
Project issues are the problems within a schedule that must be addressed before the project can be completed. They can either be created by thresholds or manually.

METHODOLOGY

Background

In this study Baglinga Minor Irrigation Project is considered for case study. The scheduling of various activities from preliminary investigation to the actual completion of project is done.

Project Data Collection

Data required for the study of the case is collected from the Government offices of Maharashtra Government. The Preliminary Investigation Reports, Detail Designs, Preliminary planning helps to further scheduling of various activities.

Project Planning and Scheduling

Project planning involves following major steps :

1) **Preliminary investigation**
It consist of site selection of project from toposheets, reconnaissance survey, trail bores on alignment of earthen dam, head regulator, Spillway, etc. of Irrigation projects. It also consists of collection of Hydrological data from hydrology Department. Availability of construction material is also taken into consideration.
2) **Sampling and Data analysis**
The cores obtained from trail bores then sent to the laboratory from the geological investigation. Construction material to be used there upon is tested in the laboratory to check the various properties of materials. The various constant/values obtained from such test are considered for the design of various components.
3) **Designing and Drawing**
Based upon the constants/values of various properties of various construction materials the various components such as earthen dam, head regulator, spillway, tail channel, etc. is designed and drawings are prepared accordingly by the competent design department.
4) **Land Acquisition**
As per Design and Drawing obtained from Design department the private land required for the execution of project is acquired through the revenue department as per land acquisition act 2013. Government land and Forest land if any required for project may directly handed over to the Water Resources Department through specified procedure.
5) **Estimating and Costing**
As per Design and Drawing obtained from Design department Quantity surveying is done and estimates are prepared and sanctioned from the component authority.
6) **Tendering**
As per the sanctioned estimates tender papers are prepared, online tenders are invited and bidder are allowed to participate to have competition.
7) **Execution**
After tender procedure the contractor awarded the work for execution of work at the site. He is responsible to execute the work in specified time limit.

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Project Scheduling

Project Scheduling involves the preparation of work program at the beginning of execution of work. The daily output of the various machineries is calculated. Based upon this number of various machineries is deployed at site to complete the work in specified time. The work program is shown in following fig. 1.

BYMONTHLY CONSTRUCTION PROGRAMME

Name of Work :- Construction of Earthen Dam, W.W., Approach and Tail channel & Head Regulator of Baglinga M.I. project Tal. Chikhaldara, Dist. Amravati.

Item No.	Item of Work	Unit	Quantity	Ist Month	IInd Month	IIIrd Month	IVth Month	Vth Month	VIth Month	VII Month	VIII Month	IX Month	X Month	XI Month	XII Month
1	Excavation in Soft Strata etc. Complete.	Cum	66526		20000	20000	20000	6526	-	-	-	-	-	-	-
2	Excavation in Hard strata, etc. complete.	Cum	88816	-	20000	20000	20000	10000	10000	8816					
3	Providing and laying drainage arrengment etc Complete	Cum	3731	-	-	1000	1000	1000	731	-	-	-	-	-	
4	Construction of Hearting zone, cot filling etc. Complet	Cum	106199	-		20000	20000	30000	20000	10000	6199				
5	Construction of Casing zone, cot filling etc. Complet	Cum	428478	-		25000	50000	75000	95000	125000	58478				
6	Providing and laying Pitching etc complete	Cum	12402	-							3000	5000	2000	2402	
7	Providing & construction cement concrete M15 etc. complete.	Cum	6669.14	-		1500	1500	1500	1500	669.14					
8	Providing & construction cement concrete M20 etc. complete.	Rmt.	695	-			150	150	150	150	95				
9	Providing and laying TMT Fe415 reinforcement etc. complete	MT	119			20	20	40	20	19					
10	Back Filling etc., complete	Cum	2071						250	250	500	500	500	71	
11	Grouting etc. complete.	Kg	99000		15000	15000	25000	25000	25000	4000					

Fig 1 : Monthly Construction Program

The daily output of various activities are calculated and machineries are allocated to various activities. The scheduling of important activities are done for every fortnight to complete the execution of work with in specified time limit. See following fig. 2.

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Fig. 2: Work Program on the basis of Daily output

Baglinga Minor Project

Tq. Chikhaldara Dist. Amravati

Work Program on the Basis of Daily Output

Sr. No.	Name of Item	Revised Quantity	Excuted Quantity	Balance Quantity	1-15 March 2022			16-31 March 2022			1-15 April 2022			16-30 April 2022			1-15 May 2022			16-30 May 2022		
					Quantity To Be Executed	Daily Output Required	Machinery Required	Quantity To Be Executed	Daily Output Required	Machinery Required	Quantity To Be Executed	Daily Output Required	Machinery Required	Quantity To Be Executed	Daily Output Required	Machinery Required	Quantity To Be Executed	Daily Output Required	Machinery Required	Quantity To Be Executed	Daily Output Required	Machinery Required
1	Hearting	99990	54722	45268	14400	960	Dumper - 14 Dozer - 1 Water Tanker - 1 Roller - 1	10080	672	Dumper - 11 Dozer - 1 Water Tanker - 1 Roller - 1	8640	576	Dumper - 10 Dozer - 1 Water Tanker - 1 Roller - 1	7200	480	Dumper - 9 Dozer - 1 Water Tanker - 1 Roller - 1	5760	384	Dumper - 9 Dozer - 1 Water Tanker - 1 Roller - 1	0	0	
2	Casing																					
	A) From Available	116830	83638	33192	0	0	0	3600	240	Dumper - 2 Dozer - 1 Water Tanker - 1 Roller - 1	7200	480	Dumper - 3 Dozer - 1 Water Tanker - 1 Roller - 1	9600	640	Dumper - 3 Dozer - 1 Water Tanker - 1 Roller - 1	14400	960	Dumper - 4 Dozer - 1 Water Tanker - 1 Roller - 1	0	0	
	B) Borrow	372620	154336	218284	38400	2560	Dumper - 9 Dozer - 1 Water Tanker - 1 Roller - 2	52800	3520	Dumper - 14 Dozer - 2 Water Tanker - 2 Roller - 2	52800	3520	Dumper - 14 Dozer - 2 Water Tanker - 2 Roller - 2	43200	2880	Dumper - 12 Dozer - 2 Water Tanker - 2 Roller - 2	33600	2240	Dumper - 10 Dozer - 2 Water Tanker - 2 Roller - 2	0	0	
3	Concrete	7512	3766	3746	450	30	Ajex - 1 Water Tanker - 1 Vibrator - 3 Labour - 10	750	50	Ajex - 1 Water Tanker - 1 Vibrator - 3 Labour - 10	750	50	Ajex - 1 Water Tanker - 1 Vibrator - 3 Labour - 10	825	55	Ajex - 1 Water Tanker - 1 Vibrator - 3 Labour - 10	525	35	Ajex - 1 Water Tanker - 1 Vibrator - 3 Labour - 10	450	30	Ajex - 1 Water Tanker - 1 Vibrator - 3
4	Pitching	8834	0	8834	150	10	Blasting Unit - 2 Dumper - 1 JCB - 1 Labour - 5	750	50	Blasting Unit - 2 Dumper - 2 JCB - 1 Labour - 12	1050	70	Blasting Unit - 2 Dumper - 3 JCB - 1 Labour - 16	1950	130	Blasting Unit - 2 Dumper - 4 JCB - 1 Labour - 20	2400	160	Blasting Unit - 3 Dumper - 5 JCB - 1 Labour - 24	2550	170	Blasting Unit - 3 Dumper - 5 JCB - 1 Labour - 24

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CONCLUSION AND FINDINGS

In this study scheduling of various activities involved in the construction of Baglinga Minor Irrigation Project is done by calculating the daily output of various machineries and equipments. In this research the planning for the completion of project is considered from the preliminary investigation to George filling of the project. In this study we found out some issues that one have to face during the planning phase and during the construction of the project.

During planning stage, land acquisition is the major issue to be face by implementing agency. As far as the land acquisition is concern, acquisition of forest land the most complex procedure. It has been seen that delay in completion of the project is mainly due to the land acquisition of private and government land.

During Construction stage, the most common hurdle is monsoon and the flood flowing through the river. Electric lines if any comes under submergence or crossing the dam line needs to be shifted outside the submergence or Dam area. Rehabilitation of the villages under the submergence area of the project. There are total 18 compulsory facilities to be provided to the rehabilitated villages viz. water supply, School building, Roads, Electricity, community hall, etc.

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