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Effective Scheduling and Time Management of Dhamra Railway Project Using Primavera P6

S.A. Rao [1, *], S.B. Patel [1], P.N. Jain [1], V.M. Patel [2]

[1] Department of Civil and Infrastructure Engineering, Student (B.E.), Adani Institute of Infrastructure Engineering, Ahmedabad, 382421, India
[2] Department of Civil and Infrastructure Engineering, Professor, Adani Institute of Infrastructure Engineering, Ahmedabad, 382421, India

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Abstract

Indian construction industry is growing quickly and huge development projects are going on. Most certainly it's justifiably or in a roundabout way connected with the Indian economy, the speed with which projects complete have appeared to influence the GDP of the country. Appropriate scheduling and planning are substantial in construction projects for decreasing and controlling postponements of the project, while an error in the same causes squandering of a significant quantity of time, capital, resources, and quality. Despite firm principles and policies, the monitoring process may be inefficient because of the practical problems prevailing or rising in the project. An attempt has been made in realizing the practical problems in project execution will contribute to proper recognition of the problem areas and implementing mitigation. The main objectives of this study are to plan, schedule, monitor, and control a railway infrastructure i.e. Dhamra Railway Project, Orissa, India with the help of Oracle Primavera P6 software. The review of various research articles has been performed and twenty-five factors from nine categories are shortlisted for the study and the time factor is considered for analysis. Thereafter, critical time analysis of the project has been performed, listing project activities with duration, their logical relationships, scheduling, and network updating considering factors from the nine categories. The main challenges leading to delays are climate, government approvals, material availability, and the remote project location. Further, project crashing is done by provision of additional labour resources to critical activities and observation can be made that a raise of 21% of labour resources would offer a reduction of 17% of the activity completion time, this trend doesn't imply that surging the resources directly reduces duration, it will reduce duration but up to the minimum fundamental duration required only.

Keywords: Railway project, Delay factors, Project Scheduling, Project Updating, Project Crashing

1. Introduction

Many big construction projects are ongoing in India that helps the nation to grow economically as well as globally. Today construction industry in India is the 2nd largest employment-generating sector. It contributes to about 9-10% of India's GDP and likely to increase to 15% by 2030. In spite of the prominence and the worthiness of the Indian construction sector, it can be distinguished that the owners, consultants, and contractors are unable to give importance to evaluate the time and cost overruns at the end of the project.

Project management is the way by which guiding and managing human and material resources during the life of a project by using recent management practises to accomplish determined aims of scope, cost, time, quality and partakers satisfaction. There are mainly six phases of project management, which in the project are as follows: definition, initiation, planning, execution, monitoring & control, closure of the project. Usually scheduling comprises of the breaking the entire commenced project works into minor definable, distinguishable and quantifiable activities / works and then creates the logical relations between them.

Project management software system is a method involving estimation, sequencing the activities, resources assignment. Various project handling software are available in market viz. Microsoft project (MSP) and Primavera, which are generally used for planning & scheduling. MSP is such software program for applying project management values and ventures, projects, and portfolios. It is

intended to ease the management of project and the requirement of organizations that handle multiple of projects altogether. It also helps in project dividing in manageable work packages by use of critical path technique; it also aids in project review by Gantt chart.

The Oracle Primavera P6 software is utilized for effective project handling of ongoing railway project "Dhamra Railway Project" located at Bhadrak district of Orissa. The motive to pursue such a challenging project emerged when the connection established with the development team of the project and learnt briefly about how the port associated railway construction is accomplished, also the nature of such vast, diverse and multiple stake project is coordinated.

*Corresponding author. Tel: +917405850117; E-mail address: shivamrao.cie16@gmail.com

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Briefing about the construction project, here is the concise introduction of the studied construction project, Dhamra railway project is the venture involving construction of the 60 kilometres long railway line providing link between Dhamra port and Howrah-Chennai mainline operated by the East Coast Railway an integral part of the Indian Railways on Eastern region on Indian subcontinent. The railway line is dedicatedly developed for transportation of freight. goods most likely which are imported or exported via Dhamra port. The construction of railway line involves of construction of P-way of Broad-Gauge BG (gauge length = 1.676m) track, five in between stations, culverts, bridges, substation, loco shed all-inclusive of OHE and Signalling and Telecommunication.

2. Literature Review

The study by Pankaj Varsanil et.al [7] described the utilization of Primavera P6 in construction projects and benefits of Primavera P6 software are mentioned such as efficient management of multiple projects can be done, effectually project scheduling by allocating more than two relationships at a time to an activity and noticeably decreases the float, convenient in resource smoothing and resource-levelling processes and its more effective, less time consuming. The software provides detailed info regarding management of cost, time, working hours, update and monitoring, and activity delay which improve efficiency in delivering services. The S-Curve gives the movement of resources vs time, helping the resource management. Also, software finds the zero-float activities of the schedule so that high priority can be given to these activities and delays in the project can be evaded. Through the utilization of this software roughly 5% decrease in the cost of labour can be attained.

Abuzar Aftab Shaikh et al. [1] the study shows Primavera P6 gives a cautionary when analysed the Schedule Variance (SV), it gave a non-positive value, so software warned that the project lags planned Schedule by 17.80%. The Schedule Performance Index (SPI) of 0.822 specifies that the efficiency of project as of now is 82.2% compared to what originally planned. The positive values of Cost Variance (CV) and Cost Variance % (CV%) found are ₹11,33,836.8 and 3.656% respectively thus indicating the project is under budget, also it can be said that the project is within budget as the Cost Performance Index (CPI) obtained is 1.03 (>1). After 11months updating was done and the project was delayed by next 3 months and this rose the project duration to 20 months, for the project finished within the planned time it should be levelled and smoothened by deploying more labours, timely material delivery and managing the resources with utmost care further, the study clarifies notion that Primavera software is an useful tool for monitoring the project progress, cost accompanying with progress and managing to evade delays.

Andrew Fernans Tom et al. [2], the article presented a study to understand the growth of Standard Design Factory (SDF) construction work and finding the discrete issues coming in the process. The evaluation of current project management system is done and efficient planning, monitoring & controlling are presented by the outcomes the necessity and usefulness of a project management software like Primavera P6 is the need of the hour in a construction project. Bypassing the technicality, it can be derived that lack in the application of monitoring policies has been detected. Increased tracking & controlling efficiency for projects can be achieved while significantly lower time and effort in updating is required by the detailed layouts that Primavera P6 software offers with several other programs within the software.

S. M. B. Jaswanth et al. [8] said that optimization of schedule by 6% can be achieved with the help of Primavera P6. The cost related to the initially planned budget varied by 2.9% post cost optimization. The errors of the organisation in terms of planning and scheduling are identified in this study.

Mrs. K. Priya et al. [6], this case study the planning, analysis, and design of G+13 multi-story residential building was done in primavera is Start date is 11 March 2019 and Finish date is 16 June 2022 and with effectively scheduling the project a decrease in duration of 13.03% is detected which will raise the project cost also. In an actual time, project, resolving schedule control using primavera P6 software provides the best result that can be understood. In the project without moving any resources to optimize, the entire duration via the level of efforts, resource-dependent, and constraint have been decreased. The real-time project solved using this optimization software shows that the finest converging outcome can be attained.

Diana M. Franco-Duran et al. [5] stated Primavera P6 and Microsoft Project are both renowned scheduling software in the construction industry. Even though these programs assist planners to construct the project plan and to report the project status, they lack support in the decision process when it comes to resource project allocations and constraints. As a mitigation, the resource supply-demand problem, Resource-Constrained Scheduling (RCS) practices have been inculcated in Primavera P6 and MS Project. After testing Primavera P6 versions and MS Project v 2016, both software packages generate phantom float in resource-constrained schedules as to remove phantom float no any algorithm is applied. The actual float values may be lesser than calculated during RCS, which results in incorrect identification of the critical path and causing an impact by delaying event in the project completion time.

Ankit Jain et al. [3], study shown project plan on an ongoing project of the bridge (210m span), reduction of the delay was done by allocating resources as per activity demand based on consumption as per I.S. 7272 part-1. The study enlarged work breakdown structure to activity level to have proper lagging of activities and their scheduling, by the proper linking of activities, the time-lapse reduces simultaneously. The cost proportionate is reduced, overall cost decreased by 14.6% due to a decrease in time consumption and effective management of available resources. In general, it can be said that management of all activities and observations on their previous and next activity is necessary to run activities concurrently, to optimize the time and cost and the Oracle Primavera software helped in various operations for this project, which in turn benefitted reducing delays and overall cost of the project.

S. Ragavi et. al [9] article reflects a case-study of an apartment building for project management using Microsoft Project and Primavera to showcase appropriate planning and

scheduling is done. In numerous projects resource levelling is crucial to preserve proper resource allocation, also for more than one projects under a company such study must be done to avoid over allocation. A significant standard for handling multiple projects is scheduling real-time projects and creating resource-controlled project schedule as per the site condition, scheduling done by the Microsoft project software gives decent schedule monitoring to a project.

Arindam Debnath et. al [4] emphasized that Activity ID and Activity Description both are generally taken for granted but they could upgrade the nature of the timetable if applied rightfully. The Primavera software enabled the analysis of the project input data further also produced the result information which compared the project's original plan with achieved project's required date. Ultimately the software program relates all the schedule methods and gives the actual progress of the project from which timely and righteous decisions can be taken by the project planner or concerned managers regarding the schedule parameters.

T. Subramani et al [10], in this study the planning, scheduling, and updating was done for the activities using Primavera P6 software and the deviation in scheduled in contradiction of planned schedule was determined. The Primavera P6 software enabled the formation of work breakdown and within it the activities were placed a separated project calendar has been prepared in the software. The sequential logic of activities developed by assigning suitable predecessors and successors for each activity, for the duration of the activities by considering the available limit of resources and quantity of work to be done the duration was derived. The study also associates the cost variation due to the delay of the project and re-scheduling the project by the project crashing process.

Wali. K. And Othman.S. [11] examined the fame of using Primavera and Microsoft project in construction projects in Erbil City, results showed the comparison between Primavera and Microsoft Project, it found that 34.8% of respondents had a familiarity with Microsoft rather than only 21.7% of respondents had familiarity regarding Oracle Primavera. While, only 13% of respondents used Microsoft Project compared to only 2% used Oracle Primavera, but 78% neither Microsoft Project nor Oracle Primavera, the outcomes indicate that despite the low use of both techniques but the Microsoft Project is the first choice of the respondents. Unfortunately, the reason behind the limitation of using these tools in construction projects is due to the deficiency of experience and poor training programs; so, the most of project managers preferred to use old-style methods rather than using Microsoft Project and Oracle Primavera programs.

3. Case Study

In the Bhadrak district of Orissa, India, on the banks of Dhamra River, a small village Dhamra is located. During 15th Century for coastal trade among north Orissa and Kolkata, Dhamra port was established. In April 1998, contract for developing Dhamra port as a deep seaport, nearly 7kms far from the shore of Bay of Bengal was made.

Dhamra port connected with the railway line at Bhadrak with a 125-m-broad service passage that can lodge 2 railway lines and a 4-laned road along with utility lines viz. transmission line and pipelines. The various type of cargo - import, export both, mainly coal, various fertilizer, steel coils, etc. are to be dispatched from the port to the Howrah-Chennai mainline.

The construction of a 62 km rail line from Dhamra to Bhadrak on the Howrah-Chennai mainline is ongoing which is considered as the study area for this project. The study area for this project as mentioned earlier is the rail line from Dhamra to Bhadrak on the Howrah-Chennai mainline. There are in total 5 railway stations with staff quarters throughout the railway line namely Dhamra terminal yard, Bansada railway station, Gurudaspur railway station, Tihidi railway station, and Bhatatira railway station.

The complete project length is divided into five phases in this study. The first phase starts from Dhamra Terminal Yard (CH 0.00) extending till the first 10 kilometers (CH 10.00) followed by the second phase of 10 kilometers from (CH 10.00) to (CH 20.00), then the third phase of 10 kilometers from (CH 20.00) to (CH 30.00) and the last two phases, fourth phase & fifth phase are each of 15 kilometers from (CH 30.00) to (CH 45.00) & (CH 45.00) to (CH 60.00) respectively, making in total 60 kilometers, as in Fig 1.

The entire project has 5 phases and each phase consists of these various integrated departments which ultimately are part of the railway track and without each department being executed in a regulated and flawless manner the successful train movement operation doesn't stand any chance, the departments are as follows: Engineering & Design, Procurement, Civil Construction, Signaling & Telecommunication (S&T), Overhead Equipment (OHE) & Commissioning and Handover. Thereafter, within the five phases of the entire track length, every individual phase comprises of different structures as per the design and the structures may vary in terms of occurrence, design dimensions, elevation and utilities from phase to phase, the structures are as follows: Railway Station, Box Culvert, Pipe Culvert, Culvert, Level Crossing, Bridge, River Bridge & Road Under Bridge (RUB) which are shown in Table-1 with the numbers throughout the track length of 60kms.

Table-1. Summary of structures

CH 0.00 to CH 60.00 (60 kms)			
Level Crossings	31	Bridges	8
Box Culverts	11	Road Under Bridges	3
Pipe Culverts	13	River Bridges	4
Culverts	17		

Fig.1 Chainage markings for the total 60km length
Note: path in Blue denotes Howrah-Chennai mainline and Red path denotes Dhamra to Bhadrak line

4. Project Scheduling

The Dhamra railway project construction activities are scheduled by the utilization of an excellent project planning, scheduling, monitoring and controlling tool that is Oracle Primavera P6. The whole project is split into five phase and hence these phases are scheduled as 5 different construction phases within the single project with all the engineering, designing, procurement and commissioning & handover activities covered under the single project head, with the understanding that the Dhamra Railway project is a greenfield project. The work to be performed is coordinated to the locational parameters that directly or indirectly lay their effects on the project schedule. Steps involved in project schedule management in Primavera P6:

Creating an ideal schedule: To make a schedule for any project, initial step is to gather information accessible for undertaking the project.

Creating new projects: A project consists the numerous set activities and related data that establishes an arrangement for making a work package or task. The project is made under the separate divisions in EPS and allocated the individual in control from OBS to it.

Creating Work breakdown structure (WBS): It is a hierarchy of work that must be cultivated to finish a project. Planned for the Dhamra Railway Project, the WBS is divided into four Task level namely Engineering, Procurement, Construction and Commissioning & Handover.

The first task level i.e. Engineering consist of the designing part of the project. However, before designing, survey work has to be carried out which is the primary requirement of any project. Thus, Engineering is further divided into three-work package called Planning, Designing and Review & Approval. The work package Planning has two parts: Preliminary Survey consisting different types of survey like utility Survey, topographic survey etc. and Parametric estimate giving rough or approximate cost of the project. The work package Designing has seven parts: Feasibility report (traffic forecasting, environmental effect of the project etc.), Detailed Project report made by third party consultant and has to be approved by concerned legal authorities. Next part is preparation of Engineering Scale Plan, Signaling & Interlocking Plan and Layout Plan of OHE, which is the designing part of the project. These designing leads to preparation of detail estimate and specifications of the project for further tendering process. The third work package Review and Approval has two parts: internal management approval i.e. approval from the client's side and Indian Railway Management Approval i.e. approval from Railway authorities.

The second task level i.e. Procurement is to obtain human and material resources for the project; it is divided into two work packages namely, Tendering & Material order. The work package tendering consists of floating of tender, submission of bid by vendors, Approval by RDSO (Research Designs & Standards Organization), etc. The second work package Material order is for procurement of construction material that is done by creating and sending purchase order by RFQ and selecting vendor based on that, receiving materials and goods with quality check by RDSO, making financial transaction with vendor and closing purchase order with maintaining the records.

The third task level i.e. construction which is the execution part of the project, the construction of 60 km long railway is divided into five construction phases. Mentioning all the work packages from all the phases are earthwork of p-way, Railway line, Station, building and other structures, major structures. Earthwork of P-way consist of cutting and filling of earth, compaction and laying blanketing materials. Railway line work package consist of laying and fitting of railway track, indoor & outdoor S&T. works, erection of OHE. The third work package is Station, Buildings and other structure, which concerns with the construction of station & platforms, loco shed, weighbridge, substation and staff quarters as per phase requirement.

Work Package Major structure contains the construction of bridges, pipe & box culverts, river bridges, level crossing, etc. Planning & scheduling of this task should be done carefully as resource assignment and external environmental factors plays a crucial role in completion of this part.

The fourth and the final task level is Commissioning & Handover. Here the quality of construction is checked and verification of documents takes place. After verification, procedure of completion of project in terms of construction begins by financial closure between client and contractor with signing off record of hand over form and distribution of O & M manuals and certificates. Fig. 2 shows summary of WBS created in primavera software with the work packages and number of activities under it.

WBS Code	WBS Name	Total Activities
DRP	DRP	594
DRP.1	Engineering	34
DRP.1.1	Planning	7
DRP.1.2	Designing	23
DRP.1.3	Review & Approve Design	4
DRP.2	Procurement	22
DRP.2.3	Tendering	12
DRP.2.1	Material Order	10
DRP.3	Construction	531
DRP.3.1	Construction Phase 1	84
DRP.3.1.1	Railwayline	17
DRP.3.1.1.1	Track	6
DRP.3.1.1.2	Signalling &Telecommunication	6
DRP.3.1.1.3	Overhead Electrification	4
DRP.3.1.2	Stations, Buildings Other Structure	16
DRP.3.1.2.4	Loco Shed	6
DRP.3.1.2.5	Staff quaters	3
DRP.3.1.2.6	Weighbridge	3
DRP.3.1.2.1	Stations & Platforms	3
DRP.3.1.3	Major Structures	47
DRP.3.1.3.1	Bridges	12
DRP.3.1.3.2	River Bridges	8
DRP.3.1.3.3	Pipe Culvert	6
DRP.3.1.3.4	Level Crossings	20
DRP.3.1.4	Earthwork (P-Way)	3
DRP.3.2	Construction Phase 2	100
DRP.3.3	Construction Phase 3	145
DRP.3.4	Construction Phase 4	123
DRP.3.5	Construction Phase 5	79
DRP.4	Commisioning & Handover	6
DRP.4.1	Commisioning	1
DRP.4.2	Handover	5

Fig. 2: Table view of WBS

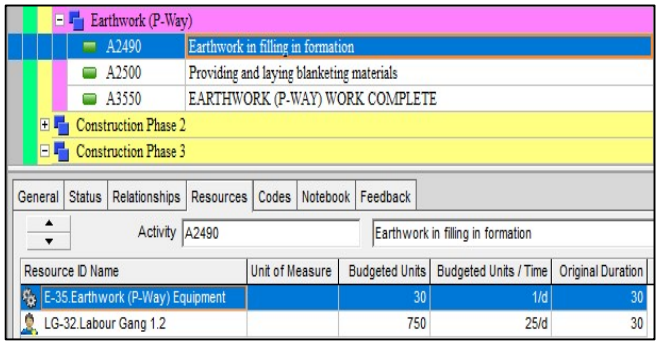

Fig. 3 Resource Allocation

Table-2. Annual Non-working days

Year	*2018*	*2019*	*2020*	*2021*	*2022*	*2023*
Non-working days	25	26	43	47	46	46

Activities and Relationships: Activities, the smallest division of the project, which are the fundamental elements. The workflow of the project depends on the relationship between activities. By performing activities parallel, restraints of the critical path can be reduced and this can be done in primavera software by differentiating relationship between the activities. The time to complete these activities i.e. duration of the activity inputted in days.

Govt. Approval: Different types review and approval essentially required for every specific kind of construction and the infrastructure projects are humongous & complex, often there has been observed the approving authority can't match the pace and lags to review the documents. Similarly, such instances are induced in this project too.

Blanketing Layer material: When the soil is below standards, rainfall is heavy and high traffic density, blanket layer is required over the formation, without it problems such as heaving of formation arises. The unavailability of appropriate blanketing layer material within the nearby vicinity, and the selection trials of chosen material for its finalization. Achieving the RDSO standards extended the duration of earthwork.

Calendar: Project Calendar is the significant part of project schedule. The project calendar exhibits the working days, non-working days, holidays. In this project, 8 hours a day are the assigned working hours from 9 am to 6 pm having lunch break from 1 pm to 2 pm, all Sundays as non-working days. In monsoon efficiency of work is approximate 50 %, thus 4 hours a day taken for months of July, August and September.

Republic Day, Maha Shivaratri, Holi, Ram Navami, Odisha Day, Ratha Yathra, Independence Day, Bakri Id / Eid al Adha, Janmashtami, Ganesh Chaturthi, Mahalaya Amavasye, Vijaya Dashami, Diwali, Eid e Milad etc. are one day holidays provided while 15days break for festivals like Holy, Durga pooja and 5days Diwali break is provided, which combinedly mentioned in the Table-2.

Resources: It is an entity that aids accomplishment of project activities such as manpower, machinery & equipment, material. As previously mentioned, project is divided into 5 phases and in each phase 3 labour gang is assigned. In primavera, assigned name for phase 1 gang 1 is Labour Gang 1.1. Similarly, for phase 1 gang 2 is labelled as Labour Gang 1.2 & for phase 2 gang 3 it is Labour Gang 2.3. In each labour gang initially 25 labour per day are allotted. For equipment used for construction, every work package from construction level, its respective equipment has been created having unit equipment including set of equipment required for construction of that work packages activities, example of resource allocation is shown in Fig. 3.
Scheduling: The final step of project planning is scheduling. It generates critical path of the project and represent it through Gantt chart & network diagram. All the activities with respect to their relationship and duration get their start and finish dates indicating duration of the whole project. In the project, scheduling is done from 18 January 2018. When run schedule command is given the following results were obtained, the project started from 18 January 2018 and finished on 7 July 2023 having duration of 1409 days. The start and finish dates of various task levels and their respective working duration is shown in Fig. 4. As the construction of phase 1,2,3,4 & 5 was scheduled simultaneously i.e. the execution of all phases will start simultaneously the stating date of construction of all phases is same 10 June 2019. The construction in phase 3 has the maximum duration as construction of many major structures are there.

5. Project Updating

These are a few reasons for which updating is done such as estimation error during planning, unforeseen situations and National catastrophes. The method of surveying the progress of the project execution is known as "project updating". During updating of a project network, another critical path may show up given a decrease in slack time of a portion of the previously determined non-critical activities, which may prompt new extended project requirements. The conditions that led to the project updating have been listed in Table-3 and described as follows:
DPR submission: Detailed Project Reports (DPR) are the elaborate and informative document, the third-party consultant appointed for preparation of DPR exceeded the stipulated time of submission leading to the delay in the overall project schedule.

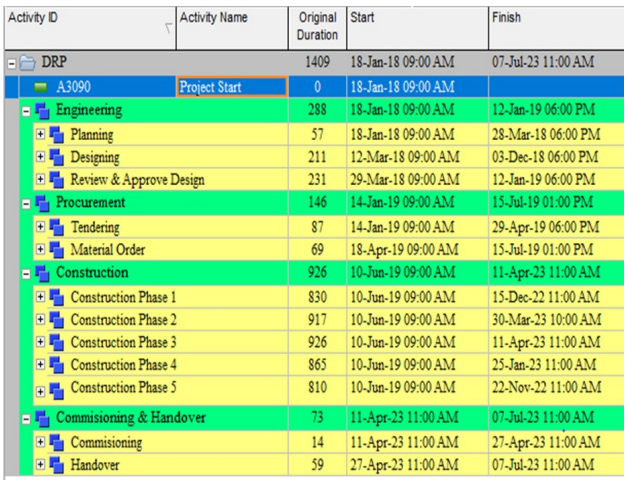

Fig 4. Scheduled Project Duration

Table-3. Project Network Updating Summary

Delay Category	Delay Cause	Delay Specifics	Delay (Days)	Pre-Delay Schedule	Post-Delay Schedule
Consultant	DPR Submission	Project Detailed Studies and Design process exceeded	20	F:26/06/2018	F:20/07/2018
External	Govt. Approval	Government Approval took more time than anticipated	22	F:12/01/2019	F:5/03/2019
Material	Blanketing Layer material	Availability & Selection trials of Blanketing Layer material	15	F:06/09/2019	F:06/01/2020
External	Extended Rains	Continued Rainfall in October 2019	31	Complete Project Duration got affected by 31 days of more rains with all applied consideration of rains.	
Project	Bulbul Cyclone	Bulbul Cyclone led to heavy rains, squalls, crop damage, uprooted tree and knocked power lines	20	Complete Project Duration Escalated by 20 more days.	
Contractor	Building Construction delay	Poor site management & Supervision in Station Buildings	30	F:19/08/2020	F:10/02/2021
Complete project duration changed from				07-07-23	28-09-23

Extended Rains: The rainy season of Odisha starts in July and continues until September. There is heavy rainfall in August even throughout the rainy season, considering monsoon the efficiency of work reduces to 50 %, and it has been fed in the project schedule, but the monsoon anticipated till Sept 2019 prolonged till Oct 2019, ultimately increased duration of the project as the duration of inefficient work rose by a month more.

Bulbul Cyclone: In Nov 2019, a very severe tropical cyclone named Bulbul hit the Orissa, eastern coast of India. The cyclone induced heavy rainfall, flash floods and storm. Adversities and destruction caused due to this cyclonic storm were windstorm, excessive rainfall, and agriculture and horticulture damage, power cuts and slowed down transportation system, causing the whole project stoppage for a fortnight.

Building Construction: Nevertheless, it's a railway project, it comprises some stations, staff quarters and other conventional structures similar to residential buildings, and commonly these structures are running behind of the planned schedule sometimes due to major work delays but the delays are governed by works such as mechanical, electrical, plumbing, carpentry, painting, etc. Similarly, the station buildings suffered elongation of finish time by around a month, the updated project details are in Fig.5.

6. Project Crashing

Crashing indicates a specific assortment of project schedule compression, which is done with the motivations behind diminishing out the project completion time.

A similar attempt made to crash the project network schedule, as after the project updating process, the project completion escalated from 7 July 2023 to 28 Sept 2023 i.e. 84 calendar days. Henceforth to again bring back the project network schedule on the originally planned path the crashing procedure has been performed, and fortunately, the rescheduled project network happens to resemble the originally planned project completion date, with no drastic natured changes within the project environment, thus the harmony maintained.

The extended project completion time of 84 days could be compressed by firstly allocating additional equipment resource, secondly by allocation of more labour resources in the form of extra gangs or lastly allocating both labour as well as equipment resources to all the activities that lie on the critical path or the zero-float path.

The method to compress the extended duration of used here is to allocate extra labours to individual gangs linked to

U-DRP		1451	18-Jan-18	28-Sep-23
A3090	Project Start	0	18-Jan-18	
Engineering		330	18-Jan-18	05-Mar-19
Planning		57	18-Jan-18	28-Mar-18
Designing		231	12-Mar-18	26-Dec-18
Review & Approve Design		273	29-Mar-18	05-Mar-19
Procurement		146	06-Mar-19	25-Nov-19
Tendering		87	06-Mar-19	17-Jun-19
Material Order		69	06-Jun-19	25-Nov-19
Construction		926	30-Aug-19	03-Jul-23
Construction Phase 1		838	30-Aug-19	18-Mar-23
Construction Phase 2		917	30-Aug-19	21-Jun-23
Construction Phase 3		926	30-Aug-19	03-Jul-23
Construction Phase 4		895	30-Aug-19	25-May-23
Construction Phase 5		810	30-Aug-19	11-Feb-23
Commisioning & Handover		73	03-Jul-23	28-Sep-23
Commisioning		14	03-Jul-23	19-Jul-23
Handover		59	19-Jul-23	28-Sep-23

Fig 5. Updated Project Duration

Table-4. Project Network Crashing Summary

PHASE	WBS	ID	ACTIVITY NAME	ORIGINAL			CRASHED			EXTRA LABOR DAYS	ACTIVITY DURATION DIFFERENCE
				LABOR	ACTIVITY DURATION	TOTAL DURATION	LABOR	ACTIVITY DURATION	TOTAL DURATION		
2	Bridge 4	A3490	Earth work in excavation in foundation	25/d	20	180	30/d	17	151	85	3
		A3500	Pile work	25/d	60		30/d	50		250	10
		A3510	Pier work	25/d	55		30/d	46		230	9
		A3520	Providing steel girders duly launched in position	25/d	45		30/d	38		190	7
	Bridge 5	B1030	Pile work	25/d	60	180	30/d	50	161	250	10
		B1040	Pier work	25/d	55		30/d	46		230	9
	Bridge 6	B1660	Pile work	25/d	60	180	30/d	50	161	250	10
		B1670	Pier work	25/d	55		30/d	46		230	9
	Box Culvert 3	B1840	Earthwork	25/d	10	120	30/d	8	101	40	2
		B1850	Bottom Slab	25/d	20		30/d	17		85	3
		B1860	Vertical Wall	25/d	30		30/d	25		125	5
		B1870	Deck Slab	25/d	20		30/d	17		85	3
		B1880	Wing Wall	25/d	40		30/d	33		165	7
	Box Culvert 4	B1790	Earthwork	25/d	10	120	26/d	10	116	10	0
		B1800	Bottom Slab	25/d	20		26/d	19		19	1
		B1810	Vertical Wall	25/d	30		26/d	29		29	1
		B1820	Deck Slab	25/d	20		26/d	19		19	1
		B1830	Wing Wall	25/d	40		26/d	38		38	2
	Box Culvert 5	B1740	Earthwork	25/d	10	120	30/d	8	101	40	2
		B1750	Bottom Slab	25/d	20		30/d	17		85	3
		B1760	Vertical Wall	25/d	30		30/d	25		125	5
		B1770	Deck Slab	25/d	20		30/d	17		85	3
		B1780	Wing Wall	25/d	40		30/d	33		165	7
3	Track	C1060	Ballast laying	25/d	25	110	30/d	21	93	105	4
		C1070	Sleeper	25/d	25		30/d	21		105	4
		C1080	Rail	25/d	20		30/d	17		85	3
		C1090	Rail fitting	25/d	10		30/d	8		40	2
		C1390	Buffer Stops (Dead End)	25/d	20		30/d	17		85	3
		C1400	Points & Crossing (1 in 8 1/2 & 1 in 12)	25/d	20		30/d	17		85	3
	Bridge 7	C1020	Earth work in excavation in foundation	25/d	20	180	30/d	17	151	85	3
		C1030	Pile work	25/d	60		30/d	50		250	10
		C1040	Pier work	25/d	55		30/d	46		230	9
		C1050	Providing steel girders duly launched in position	25/d	45		30/d	38		190	7
	Bridge 8	C1650	Earth work in excavation in foundation	25/d	20	180	30/d	17	151	85	3
		C1660	Pile work	25/d	60		30/d	50		250	10
		C1670	Pier work	25/d	55		30/d	46		230	9
		C1680	Providing steel girders duly launched in position	25/d	45		30/d	38		190	7
	Box Culvert 6	C1240	Earthwork	25/d	10	120	30/d	8	95	40	2
		C1250	Bottom Slab	25/d	20		32/d	16		112	4
		C1260	Vertical Wall	25/d	30		32/d	23		161	7
		C1270	Deck Slab	25/d	20		32/d	16		112	4
		C1280	Wing Wall	25/d	40		32/d	31		217	9
	Box Culvert 7	C1690	Earthwork	25/d	10	120	30/d	8	95	40	2
		C1700	Bottom Slab	25/d	20		32/d	16		112	4
		C1710	Vertical Wall	25/d	30		32/d	23		161	7
		C1720	Deck Slab	25/d	20		32/d	16		112	4
		C1730	Wing Wall	25/d	40		32/d	31		217	9
	Box Culvert 8	C1740	Earthwork	25/d	10	120	30/d	8	95	40	2
		C1750	Bottom Slab	25/d	20		32/d	16		112	4
		C1760	Vertical Wall	25/d	30		32/d	23		161	7
		C1770	Deck Slab	25/d	20		32/d	16		112	4
		C1780	Wing Wall	25/d	40		32/d	31		217	9
	Pipe Culvert 8	C1790	Earthwork	25/d	20	90	32/d	16	72	112	4
		C1800	Installation of pipe	25/d	30		31/d	24		144	6
		C1810	Head Wall & Wing Wall	25/d	40		31/d	32		192	8
	Pipe Culvert 9	C1820	Earthwork	25/d	20	90	32/d	16	72	112	4
		C1830	Installation of pipe	25/d	30		31/d	24		144	6
		C1840	Head Wall & Wing Wall	25/d	40		31/d	32		192	8
4	Pipe Culvert 1	D1290	Earthwork	25/d	20	90	30/d	17	75	85	3
		D1300	Installation of pipe	25/d	30		30/d	25		125	5
		D1310	Head Wall & Wing Wall	25/d	40		30/d	33		165	7
	Pipe Culvert 1	C1820	Earthwork	25/d	20	90	30/d	17	75	85	3
		C1830	Installation of pipe	25/d	30		30/d	25		125	5
		C1840	Head Wall & Wing Wall	25/d	40		30/d	33		165	7
	Pipe Culvert 1	C1820	Earthwork	25/d	20	90	30/d	17	75	85	3
		C1830	Installation of pipe	25/d	30		30/d	25		125	5
		C1840	Head Wall & Wing Wall	25/d	40		30/d	33		165	7
TOTAL					2060			1712		8792	348

the critical activities of the project in such a way that there is no such compulsion to assign all the critical activities with the same number of increase in the labours preventing the over allocation of labour resources to the activities even though the activities completion can be satisfied with optimum number of labour resources. For an instance some of the activities have 32 labours working per day, on the other hand 31 labours working per day are allocated, while there are activities 30 labours working per day as well as few activities comprise 26 labours working per day too, as shown in Table-4.

Initially, the planned project duration is 5years 5months and at present 2 years 2months have passed. When an estimate of the completion of the project was made, it was forecasted that until present, the project has been lagging by 2 months 16days. After performing the crashing of the network, it was rescheduled in such a manner that it coincided the planned schedule.

After the crashing exercise was accomplished, in general an observation could be made stating that an increment of 21 percentage of labour resources would offer in return, a reduction of 17 percentage of the activity completion time. However, this trend does not imply that surging the resource will directly reduce the duration, it will reduce the duration but up to the min. fundamental duration required only not beyond it.

7. Conclusion

The project location on the India's east coast experiences frequent severe cyclones, excessive rainfall for extended durations, all these parameters can't be mapped exactly in the project schedule but a lumpsum provision can be made, the actual impact is inputted at later stage causing alterations in the successive activities. Cyclone Fani, Cyclone Bulbul and anticipated Cyclone (Amphan) are fine illustrations.

Material availability is a cause of the adjournment in the construction, and its noticed that the appropriate quality material is difficult to obtain from nearby vicinity as well as once obtained the selection trials for matching confirming quality and standards is an add-on challenge too, the blanketing layer material availability, delayed delivery of sleeper are the examples.

One of the parameters causing delay observed is the government approval, precisely the railway authorities are directly concerned to the project, as an infrastructure project there are abundant guidelines, standards, approvals and documents to be submitted for review. Depending upon the criticality of the job the processing time may vary in days, weeks, months or maybe yearly (court cases) and the associated delay will be of the same order, caused primarily by the govt. authorities.

Since, the construction stages of project are in the beginning period the project updating exercise, the compression of elongated project completion and the rescheduling task was straightforwardly achieved. While on the contrary attaining this simplicity would be very difficult as the project further advances because the overallocation of resources are always associated with big fat amount capital to be paid in return for assigning more resources, on the other this notion will be applicable only till the maximum budgeted resources limit isn't reached.

8. Future Scope

The parameters of cost, quality could be mapped alongside the time parameter, which enables advanced project management, helping the planning team to gauge the adversely affecting elemental factors. Further, to mitigate them with precise preventive measures, avoiding the chances of slovenly practices of the inferior project management, which ultimately lead to the downfall of the project in the longer run. The fact must be noted that only few of the construction project are functioning adhered to their schedule but the tables could be turned if the planning is given utmost importance rather than sheer execution work.

Disclosures

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