IMPLEMENTATION OF PRIMAVERA P6 ON DASU HYDROPOWER TRANSMISSION LINE PROJECT (DHTLP)

NAME: MR. OMER IQBAL

ENROLLMENT: 03-298152-020

NAME: MR. HAFIZ SAJJAD AHMAD

ENROLLMENT: 03-298152-010

SEMESTER: Fall-2016, MSPM – III

PROGRAM: MS (PROJECT MANAGEMENT)

BAHRIA UNIVERSITY LAHORE CAMPUS

SUBMITTED TO: **Mr. Muhammad Faisal Shahzad**

SUBMITION DATE: **25-Jan-2017**

EnMasse

WITNESS CERTIFICATE

This witness statement is issued to the applicants for the fulfillment of their MS (Project Management) program requirements being carried out at Bahria University Lahore Campus (BULC).

It is witnessed that **Mr. Omer Iqbal** Enrollment #: 03-298152-020 and **Mr. Hafiz Sajjad Ahmad** Enrollment #: 03-298152-010 Class: **MSPM-III** Semester: **Fall 2016** have contacted/ visited/ frequently utilized our premises/participated in our real-time projects for implementing project management skills using Primavera P6 as a leading software tool.

They, in case of participation in organization's project, have contributed fully / partially in the following project(s) and within the highlighted fields:

1. Planning,
2. Scheduling,
3. Earned Value Analysis,

They, in case of visiting/ frequently utilized premises, have been found skillful in applying Primavera P6 in the following highlighted fields (planning, scheduling, earned value analysis, report generation).

Additionally, it is noteworthy to mention that **Mr. Omer Iqbal** and **Mr. Hafiz Sajjad Ahmad** demonstrated good ethical practices, enthusiastic approach to work, task convergence capabilities, professionalism while they stay/ connection with this organization.

Certified By Company Official:
(Signature, Stamp & Date)

EnMasse Pvt Ltd. EnMasse Lahore

Mr. Noor-ul-Huda
02/1/17

Verified By Trainer:
(Signature & Date)

Mr. M. Faisal Shahzad

EnMasse (Pvt.) Limited
131-H, Model Town Lahore.
Tel: +92 - 42 - 35441981, 35441982, 35441984 Fax: 042 - 35441983
E-mail: enmasse@enmassepakistan.com Web: www.enmassepakistan.com

Omer Iqbal plagiairism Report

ORIGINALITY REPORT

6%	3%	0%	5%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

MATCH ALL SOURCES (ONLY SELECTED SOURCE PRINTED)

1%

★ Submitted to University of Bridgeport

Student Paper

EXCLUDE QUOTES	OFF	EXCLUDE MATCHES	< 1 WORDS
EXCLUDE BIBLIOGRAPHY	ON		

ABSTRACT

Pakistan has a nominal installed capacity of proximately 23,500MW. Authentic available capacity, however, is much less due to the senescence of facilities and coerced outages caused by lack of fuel and inadequate maintenance. The shortfall during peak summer hours is around 7,000 to 8,000MW against estimated peak load demand of 18,000MW. The lack of investments in the hydropower sector – which is capital intensive – led to an incrementing quota of thermal power plants. Consequently, despite sizably voluminous hydropower potential in Pakistan, especially in the Indus basin, hydropower share has declined from 64% during 1960s-to-1980s to below 30%. The Government of Pakistan (GoP) is now ramping up its investments in hydropower development and in this context; WAPDA commencing the development of the proposed Dasu Hydropower Project on the Indus River in phased move starting from 1,080MW installed capacity initially to the range of 4,320 MW to 5,400 MW at final development.

Amid the period of last Ten (10) years, EnMasse Private Limited, has accomplished an acknowledgment in Pakistan in the field of Engineering/ designing. It has made this level of progress by owing specialists having better specialized and mechanical comprehension. EnMasse Private Limited has grown extensive variety of administrations gave to Client to finish the projects/ ventures that incorporate that include surveys, planning, conceptual design, power system studies, detailed architectural design, engineering, procurement, construction supervision, plant operation and maintenance till commissioning.

EnMasse Private Limited is currently working on Dasu Hydropower Transmission Line Project as Sub-consultant of KEPCO, South Korea, and providing its services to NTDCL (National Transmission and Despatch Company Limited). The Primavera P6 (Project Management Tool) is used and implemented on Dasu Hydropower Transmission Line Project (DHTLP) funded by the World Bank for Planning, Scheduling, Monitoring & Controlling and Earned Value Analysis on actual data provided by EnMasse Private Limited. The real time Project Status Reports, Project Performance Reports, Project Cost Reports, Earned Value Analysis Reports and S-Curves, Project Baseline Schedules and S-Curves have been generated by using Primavera P6 and make part of this report and is placed in Clause 9.3. During the Execution of "Implementation of Primavera on Dasu Hydropower Transmission Line Project" number of recent year research papers have also been studied on different topics and some them are placed in the Clause 9.2 of this report.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS AND ACRONYMS

ABC	Aerial Bundle Cables
ADB	Asian Development Bank
D/C	Double Circuit
EIA	Environmental Impact Assessment
EnMasse	Engineering & Management Advisory Services
EPS	Enterprise Project Structure
ELR	Energy Loss Reduction
ETAP	Electrical Transient Analyzer Program
EVM	Earned Value Management
FESCO	Faisalabad Electric Supply Company
GoP	Government of Pakistan
HT	High Tension Lines
HESCO	Hyderabad Electric Supply Company
IESCO	Islamabad Electric Supply Company
KEPCO	Korea Electric Power Corporation
LESCO	Lahore Electric Supply Company
LT	Low Tension Lines
Ltd.	Limited
MEPCO	Multan Electric Power Company
NTDCL	National Transmission and Despatch Company
NEPRA	National Electric Power Regulatory Authority
OBS	Organizational Breakdown Structure
PES	Pakistan Engineering Services
Pvt.	Private
RAP	Resettlement Action Plan
SEPCO	Sukkur Electric Power Company
SIA	Social Impact Assessment
SIA	System Impact Assessment
T & D	Transmission and Distribution
WB	World Bank
WAPDA	Water and Power Development Authority
WBS	Work Breakdown Structure

1.0 INTRODUCTION TO THE COMPANY

During the era of last Ten (10) years, Engineering and Management Advisory Services (EnMasse) Private Limited, has achieved a recognition in Pakistan in the field of engineering. It has achieved this level of success by owing experts having better technical and industrial understanding. EnMasse has developed wide range of services provided to Client to complete the project that include surveys, planning, conceptual design, power system studies, detailed architectural design, engineering, procurement, construction supervision, plant operation and maintenance till commissioning. EnMasse has specialization in the designing of Ultra and Extra High Voltage Transmission Line and Sub-Stations, Overhead as well as Underground External Electrification and Street Light System of the Housing Schemes and Internal/ External Electrification System of Multistory Buildings, Survey and Mapping of Transmission and Distribution Lines, Power System Studies and Contract Management. [1]

EnMasse has highly qualified, experienced and technically sound personals as its resources to accomplish effective results. The resources mainly Engineers, Architects, Town Planners, Professional associates and Management specialists who with their revolutionary designs and continuous increasing experience supported by technology of new era and adaptation to external conditions has really helped in achieving and maintaining the company's operational objectives for the excellent output.

The relationship between client and company strongly based on giving complete satisfaction with its services, documentation, technical back up, prompt consideration and attentive response to all requests and comments and at the same time following the standards procedures for engineering excellence.

The Company's key experts are highly experienced, professionally competent and technically sound in the field of Transmission System especially the EHV System and Distribution System and have given the large amount of contribution for the development of Transmission System up to 765kV and DISCOs Distribution networks in Pakistan.

The standard of EnMasse is further raised by a panel of advisors whose expertise and experience has added glamour to its standing and really acting like cheery on the top. The key experts and advisors of EnMasse have done the main developmental projects of WAPDA in

Power Sector especially in Transmission System up to 765 kV which includes the stages from planning to completion which is spread over a period since starting from establishment of WAPDA. Their contribution remained remarkable in the field of transmission lines and grid stations, and they have set milestone and look ahead in the development of electric power infrastructure of the Country.

1.1 Field of Activities

The Services offered by EnMasse in various fields are listed as under: [1]

Pre-feasibility and Feasibility Studies	• Reconnaissance studies • Preliminary Survey and Investigation • Development of Alternate Proposal • Design and Cost Estimates • Evaluation of Technical and Economic Feasibility
Investigations	• Survey & Mapping • Geo-technical Investigations • Hydrological, Hydro geological, Soil & other Service
Design	• Preliminary Design & Cost • Model Tests • Computer Simulations • Detailed Design & Specifications • Detailed Drawings
Tender & Contract Documents	• Bills of Quantities, Cost Estimates & Schedules • Preparation of Tender Documents • Evaluation of Tender & Recommendations • Contract Documents
Construction Supervision & Contract Management	• Contract Coordination • Construction Supervision, Quality Assurance & Monitoring • Certification of Periodic Payments to Contractors, Equipment Inspection & Commissioning • Legal & Financial Arrangements

Post-Construction Services	• Completion Reports • Operation & Maintenance Manuals • Routine Maintenance & Safety Inspection • Performance Monitoring
Environmental and Resettlement Studies	• Environmental Impact Assessment (EIA) • Resettlement Action Plan (RAP) • Social Impact Assessment (SIA)
Power System Studies	• Load Flow Studies • Power System Stability Studies • System Fault Level Studies • Assets Evaluation • Power Tariff Studies

Table 1: Field of Activities

1.2 Organization Vision/ Mission

1.2.1 Vision

Provide and create comprehensive, integrated solutions in industry development and advanced solutions to any technology in all over the world.

1.2.2 Mission

To embark on collaborative services which offer opportunities for long-term relations with clients.

1.3 Company Registration

- EnMasse is registered as Consulting Engineers at Serial No. CONSULT/ 1253 of the Register of Pakistan Engineering Council, for Civil and Electrical Works Only.
- EnMasse is ISO 9001: 2008 Certified.

1.4 Summary of Projects

Projects are mainly divided into two categories i.e. which have been done in the past and those which are currently in progress by EnMasse Private Limited. In both categories it is evident

from level of expertise, skills and technical knowledge of the company in the field of giving consultancy from past Ten (10) years. [1]

1.4.1 On-Going Projects

Following are the On-going Projects at EnMasse Private Limited in Power System Transmission and Distribution (T&D) Division: [1]

- EnMasse Private Limited is currently providing its Consultancy Services to NTDCL (National Transmission and Despatch Company Ltd.) for Engineering, Construction Supervision, Testing and Commissioning of 765kV double circuit (D/C) Dasu Hydropower Transmission Lines from Dasu Hydropower Plant (HPP) to Islamabad via Mansehra of about 250Kms as Sub-Contractor of KEPCO (Korea Electric Power Corporation).

- EnMasse Private Limited is presently providing Consultancy Services for Engineering and Construction Supervision of Five (5) Nos. 132kV Grid Stations and Associated 132kV Transmission lines under ADB Loan (Tranche II) and Seven (7) Nos. 132kV Grid Stations and Associated 132kV Transmission lines under ADB Loan (Tranche III) in MEPCO, Multan, Pakistan. Details of the Grid Stations are as follows:

  (i) 132kV Ali Pur Grid Station
  (ii) 132kV Fateh Pur Grid Station
  (iii) 132kV Noor Pur Grid Station
  (iv) 132kV Kamir Grid Station
  (v) 132kV Miran Grid Station
  (vi) 132kV Chak-83/12- Grid Station
  (vii) 132kV Dahranwala Grid Station
  (viii) 132kV Faqirwali Grid Station
  (ix) 132kV Fort Abbas Grid Station
  (x) 132kV Shah Sadar Din Grid Station
  (xi) 132kV Mubarik Pur Grid Station
  (xii) 132kV Chunna Wala Grid Station

- EnMasse Private Limited is also currently providing Consultancy Services for Conducting Environmental Studies for Third Party Validation Environmental Monitoring and Management Plan of 36 Nos. 132kV Grid Stations with 30 Km Allied Transmission Lines of LESCO, Lahore and 220kV Grid Station Kassowal and Allied Transmission Lines to NTDC (National Transmission and Despatch Company Ltd.), Pakistan.

- Contract for Consultancy Services for Construction Supervision, Testing and Commissioning of Six (6) Nos. 132 kV Grid Stations, 175 Kms Transmission Lines and Allied activities in HESCO under the financing of ADB (Asian Development Bank) against Loan No. 2972 Tranche-III has also been awarded to EnMasse Private Limited in February 2015 and Consultancy services for following Grid Stations and Transmission Lines are in progress and their details are as:

Grid Stations

(i) 132 kV New Matli Grid Station (NEW)
(ii) 132 kV T.G Ali Grid Station (Conversion)
(iii) 132 kV Digri Grid Station (Conversion)
(iv) 132 kV Tando jan Muhammad Grid Station (Conversion)
(v) 220 kV/ 132kV Hala Road Grid Station (Extension Bay)
(vi) 132 kV Hala Road Grid Station (Extension Bay)

Transmission Lines

(i) TM Khan 132 kV New Matli D/C (2KMs)
(ii) New Matli – 132 kV to TG Ali (30KMs)
(iii) T.G.Ali – 132 kV Digri (31KMs)
(iv) Digri – 132 kV Tando jan Muhammad (20KMs)
(v) 132 kV TJM – 132 kV Naukat (30KMs)
(vi) 132 kV Hala Road – Hala (65KMs)

- EnMasse Private Limited is also currently providing its Consultancy Services for Engineering/ Design, Construction Supervision, Testing & Commissioning and Allied activities for following Grid Stations in private sector as under:

(i) 132 kV Grid Station, Rohri Cement Factory, Sukkur
(ii) 132 kV Grid Station, Phase VIII (CBW) DHA Lahore
(iii) 132 kV Grid Station, Phase IX DHA Lahore

- EnMasse has also been engaged for providing Consultancy Services for the Testing and Commissioning of Pakistan's first Wind Power Project of 50 MW at Jhampir in Sindh, Pakistan.

1.4.2 Completed Projects

Following are the list of Completed Projects at EnMasse Private Limited in Power System Transmission and Distribution (T&D) Division: [1]

- EnMasse had been provided Consultancy Services to LESCO, FESCO, HESCO, MEPCO, IESCO and SEPCO (Distribution Companies) for Deposit Works, SAP-ELR/DOP (System Augmentation Program), Rural Electrification Works & B-3 Service Connection for the years 2012, 2013, 2014 and 2015 which includes Vetting of Estimates Prepared by the Client, Financial and Technical Review and Control of Issuance of Materials to the Contractors as per the Estimates, Verification of Material Installed at sites and Preparation of Reconciliation Statements, Construction Works Monitored with reference to the WAPDA (Water & Power Development Authority) Specifications and Standards, Assistance to be provided to the Client in the Acceptance of the Completed Projects and Preparation of Completion Reports.

- Consultancy Services for Rehabilitation of Existing Power Distribution System in Walled City, Lahore which includes Installation of 630/ 400/ 200 kVA Transformers, HT/LT Structures, HT/LT Cables/ Insulated Conductors (Mains & Services), Line Hardware, Insulated Hardware, Accessories; Replacement of Electro-mechanical (Single/Three Phase) Meters and Defective meters with the new Static Energy Meters; Re-fixing of existing (Single/Three Phase) Meters at appropriate places; Dismantlement of outlived/ worn out existing network; Testing & Commissioning on 300 Nos. of Job Orders of Walled City Lahore.

- In a Joint Venture with PES (Pakistan Engineering Services), Karachi, EnMasse had provided the Consultancy Services to HESCO for Asian Development Bank/ World Bank Funded Project which included: Preparation of Preliminary Design, Preparation of Tender Documents, Bid Evaluation, Detailed Design, Construction Supervision, Award of Contract, Testing and Commissioning of HT/LT feeders for the Replacement of LT Bare Conductor with Aerial Bundled Cables (ABC) on 3000 Nos. of Job Orders in LT Distribution Networks of HESCO/ SEPCO and for the Rehabilitation of 11kV selected Feeders of HESCO. EnMasse has the privilege of Introducing this new Technology of ABC (Aerial Bundled Cable) in Pakistan for the first time which has given tremendous results in terms of continuity of power supply and for the elimination of power theft in congested areas of Sindh, Pakistan through direct hooking.

- EnMasse Private Limited has successfully completed the Construction Supervision of following 132kV Grid Staions:
  (i) 132kV WAPDA Town Grid Staion, Multan.
  (ii) 132kV Qasim Bagh Grid Station, Multan.
  (iii) 132kV Grid Station LAR, Multan.
  (iv) 132kV Khadim Steel Industries Grid Station, Faisalabad.
  (v) 132kV Flying Cement Grid Station, Khushab.

- EnMasse Private Limited had completed the projects of Electrification Design of following Housing Societies which included Comprehensive Survey of site for the Assessment of Load, Designing of 11kV and 0.4kV Feeders and Sub-stations of Appropriate Capacities by using Software for Feeder Analysis and the LT Network:
  (i) Canal View Housing Society, Lahore
  (ii) Prime Homes Housing Society, Lahore
  (iii) UNZE Housing Society, Lahore
  (iv) KEMC Housing Society, Lahore

- EnMasse Private Limited had recently provided its Consultancy Services to Azad Kashmir Hydro Electric Board (AJK-HEB) for Preparation of Load Flow, Short Circuit and System Stability Studies of four Nos. following Hydropower Projects:
  (i) 3.2 MW Rehra Hydropower Station
  (ii) 3.0 MW Qadirabad Hydropower Station

(iii) 3.2 MW Hattian Hydropower Station

(iv) 3.2 MW Kathai Hydropower Station

- EnMasse Private Limited had also provided Consultancy Services to Engro Foods Limited, National Hospital and Jamal Nasir Steel Mills Lahore for the Assessment of Load and for providing power to these entities from LESCO network. The firm has also provided its Engineering Advisory Services to Noon Sugar Mills for Load Flow, Short Circuit and System Stability Studies for Dispersal of 4.0 MW Power to 132kV Bhalwal Grid Station, FESCO Region.

- EnMasse Private Limited had delivered Consultancy Services for Engineering, Construction Supervision, Testing & Commissioning and Allied Activities for Five (5) Nos. 132kV Grid Stations and 310Km, 132kV Transmission Lines under Power Distribution Enhancement Project Financed by Asian Development Bank (ADB) in Hyderabad Electric Supply Company (HESCO) Hyderabad, and Sukkur Electric Power Company (SEPCO) Sukkur, Pakistan.

- EnMasse Private Limited had provided its services to WAPDA House for Evaluating Faulty/ Hazardous Network at WAPDA House, Lahore, Pakistan and Remedial/ Rectification Proposals with preparation of Engineers Estimate and Tender Documents. EnMasse has completed the project of Load Analysis/ External and Internal Electrification of BARAAT GHAR, Model Town, Lahore.

- EnMasse Private Limited had carried out various Environmental Studies (EIA/ESA) of 500kV/ 220kV Transmission Lines and Substations Projects of Pakistan, which include EIA/ ESA Studies of HIC-I (Lot-II) 220 kV Transmission Lines, 220kV Ghazi road Grid Station & feeding Transmission Lines, 220 kV Grid Station Dera Murad Jamali, 220 kV UCH- SIBBI Transmission Line and 500/220 kV Shikarpur Grid Station and Feeding Transmission Lines.

- EnMasse Private Limited is fully equipped with highly Trained and Experienced Professionals in its Contract Department to carry out National/ International Tendering/ Bidding/ Evaluation of Financial, Commercial, Legal and Technical Proposals for the Procurement of Services and Material and Sponsors. Our firm has carried out

evaluations as per the guidelines of Pakistan Engineering Council (PEC) and under the guidelines of Donor Banks.

- EnMasse Private Limited provided Consultancy Services and Contract management for M/s MECON Pvt. Ltd. for Survey, Estimation, Bid Preparation, Geo-Technical Study, Route profile, Design, Drawing and Construction Supervision, Testing and Commissioning and Preparation of Completion Reports of 220 kV Dadu-Khuzdar Transmission Lines (Lot-II).

- EnMasse Private Limited had provided its Consultancy Services for the Construction Supervision of 220kV GIS Bandala Grid Station and Allied 220 kV Transmission Lines Faisalabad, 220kV Toba Tek Singh (TTS) Grid Station and Allied 220 kV Transmission Lines and 220 kV Okara Grid Station and Allied 220 kV Transmission Lines to NTDC (National Transmission and Despatch Company Ltd).

- EnMasse Private Limited has also provided Consultancy Services for Construction Supervision, Testing & Commissioning of Five (5) Nos. 132 kV Grid Stations and 310kM Transmission Lines on the Trunkey Basis, Allied activities under Power Distribution Enhancement Project (TRANCHE-2) financed by ADB in HESCO and SEPCO Distribution Companies. Details of the Projects are given below:

i. **132kV Grid Stations**
   - 132 kV Jacobabad New (SEPCO).
   - Conversion of 66 kV to 132 kV Grid Stations.
     a. Sukkur City (SEPCO)
     b. Larkana City (SEPCO)
     c. Talhar City (HESCO)

ii. **132kV Transmission Lines**
   - Thull-Jacobabad (In & Out at Jacobabad 2) (SEPCO)
   - Araian Road-Sukkur City (SEPCO)
   - Dadu New-Mehar-Larkana-3 (SEPCO)
   - Larkana 2-Larkana old (SEPCO)

- T.M Khan-Badin (In & Out at Talhar) (SEPCO)
- In & Out for Kandiari (HESCO)
- Kandiari-Sanghar 2nd Circuit (HESCO)
- Mirpurkhas-Kindairi 2nd Circle (HESCO)
- 220/ 132 kV Shikarpur Larkana-2 (SEPCO)

- EnMasse Private Limited had also Provided Consultancy Services for Engineering, Design and Construction Supervision of following projects:

  (a) 132 kV Qasim Bagh Grid Stations Multan in MEPCO under EPC Contract.
  (b) 132 kV WAPDA Town Grid Stations Multan in MEPCO.
  (c) 132 kV Flying Cement Factory Grid Station and Allied 132 kV Transmission Line.
  (d) 132 kV Grid Station LAR in MEPCO under EPC Contract.
  (e) 132 kV Consumer Grid Station, Khadim Steel Industries (KSI) M-3, Industrial Estate Faisalabad.

- EnMasse Private Limited had provided its Services in Power Distribution Projects regarding Preparation of Preliminary/Detailed Design, Bid Evaluation, Preparation of Tender Documents, Award of Contract, Construction Supervision, Testing and Commissioning of HT and LT feeders with the Financial Assistance of ADB and WB in the Jurisdiction of HESCO/SEPCO. The work involved is as under:

  (a) Rehabilitation/ Bifurcation of 11 kV selected feeders.
  (b) Installation of three phase meters on 200 kVA and 100 kVA distribution
  (c) Transformers or AMR System (Automatic Meter Reading System).
  (d) Installation of Aerial Bundle Cable along with complete insulated accessories up to the consumer meter/ premises by replacing the bare LT network.

- EnMasse Private Limited had also provided its Services in the domain of consultancy for SAP-ELR/DOP, Deposit work and Rural Electrification Program in FESCO for the year 2012-14, LESCO for the year 2012-14, MEPCO for the year 2013-14, HESCO for the year 2013-14 and SEPCO for the year 2013-14.

1.5 License Holder of ETAP Power System Simulation (PSS) Software

EnMasse Private Limited has provided Advisory Services on ELR (Energy Loss Reduction) Projects on load Management to various private utilities having equipped with ETAP (Electrical Transient Analyzer Program) Software Version 11.0.0 for the Load Flow Studies and Area Planning of 11 kV Feeders and LT Lines.

1.6 Organization Structure

The organization structure of M/s EnMasse Private Limited are as shown below:

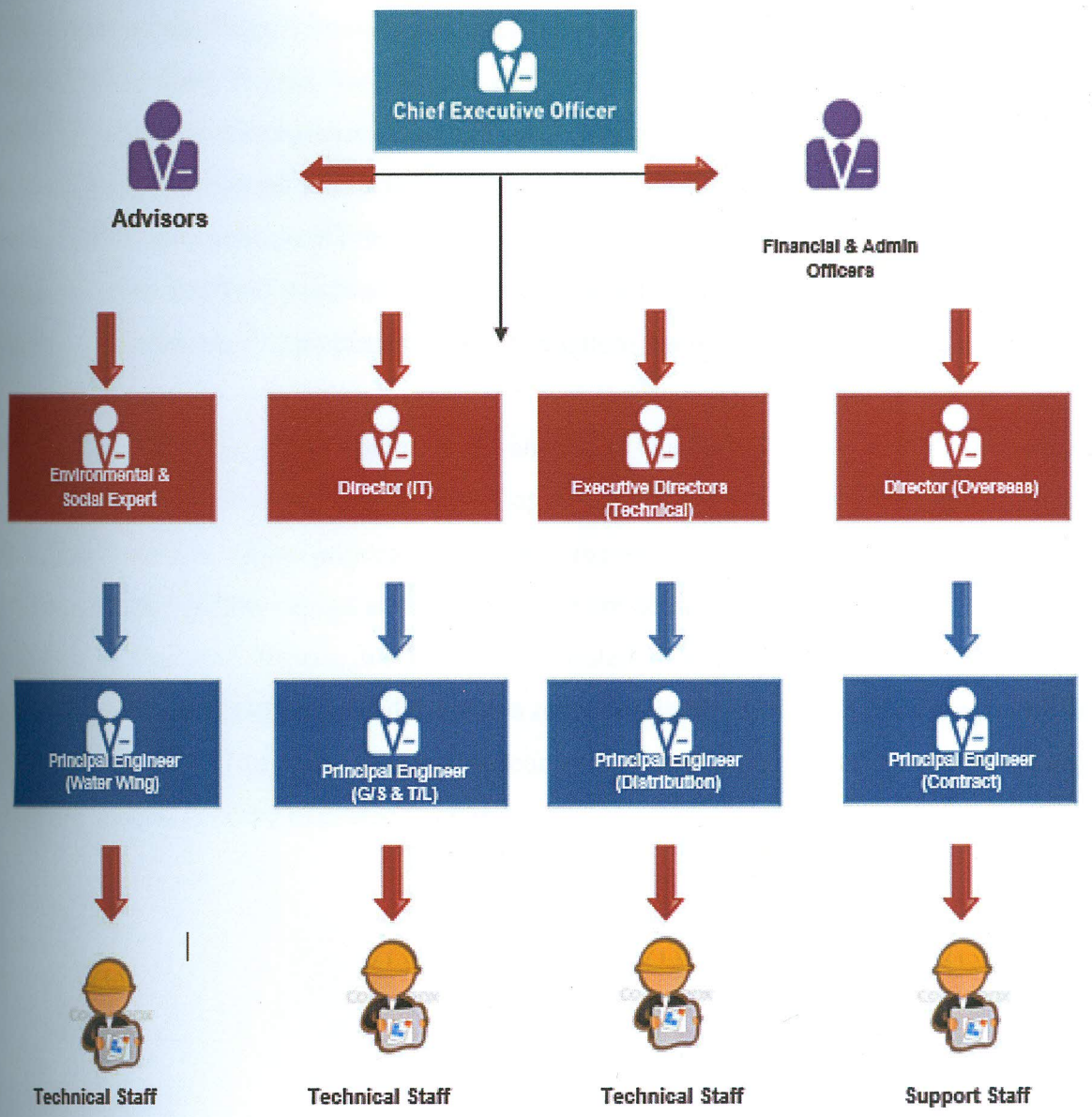


Figure 1: *Organization Structure of EnMasse Private Limited*

1.7 Report Outline

This report includes seven segments which depicts thoroughly about the Implementation of Primavera P6 (Project Planning, Scheduling and Monitoring and Controlling Tool) on Dasu Hydropower Transmission Line Project. Section 1 includes about the Introduction to the Organization, Vision, Mission and Summary of Projects which have been done in the past and those which are right now in advance by EnMasse Private Limited (the company). Section 2 for the most part examined about the Project Charter of Dasu Hydropower Transmission Line Project. Section 3 depicts and talked about the Stakeholders and Stakeholder Analysis for Dasu Hydropower Transmission Line Project and it likewise examined about Stakeholder Register. Section 4 shows the Scope Statement of DHTLP which incorporates the Scope Description of Project, Deliverables, Project Assumptions & Constraints and Project Exclusions. Section 5 briefs about the Risk Management Plan of Dasu Hydropower Transmission Line Project and extensive Risk Management Plan is talked about in detail. Segment 6 give detail portrayal about the Practical Implementation of Primavera P6 on Dasu Hydropower Transmission Line Project. Distinctive ideas and focal points of Primavera over MS Project is likewise talked about in this statement. Conclusions and proposals/ recommendations for this activities are set in Section 7.

The Section 9 of this report comprise of annexure which is further isolated into three Clauses/Sub-areas. Clause 9.1 contain CBT Log which depicts the issues we have confronted amid the execution of subject project/ venture in Primavera and how we take care of these issue by taking assistance from various sources and same are additionally specified in it. Clause 9.2 comprises of Research Papers; we have concentrated diverse research papers and taking assistance from these late paper amid execution of this project/ venture and same are joined for reference. Clause 9.3 contains the real outcomes acquire amid execution and checking/ monitoring and controlling of project/ venture work.

2.0 PROJECT CHARTER

2.1 Project Name

Consultancy Services for Dasu Hydropower Transmission Line Project (DHTLP).

2.2 Project Purpose/ Justification

Pakistan has a nominal installed capacity of proximately 23,500MW. Authentic available capacity, however, is much less due to the senescence of facilities and coerced outages caused by lack of fuel and inadequate maintenance. The shortfall during peak summer hours is around 7,000 to 8,000MW against estimated peak load demand of 18,000MW. The lack of investments in the hydropower sector – which is capital intensive – led to an incrementing quota of thermal power plants. Consequently, despite sizably voluminous hydropower potential in Pakistan, especially in the Indus basin, hydropower share has declined from 64% during 1960s-to-1980s to below 30%. The Government of Pakistan (GoP) is now ramping up its investments in hydropower development and in this context the Water and Power Development Authority (WAPDA) is commencing the development of the proposed Dasu Hydropower Project on the Indus River in phased move starting from 1,080 MW installed capacity initially to the range of 4,320 MW to 5,400 MW at final development. [2]

National Transmission and Despatch Company (NTDC) is in charge of the advancement and operation of Transmission System in Pakistan. Hence NTDC would be in charge of mass exchange of force produced from the proposed Dasu Hydropower Project to the national network at a fitting or more suitable area. Dasu Hydropower Project (DHP) is one of the 26 Hydropower Plants included in the Feasibility Study for Voidance of Power from 26 Hydropower Projects on River Indus and its Tributaries in Northern Areas. Dasu Hydropower Project (DHP) is situated on the River Indus of approximately about 210km upstream from Tarbela Dam and approximately about Seventy four (74km) downstream of Diamer – Basha Dam site. It is located about 250 km from Pakistan Capital City Islamabad. DHP would have total capacity of 5,400 MW and its first phase of stage 1 of about 1,080 MW is expected to be online by June 2019. [2]

2.3 Project Objectives

The overall objectives of the Project are: [2]

- To Conduct the System Studies and Prepare the Techno-Economic Analysis Report for the Selection of Appropriate Voltage Level for Dasu Hydropower Project.
- To Prepare Tender Level Engineering Design.
- To Conduct the Environmental and Social Safeguard Studies for one Double Circuit (D/C) 500kV/ 765kV transmission lines from Dasu to Islamabad via Mansehra and prepare the EIA (Environment Impact Assessment), SIA (System Impact Assessment), EMP and SMP Reports (Environmental & Social Management Reports including Plans).
- To Prepare the Pre-qualification and Bidding Documents including Engineering and Economics, Environmental, and Social Studies.

2.4 Scope of Work

The scope of work includes the Consultancy Services accommodates the Preliminary Survey for two Routes 500kV/ 765kV Transmission Lines from Dasu to Islamabad via Mansehra, Route Alignment, Geotechnical and Soil Investigations, Preparation of Tender Level Engineering Design, Environment and Social Impact Assessment Studies and their Management Plans, Preparation of Pre-qualification and Bidding Documents, Bid Evaluations and Support of the Client During Tendering and Award of Contract for Double Circuit (D/C) 500kV/ 765kV Transmission Line from Dasu to Islamabad via Mansehra. The selection of the voltage level will be Finalized Predicated on the Recommendation in Review on Previous System Study and Techno-Economic Analysis Report. [2]

These work are to be predicated on a Technically Viable, Optimal, and Cost Efficacious Design and Construction Plan including Safeguards Studies for Double Circuit 500kV/ 765kV Transmission Line from Dasu to Islamabad via Mansehra, which envisages and counters the different issues posed by the arduous and inaccessible Terrain, High Altitude, Environment Hazards, Inclement weather, etc. These works will be carried out by a hired Consultant keeping in view good Engineering Practices, Applicable Standards, Code, and Guidelines; and will compose the substructure for project appraisal by the Government of Pakistan, the World Bank, and/or other International Financial Institutions. [2]

2.5 Success Criteria

The following success criteria is proposed to achieve the objective of the project, and its more appropriate which shall include, but not limited to the tasks and assignments, activities outlined below. These are broadly grouped into four tasks:

- System Studies, Surveys, Geotechnical and Soil Investigations, Tender Level Engineering Designs, Cost Estimates, and Preparation and Evaluation of Pre-qualification and Bidding Documents as per requirement of Financing Agency.
- Environmental Assessment, Planning, and Management.
- Social Assessment, Planning, and Management.
- Training to NTDC Officials, provide Technical Assistance and Support where/ if requested by NTDC.

2.6 High Level Requirement

- Task A1: Review of Feasibility Study & Use of Existing Information/Data
- Task A2: Transmission Line Route Alignment and Survey
- Task A3: Preparation of Tender Level Engineering Design

  (i) Sub-Task A3.1: Collection of Data and Investigations.
  (ii) Sub-Task A3.2: Design Criteria.
  (iii) Sub-Task A3.3: Project Implementation Planning and Procurement Packaging
  (iv) Sub-Task A3.4: Preparation of BOQ and Costing.
  (v) Sub-Task A3.5: Management Plan, EIAs, Environmental Assessment etc.
  (vi) Sub-Task A3.6: Preparation of RAP (Resettlement Action Plan), SIA & Beneficiary Participation Aspects.

- Task A4: Tender Documents Preparation.
- Task A5: Tendering and Contracting.
- Task A6: Technical Training.
- Task A7: Preparation of System Impact Assessment (SIA) Study.
- Task A8: Geotechnical Investigations.

2.7 Project Assumptions/ Constraints

- The Client will provide all of the subsisting information, data, reports, maps, and studies conducted so far including feasibility study for evacuation of power from 26 already planned hydropower plants (HPPs).
- Voltage level at the time of contract was not finalized and it will be finalized; predicated on the recommendations provided later in the Review on already existing or previous system study and Techno-Economic Analysis Report.
- The client will provide the route alignments of transmission line from Dasu-Mansehra (already carried out under the previous feasibility study) and re-alignment of routes wherever required.
- Consultant will provide the technical assistance and training to the six personnel of the Client.
- Consultant will carry out the EIA (Environmental Impact Assessments) study by following the World Bank (WB) Guidelines, Pakistani Environmental Regulations and WB Operational Policies (Operational Policies 4.01).
- Consultant will do/ perform/ accomplish SIA (Social Impact Assessment) as desired/ required by Govt. of Pakistan (GOP) and the World Bank Guidelines for sundry project activities/ works.
- The Consultant will prepare the Transmission Line Design Criteria Report according to the international standards mentioned in subsequent clause in the contract documents.

2.8 Contracted Budget

The contracted budget for the Consultancy Services for Dasu Hydropower Transmission Line Project (DHTLP) is approximately about 300 Million Pakistani Rupees which includes Remuneration, Reimbursable, Deliverables, Taxes and Contingency Costs. The World Bank will provide the Financial Assistance through Ministry of Water & Power (MoWP) for this project.

2.9 Completion Period

As the contract is Time-Based Contract; so the total duration for completion the project is about Twenty Eight (28) Months, starting from the 9th March, 2015 to 30th June, 2017.

2.10 High Level Risks

Following are the list of Risks which are identified by taking Expression of Interest (EOI), Request for Proposal (RFP) and Contract Documents/ Agreements into account.

- Non-availability of previous feasibility studies.
- Non-availability of system study data.
- Non-availability of metrological data according to the required format.
- Selection of voltage level may take longer time than expected.
- Voltage level selection report may need more data/ justification than expected.
- Previous route alignment may not up to the mark/ or need complete realignment.
- In case of approval of 765kV voltage level more resources may be required.
- There may be security threat for international/ local key experts in Pakistan especially at project site.
- There may be some conflict arises between consultant and client regarding selection of voltage level.

2.11 Major Deliverables

The list of the major deliverables are mentioned below in table.

Major Deliverables
Review of Feasibility Study/ Inception Report
Preparation of Report on Review of Previous System Study
Preparation of Techno-Economic Analysis Report
Pre-Qualification Document
Report on Loading Zone including Loading Wind Maps
Route Alignment and Survey Report
Preparation System Impact Assessment (SIA) Study Report, EIA & SIA Reports
Evaluation and Shortlisting of Bidders Report
Engineers Estimate

Engineering Design Report
Bidding Documents
Contractors Bids Evaluation Report
Award of Contract

Table 2: *Major Deliverables List of DHTLP*

2.12 Project Governance Requirements

Dasu Hydropower Transmission Line venture/project shall be within/ inside/ internally managed/ achieved by the Project Manager with direct oversight from the Project Management Unit (PMU) Office, NTDCL. The PMU Office is chaired by the Chief Engineer/ Project Director NTDC, Executive Sponsor (World Bank) and comprised of selected stakeholders (like BOD, MD NTDCL and other NTDC departments). The Project Manager will report the project status to the Project Management Unit (PMU) Office, NTDCL and present issues, options, and recommendations to the Project Management Unit (PMU) Office, NTDCL for further authorization and sanction.

2.13 Project Manager and Responsibilities

The Project Manager Mr. Jae Heun Park is hereby sanctioned authority to interface with the Executive Sponsor (World Bank) and Project Sponsors (Board of Directors, MD NTDC & other NTDC departments) through Project Management Unit (PMU), NTDC, (Project In-charge), as required, consult for assets/ resources, appoint obligations inside the extent of the venture/ project, and to impart, as required, with all colleagues and administration to learn convenient and prosperous fruition of the venture/ project. The Project Manager is in charge of creating Project Plan, dealing with the schedule/ calendar, cost, and extent/ scope of the venture/ project, evaluating execution, and taking restorative and preventive activities where/if required.

2.14 Development of Project Charter

The tools and techniques used for the development of Project Charter are given below:

- Documentation Reviews
- Expert Judgement
- Facilitation Techniques

2.14.1 Documentation Reviews

It was genuinely consequential to review the Project Tender Documents (like Expression of Interest, Request for Proposal, and Amendments in RFP etc.), Term of Reference (TOR), Contract Agreement, Minutes of Meetings (MoM), Letters of Intent/ Award (LOI/ LOA) and emails etc. to prepare the Project Charter as per follow the good practices and consummate the desideratum & authoritatively mandate of the Project Sponsor. The Project Manager, Design and Survey Experts, Sub-Consultant Experts and Junior Engineers (Project Support Staff) etc. were involved in the document reviews.

2.14.2 Expert Judgement

The following experts were identified and considered important to have their view points to assess/ judge/ evaluate the inputs/ efforts/ contributions used to develop the project charter:

- Project Sponsor
- Project Management Unit
- Subject Matter Experts
- Design Department, NTDC
- Planning Power Department, NTDC
- Sub-Consultant Team/ Experts and etc.

Their judgment was not only applied to all the technical but also the management matters during the process of developing the project charter.

2.14.3 Facilitation Techniques

Brainstorming session and meetings were conducted with the stakeholders to identify the Project Assumptions & Constraints, High Level Risks, and setting the Milestones of the project.

2.14.4 ITTO Table of Project Charter

Inputs	Tools and Techniques	Outputs
Agreements (EOI, RFP, Contract Agreement and Amendments etc.)	Documentation Reviews	Project Charter
EEF (Enterprise Environmental Factors)	Facilitation Techniques	
OPA (Organizational Process Assets)	Expert Judgement	

Table 3: *Project Charter ITTO Table*

3.0 PROJECT STAKEHOLDERS AND STAKEHOLDERS ANALYSIS

The definition of Stakeholder as per PMBoK (Project Management – Body of Knowledge) is defined in very broad spectrum – anyone close/ nearby to the project/ venture is a stakeholder. For this project, the stakeholders can be categorized into following categories: [3]

1) Output Delivery Stakeholders
2) Funding Authority Stakeholders
3) Review/Audit Stakeholders
4) Outcome Affected Stakeholders

3.1 Output Delivery Stakeholders

Yield/ output conveyance partners/ stakeholders are people, gatherings, or associations in charge of the dissemination of the venture's/ projects yield. This incorporates extend colleagues/ team members and sometimes, contractual workers/ contractors. [3]

For this project output distribution stakeholders are project team (only as this project is engineering based project and no physical work is required) which includes project manager, risk officer, project coordinator, design experts, survey experts, system study experts, contract experts, local support staff, project office staff and others.

3.2 Funding Authority/ Executive Stakeholders

Funding ascendancy/ executive stakeholders are accountable/ responsible for the outcome/ conclusion of the project/ venture and grant approbation for relinquishment of funding and provision of resources. They are the corporate/ business owners of the project and support the achievement of project objectives. Funding ascendancy stakeholders include executive sponsor, project sponsors and others. [3]

For this project the executive sponsors are World Bank and Ministry of Water and Power (MoWP), Govt. of Pakistan and the project sponsors and others includes the NTDC Board of Directors, MD NTDC, Project Management Unit (PMU) office and other NTDCL functional departments.

3.3 Review/Audit Stakeholders

Review/Audit partners are gatherings or associations who need to survey or review the venture/ project and it's deliverables to guarantee that legitimate procedures are taken after and the nature of deliverables meets fitting norms. [3]

For this project review/ audit stakeholders include Project Management Unit (PMU) office, NTDCL design department, NTDCL planning power department, NTDCL environmental and social impact cell (ESIC), regulatory agencies like NEPRA, PEPRA and environmental agencies. Review/audit stakeholders often have the authority to stop a project until their concern is addressed.

3.4 Outcome Affected Stakeholders

Outcome affected stakeholders are those stakeholders which are not directly involved in the project execution, however they are affected by the outcome of the project. [3]

For this project outcome affected stakeholders are Prime Minister, GM Dasu Hydropower Project (Wapda), Dasu Hydropower Consultant (DHC), Sub-Consultant Team, Local Communities/ Peoples in Project Area and others.

3.5 Tools and Techniques Used for Identify Stakeholders

The basic tools and techniques used for identification and verification of project stakeholders and for the development of Stakeholder Register are given below:

1) Documentation Reviews
2) Stakeholder Analysis
3) Expert Judgement
4) Meetings

3.5.1 Documentation Reviews

It was compulsory to review the Project Tender Documents (like Expression of Interest, Request for Proposal, and Amendments in RFP etc.), Term of Reference (TOR), Contract Acquiescent, Minutes of Meetings (MoM), Letters of Intent/ Award (LOI/ LOA) and emails etc. for the identification of main/ major stakeholders and the preparation of the stakeholder register by follow the good practices. The Project Manager, Design and Survey Experts, Sub-

Consultant Experts and Junior Engineers (Project Support Staff) etc. were involved in the document reviews.

3.5.2 Stakeholder Analysis

It was genuinely vital for this project to determine which stakeholders intrigues should be taken into account throughout the life of the project. We utilized the Mendelow Matrix to group the stakeholders predicated on their caliber of ascendancy ("power") and their caliber of concern ("interest") regarding the project outcomes. It is paramount to prioritize the stakeholders to ascertain the efficient utilization of effort to communicate and manage their prospects. [4]

Power/ Interest Grid additionally called Mendelow Matrix, grouping the stakeholders predicated on their caliber of ascendancy ("power") and their caliber/ concern ("interest") is given below.

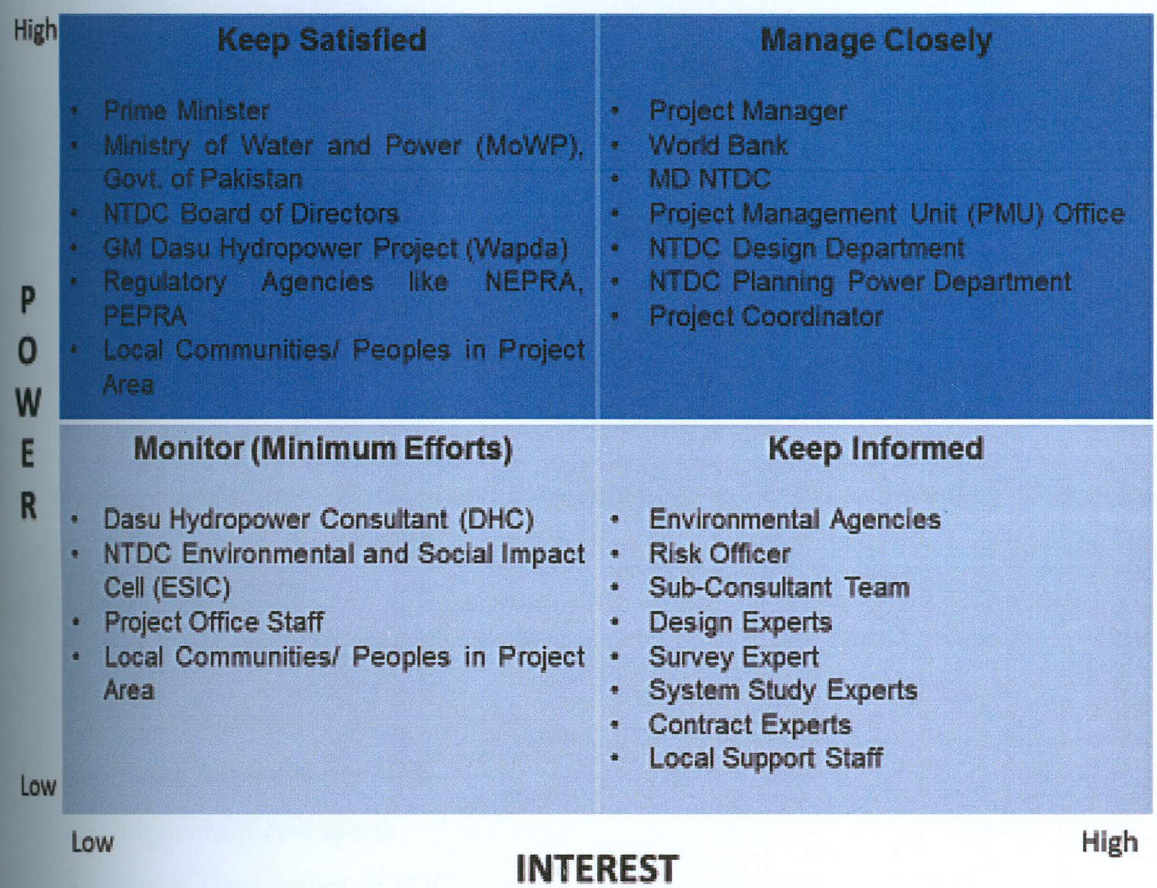


Figure 2: Power-Interest Grid of DHTLP

It is also important to group the stakeholders based on their level of authority ("power") and their active involvement ("influence") in Project. For this Power/ Influence grid is used.

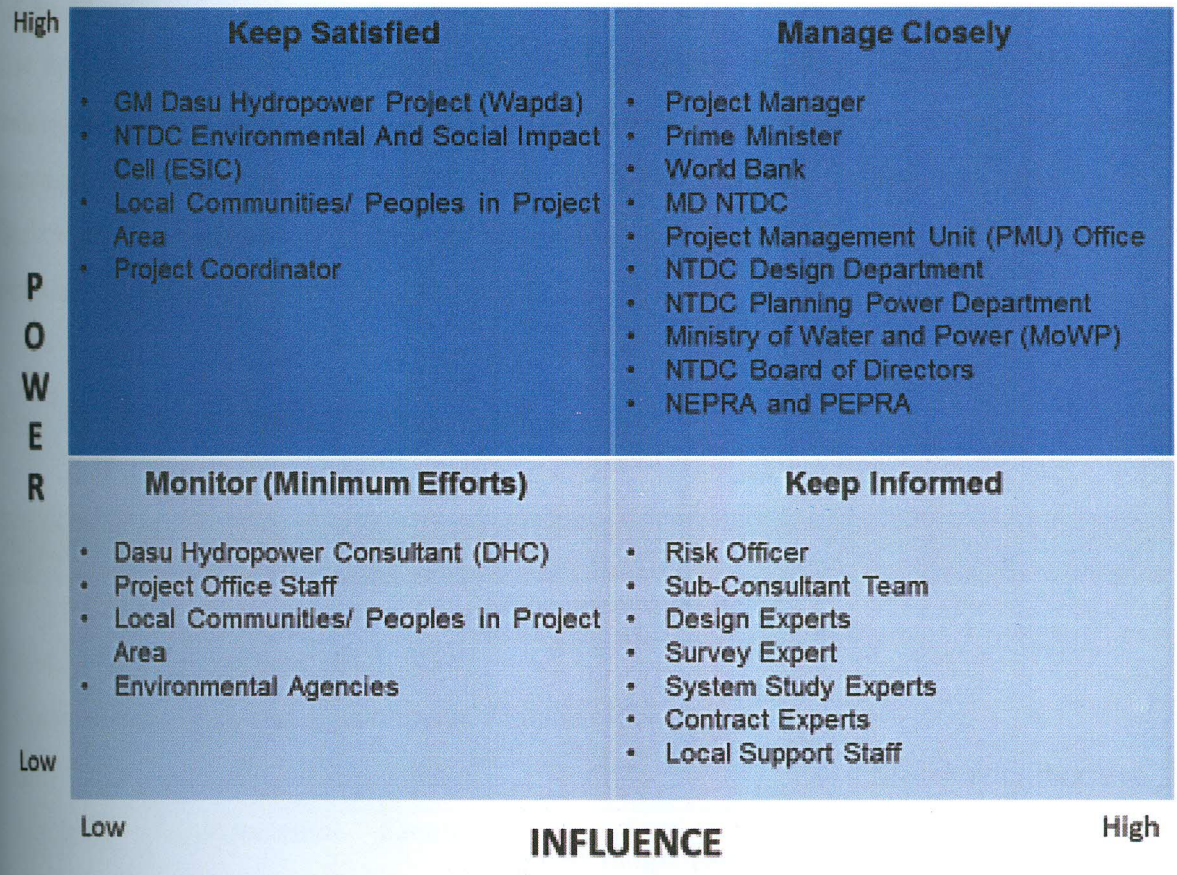


Figure 3: *Power-Influence Grid of DHTLP*

3.5.3 Expert Judgement

The following experts were identified and considered consequential to have their view points to ascertain comprehensive identification and listing of stakeholders and to prepare the stakeholder register:

a) Project Sponsor
b) Project Management Unit
c) Subject Matter Experts
d) Design Department, NTDC
e) Planning Power Department, NTDC
f) Sub-Consultant Team/ Experts and etc.

Their judgment was not only applicable to all the technical matters but also with all the management matters during the process of developing the stakeholder register.

3.5.4 Meetings

The Project Manager were arranged the profile analysis meetings to develop the better understanding of major project stakeholders (which were identified during the project documentation reviews) and project staff. In these meetings information about roles, fascinations and interests, erudition and knowledge, and the overall position of major project stakeholders were exchanged and analyzed. [4]

3.6 ITTO Table of Identify Stakeholders

Inputs	Tools and Techniques	Outputs
Project Charter	Documentation Reviews	Stakeholder Register
Procurement Documents (EOI, RFP, Contract Agreement and Amendments etc.)	Stakeholder Analysis	
Enterprise Environmental Factors (EEF)	Expert Judgement	
Organizational Process Assets (OPA)	Meetings	

Table 4: *Stakeholders Identification ITTO*

3.7 Stakeholder Register

The stakeholder register should be consulted and updated on a conventional basis, as stakeholders may change or incipient ones identified throughout the life cycle of the project. The stakeholder register for Dasu Hydropower Transmission Line Project/ Venture is shown below. [4]

Sr. No.	Person Name/ Organization & Position	Location	Role in Project/ Main Expectations	Stakeholder Classification		Potential Influence
				Internal/ External	Supporter/Neutral/ Resistor	Low/ Medium/ High
1	Project Manager	Lahore	Successfully complete the project within cost, time and required quality as mentioned in procurement documents.	Internal	Supporter	High
2	Risk Officer	Lahore	Identify the risk associated with the project.	Internal	Supporter	Medium – High
3	Project Coordinator	Lahore	Coordinate between different departments and ensure the safety of personnel's.	Internal	Supporter	Low – Medium
4	Design Experts	Lahore	Prepare the tender level engineering design reports/ studies.	Internal	Supporter	Medium – High
5	Survey Experts	Lahore	Preparation of survey reports and route alignment.	Internal	Supporter	Medium – High
6	System Study Experts	Lahore	To conduct the system studies for both voltage levels and prepare the report.	Internal	Supporter	Medium – High
7	Contract Experts	Lahore	To prepare the pre-qualification and bidding documents and evaluation of received bids.	Internal	Supporter	Medium – High
8	Local Support staff	Lahore	Assistance provide to the foreign and local experts.	Internal	Supporter	Low – Medium

Sr. No.	Person Name/ Organization & Position	Location	Role in Project/ Main Expectations	Stakeholder Classification		Potential Influence
				Internal/ External	Supporter/Neutral/ Resistor	Low/ Medium/ High
9	Project Office Staff	Lahore	Assistance provide to the project staff members.	Internal	Supporter	Low
10	World Bank	USA/ Islamabad	Successful completion of the project (scope of work) within the budget and schedule.	External	Supporter	High
11	Ministry of Water and Power (MoWP), Govt. of Pakistan	Islamabad	Timely completion.	External	Supporter	High
12	NTDC Board of Directors	Lahore/ Islamabad	Successful completion of the project (scope of work) within the contracted budget, schedule and desired quality.	Internal	Neutral	High
13	MD NTDC	Lahore	Successful completion of the project (scope of work) within the contracted budget, schedule and desired quality.	Internal	Supporter	High
14	Project Management Unit (PMU) Office	Lahore	Successfully complete the project (scope of work) within the contracted budget, schedule and desired quality.	Internal	Supporter	High
15	NTDC Design Department	Lahore	Tender level engineering design reports fulfil the international standards as mentioned in TOR.	Internal	Neutral	High

Sr. No.	Person Name/ Organization & Position	Location	Role in Project/ Main Expectations	Stakeholder Classification		Potential Influence
				Internal/ External	Supporter/Neutral/ Resistor	Low/ Medium/ High
16	NTDC Planning Power Department	Lahore	System study reports fulfil the TOR and it must give the comparison between different voltage levels.	Internal	Resistor	High
17	NTDC Environmental And Social Impact Cell (ESIC)	Lahore	Environmental and social studies reports must fulfil all the rules and regulations mentioned in the TOR.	Internal	Neutral	Low – Medium
18	NEPRA	Islamabad	Timely completion.	External	Supporter	High
19	PEPRA	Islamabad	Timely completion.	External	Supporter	High
20	Environmental Agencies	Lahore/ KPK/ Islamabad	Environmental and social studies reports must fulfil all the rules and regulations of Pakistan environmental agencies.	External	Resistor	Low – Medium
21	Prime Minister	Islamabad	Timely completion.	External	Supporter	High
22	GM Dasu Hydropower Project (Wapda)	Lahore	Timely completion.	External	Supporter	Low – Medium
23	Dasu Hydropower Consultant (DHC)	Lahore	Timely completion.	External	Supporter	Low

Sr. No.	Person Name/ Organization & Position	Location	Role in Project/ Main Expectations	Stakeholder Classification		Potential Influence
				Internal/ External	Supporter/Neutral/ Resistor	Low/ Medium/ High
24	Sub-Consultant Team	Lahore	Successfully complete the project within cost, time and required quality as mentioned in procurement documents.	Internal	Supporter	High
25	Local Communities/ Peoples in Project Area	KPK/ Punjab	Provision of electricity, jobs and handsome compensations.	External	Neutral	Low – Medium

Table 5: *Stakeholder Register of DHTLP*

4.0 PROJECT SCOPE STATEMENT

4.1 Project Scope Description

The project scope of work includes the following items and it will be progressively elaborated with the project progress:

4.1.1 Existing Information Usage and Review of Previous Feasibility Study

The Consultant will review/ evaluate/ assess all of the prevailing information, data, reports, maps, studies conducted so far including feasibility study for evacuation of power from 26 planned hydropower plants (HPPs) and make use of physical data of the site and available information, data, literature regarding transmission line projects carried out in similar terrain, altitude and weather conditions worldwide in preparation and performance of the Consulting Services. [2]

4.1.2 Transmission line Route Alignment and Survey

The Consultant would carry out route alignment, geotechnical assessment, estimation of BOQ including tender level foundation design and tower protection (including special foundation viz. pile foundation requirements). This includes but not limited to the following: [2]

- Review of the route alignments of transmission line from Dasu-Mansehra (already carried out under the feasibility study) and re-alignment of routes wherever required or developing alternate route alignments, if necessary.
- Route alignment for Mansehra – Islamabad section.
- Route alignment/ placement task inter-alia will comprises of but not limited to the succeeding:[2]

  (i) Identification of three alternative route alignments & selection of optimized route alignment. This shall be done through walk over survey, using low resolution satellite imageries and Survey of Pakistan maps. The output shall be in the form of final route alignment on digitized topographical map with latest details/features up to 8 km on both sides of selected route alignment.

  (ii) Digital terrain modeling of line route using high resolution satellite imageries.

  (iii) Associated field verifications.

- Preparation of survey reports including estimation of Bill of Quantities (BOQ), identification and explanation of route constraints, and infrastructure details available en-route and required to be created for construction/execution of the Project.

4.1.3 Preparation of Tender Level Engineering Design

The Consultant shall collect and analyze weather/climate data and estimate weather loading factors for design of transmission line. Based on meteorological data, altitude & terrain; the Consultant shall determine various loading zones/develop maps along the transmission line route which shall pass through terrain with varying elevation and climatic conditions, to optimize design of various transmission line elements/components. [2]

The Consultant shall perform necessary engineering & design to meet the objective/scope of the Project. The Consultant's design shall include but not limited to providing: [2]

- Design criteria, calculations, drawings, specifications for steel towers, conductor, Extra High Strength (EHS) shield wire, optical ground wire (OPGW), dampers, disc insulators, etc., including accessories and associated hardware/equipment and grounding materials;
- Foundation design;
- Construction and installation methods;
- Other documentation necessary to complete the Consulting Services.

The Consultant shall prepare a critical path schedule for the Project, starting with the tendering and contracting for International Competitive Bidding (ICB) and the construction period up to final completion, using appropriate project scheduling software. Based on the identified requirements of the various project components, the Consultant shall prepare a detailed BOQ for the project including plant, civil works, installation services, security services, vehicles, computers and software's to be provided to NTDC for its capacity building etc. [2]

4.1.4 Management Plan and Environmental Assessment

The Consultant will do the site particular Environmental Impact Assessments (EIAs) as required under the Pakistani Laws. The project is to be actualized/ implemented taking after Pakistani Environmental Regulations and the World Bank Guidelines and Operational Policies

(Operational Policies 4.01) and rules of other Global Monetary Institutions like World Bank (WB). Along these lines, the Consultant will be in charge of get ready and redesigning these records as expected to meet such prerequisites for ecological evaluation of the Project and also combined natural effects of the Project and advancement programs in the region. [2]

4.1.5 Resettlement Action Plan and Social Impact Assessment

The Consultant will do a social appraisal as required by the GOP (Government of Pakistan) and the World Bank Guidelines for different project exercises/works. In view of discoveries of the social evaluation, if land or property is to be obtained forever or incidentally as well as individuals are influenced essentially, the Consultant will decide, on their acclamations/ recommendations of the Social Assessment, the alleviation/ mitigation approach and arranging/ planning instruments vital before the World Bank's examination of the Project.These possible instruments include Social Impact Management Framework, Resettlement Policy Framework, and RAP. [2]

4.1.6 Tendering & Contracting

The Consultant will provide as and when required basic professional services to assist the Client in tendering for the project, the evaluation of offers and the award of contracts. [2]

4.1.7 Technical Training

The Consultant will likewise give specialized help and training to no less than six work force of the Client. The Consultant shall develop a comprehensive training program that enables the Client's engineers (trainees) to perform the Design & engineering services for similar projects of the Client in future. [2]

4.2 Deliverables

The list of all the deliverables required to complete the scope of work are mentioned below:

- Inception Report
- Monthly Progress Reports
- Quarterly Progress Reports
- Review of Previous System Study Report
- Techno-Economic Analysis Report
- System Impact Assessment Study Report

- Route Alignment and Survey Report
- Engineering Design Reports
- Conductor Optimization Report
- Loading Zone Report including Loading Wind Maps
- Engineer Estimates
- Environmental Impact Assessment Report
- Social Impact Assessment Report
- Resettlement Action Plan Report
- Pre-Qualification Documents
- Bidding Documents
- Evaluation Reports
- Award of Contract

4.3 Acceptance Criteria

The above mentioned deliverables will first scrutinized by the concerned departments of NTDC for the completeness of documents as per term of reference (TOR) and also checked the International Standards which were followed for the completion of these documents/ deliverables. Further these approved deliverables will be submitted to World Bank for Acceptance.

4.4 Project Assumptions and Constraints

- The Client will provide all of the subsisting information, data, reports, maps, and studies conducted so far including feasibility study for evacuation of power from 26 already planned hydropower plants (HPPs).
- Voltage level at the time of contract was not finalized and it will be finalized; predicated on the recommendations provided later in the Review on already existing or previous system study and Techno-Economic Analysis Report.
- The client will provide the route alignments of transmission line from Dasu-Mansehra (already carried out under the previous feasibility study) and re-alignment of routes wherever required.
- The Consultant will provide the technical assistance and training to the six personnel of the Client.

- Consultant will carry out SIA (Social Impact Assessment) as needed/ required by the GOP and the World Bank Guidelines for sundry project activities/ works.
- Consultant will carry out the EIA (Environmental Impact Assessments) study by following the World Bank (WB) Guidelines, Pakistani Environmental Regulations and WB Operational Policies (Operational Policies 4.01).
- The Consultant will prepare the Transmission Line Design Criteria Report according to the international standards mentioned in subsequent clause in the contract documents.

4.5 Project Exclusions

Anything which is not written in the Project Scope Description are considered to be out of Project Scope and will be treated as Project Exclusions.

5.0 RISK MANAGEMENT PLAN

5.1 Methodology

The processes discussed in Clause 11 (Project Risk Management) of "A guide to the Project Management Body of Knowledge" (PMBoK) Fifth Edition and Practice Standard for Project Risk Management of Project Management Institute (PMI) will be used for preparing the Risk Management Plan and Risk Register including Responses against each identified risks. The Tools and Techniques mentioned in each process will be used to prepare above mentioned documents.

5.2 Roles and Responsibilities

The Roles and Responsibilities table defines the project manager, risk officer, executive sponsor and project sponsor who are responsible for risk management activities throughout the project life cycle.

Role	Responsibility
Project Manager	The part of the Project Manager is to compose and affirm the Risk Management Plan, characterize the risk administration approach/ philosophy/ methodology, partake in the risk administration process, and take responsibility of negative and positive risk strategies.
Risk Officer	The Risk Officer is in charge of driving the risk management exertion, risk distinguishing proof exercises, and guaranteeing the Risk Register is kept up. The Risk Officer is in charge of giving the Project Manager suggestions with respect to risk activities.
Executive Sponsor	The Executive who gives the budgetary assets and business expert for the venture/ project. The Executive Sponsor is educated of significant risks and gives contribution to risk alleviation/ mitigation techniques/ strategies.
Project Sponsor	The Project Sponsors is the business administration group including NTDC Board of Directors, MD NTDC and other NTDC offices who is in charge of guaranteeing/ responsible that the requirements and

Role	Responsibility
	achievements inside the business territory are generally known and comprehended and guarantees that the outline of the framework meets both the useful and non-practical business objectives. The Project Sponsor is educated of real risks and gives contribution to risk moderation/ mitigation procedures/ strategies.
Project Management Unit (PMU) Office	The project should be inside overseen by the Project Manager with direct oversight from the Project Management Unit (PMU) Office, NTDCL. The PMU Office is led by the Chief Engineer/Project Director, on the benefit of NTDCL (client). The project manager present the month to month/quarterly advance reports, extend deliverables and invoices to PMU office for endorsement. The Project Manager will likewise report the venture/ project status to the Project Management Unit (PMU) Office, NTDCL and introduce issues, alternatives, and suggestions to the Project Management Unit (PMU) Office, NTDCL for approval.

Table 6: *Role and Responsibilities of Key Stakeholders of DHTLP*

5.3 Budgeting

The contingency reserve will be assigned to those identified risks or "known-unknown" (known = identified, unknown = risks) which cannot managed proactively. It will be included in the cost baseline and estimated based on various risk management techniques like Decision Tree Method and etc. Whereas, 10% of total project cost/ cost baseline will be kept as management reserve to manage the unidentified risks or "unknown-unknown" (unknown = unidentified, unknown = risks). Based on the assigned resources for risk identification and documentation i.e. risk officer and its support staff, their remuneration charges will be charged accordingly and it will be included in cost baseline.

5.4 Timing

The schedule contingencies reserves will be assigned to those activities on project which are associated with risks. These kind of activities are identified during the risk identification process or risk response planning or monitoring and controlling process. The given below table

shows the timing and frequency of the risk management processes throughout the life cycle of project.

Risk Management Processes	Timings
Risk Management Plan	Once during planning phase.
Risk Identification	Ongoing throughout all the phases of the project and also as a result of implementation of risk responses or monitor and controlling of project risks.
Qualitative Risk Analysis	Performed on all identified risks or when new risks are identified as result of implementation of risk responses or monitor and controlling of project risks. However, it is also performed on those risks whose responses are re-planned.
Quantitative Risk Analysis	Performed on all identified risks or when new risks are identified as result of implementation of risk responses or monitor and controlling of project risks. However, it is also performed on those risks whose responses are re-planned.
Risk Response Planning	Performed on all identified risks or when new risks are identified as result of implementation of risk responses or monitor and controlling of project risks.
Risk Monitoring and Control	1. Monitor response plans at project status meetings. Identify new risks and reevaluate throughout all project phases. 2. Once during the closing phase by conducting review and audit.

Table 7: *Risk Management Processes and their Timings*

5.5 Risk Categories

Risk management is a fundamental action of project management. It is vital to group risks into fitting classes keeping in mind the end goal to minimize extend disappointment rate. For this project, the main risk categories are Technical Risks, Environmental and Social Risks, Management Risks and External Risks etc. The table and figure shows the major and sub-categories for risk classification for this project and may be useful in categorizing project risks.

Category	Sub-category
Technical Risks	Term of Reference/ Scope of Work, Project Objectives, Standards, Technical Studies and Analysis, Technical Software's, Technical Reports, Drawings, Digital Elevation Model (DEM), Specifications, Technical Data, Training and etc.
Environmental and Social Risks	Culture, Environment Protection Agencies, World Bank Guidelines, Local Communities, Security and etc.
Management Risks	Project Management, Resources, Communication, Internal Procurement, Contractual Terms and Conditions, Financial and etc.
External Risks	Legislative/ Regulatory Authorities, Political, Pressure Groups, Weather, Force Majeure and etc.

Table 8: *Risk Categories in term of Major and Sub-Category for DHTLP*

Risk identification is the basis of risk management. For this Project Risk Breakdown Structure (RBS) is utilized with the end goal of risk identification. The RBS is characterized in comparable terms to the WBS, as a source-oriented gathering of venture/ project risks that sorts out and characterizes the aggregate risk introduction of the venture. Each plummeting level speaks to an undeniably nitty gritty meaning of sources of risk to the venture/ project. The RBS is along these lines a various leveled structure of potential risk sources, which can be a significant guide to comprehension the risks confronted by the venture/ project, going about as a system to structure and guide the risk administration prepare, similarly that the WBS has been the project manager most noteworthy device/ tool in arranging/ planning activities, since it scopes and characterizes the work. [5]

5.5.1 Linking of WBS and RBS

The interconnection/ interface between the Risk Breakdown Structure (RBS) of a project and its Work Breakdown Structure (WBS) is a helpful system to partner risks to the exercises of a project. The WBS utilizes a progressive structure to characterize the real errands, minor assignments and work packages (WPs) important to achieve the last/ final destinations of a project/ venture, while the Risk Breakdown Structure (RBS) arranges project risks utilizing a various leveled arrangement of wellsprings of risk. [5]

The joined utilization of WBS and RBS can be utilized to create a grid structure, which permits the project team to deal with the risk at a level of detail proper to the particular business setting. To deliver such a joined framework, risk examination is initially performed recognizing and characterizing risks utilizing the RBS, either straightforwardly or to bolster different techniques for identification, for example, conceptualizing or meets and so forth. The least levels of the RBS are then connected to the WPs in the WBS, creating a two-dimensional grid. A connection is made just if a specific risk can influence a particular Work Package. [5]

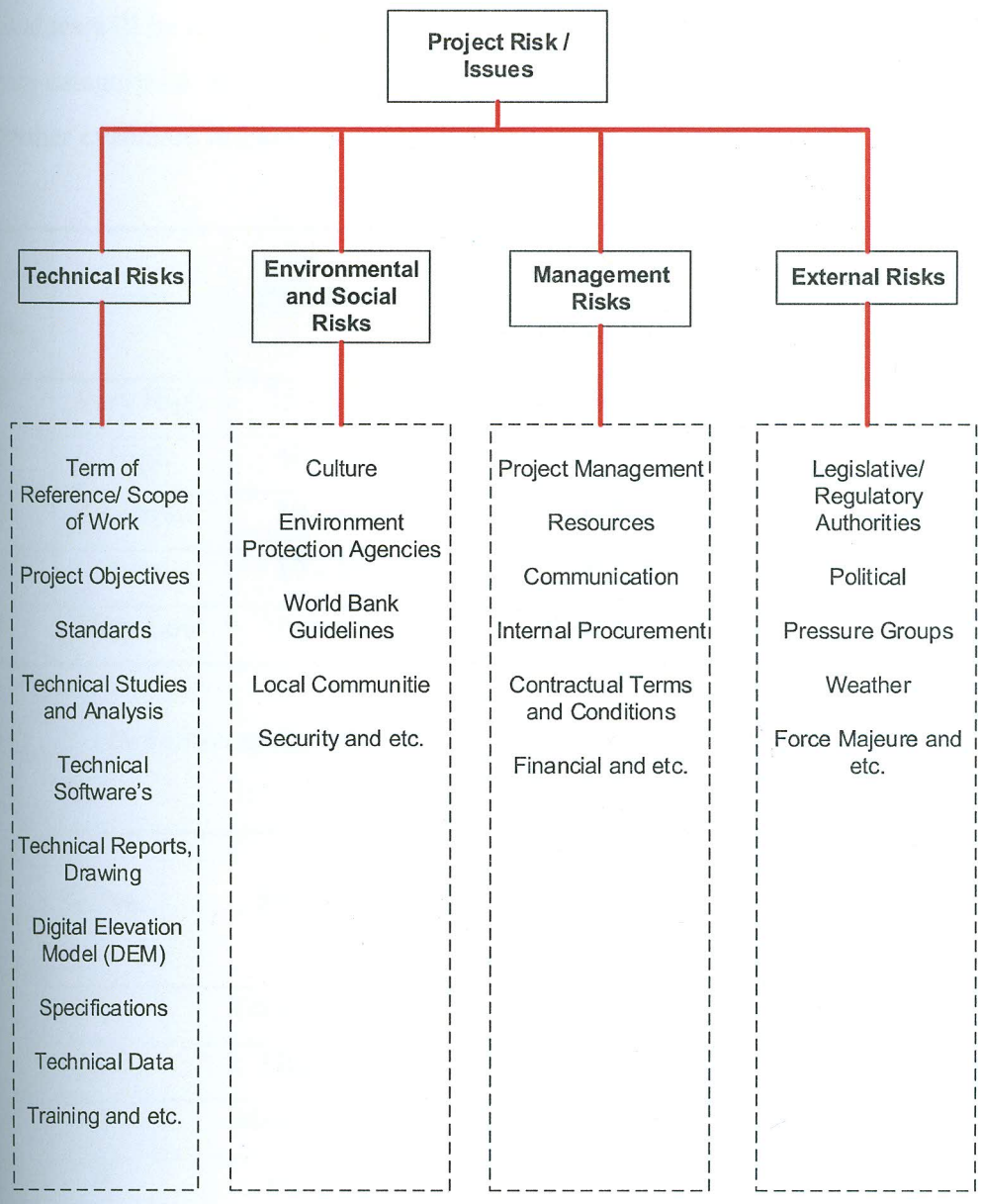


Figure 4: *Risk Breakdown Structure (RBS) of DHTLP*

5.6 Definitions of Risk Probability and Impact

For this project, the definition of Risk Probability (is the likelihood that a risk will occur) and Impact (is the effect on project objectives if the risk occurs, which may be a negative or a positive effect) is defined below in table. The probability and impact (of cost and time on project objectives) against scale is defined in percentage. As the Impact on project objectives (cost and time) are expressed in percentage so, it can be positive or negative based on the risk classification that it will opportunity or threat. However, second table mentioned below give the numeric values of probability and impact against defined scale. The combinations of these numeric values will be used to determine the risk values and it will be used to rank the risk in appropriate category i.e. High, Moderate and Low. After ranking, the risks in High category will be further evaluated in Perform Quantitative Risk Analysis process.

Sr. No.	Scale	Probability	Impact on Project Objectives	
			Cost Variation	Time Variation
1	Very High	75 - 100%	Greater Than 20%	Greater Than 15.7%
2	High	40 - 75%	12 - 20%	10.50 - 15.7%
3	Moderate	20 - 40%	6 - 12%	5.30 - 10.50 %
4	Low	10 - 20%	2 - 6%	2.50 - 5.30 %
5	Very Low	Up to 10%	0 - 2%	0 - 2.50 %

Table 9: Definition of Risk Probability & Impact on Project Objectives Cost & Time

Sr. No.	Scale	Probability Numeric Value	Impact Numeric Value
1	Very High	1.00	100.00
2	High	0.75	75.00
3	Moderate	0.40	40.00
4	Low	0.20	20.00
5	Very Low	0.10	10.00

Table 10: Definition of Risk Probability and Impact in term of Numeric Values

5.7 Probability and Impact Matrix

A probability and impact matrix is a grid for mapping the probability of each risk occurrence and its impact on project objectives if that risk occurs. The combinations of probability and impact result in a risk's being classified as high risk (red color), moderate risk (yellow color), and low risk (green color). The P-I Matrix used in this project is shown below. The risk score helps put the risk into a category that will guide risk response actions.

For this project, if the risk score is equal or greater than 30; it will be categorized into High Risk. If risk score is equal and greater than 10 but less than 30; it will be categorized into Moderate Risk and of the risk score is up to 10 then it will be categorized into Low Risk.

Probability and Impact Risk Ranking

Probability		Thearts					Opportunities					Probability	
Very High	1.00	10.00	20.00	40.00	75.00	100.00	100.00	75.00	40.00	20.00	10.00	1.00	Very High
High	0.75	7.50	15.00	30.00	56.25	75.00	75.00	56.25	30.00	15.00	7.50	0.75	High
Moderate	0.40	4.00	8.00	16.00	30.00	40.00	40.00	30.00	16.00	8.00	4.00	0.40	Moderate
Low	0.20	2.00	4.00	8.00	15.00	20.00	20.00	15.00	8.00	4.00	2.00	0.20	Low
Very Low	0.10	1.00	2.00	4.00	7.50	10.00	10.00	7.50	4.00	2.00	1.00	0.10	Very Low
		10.00	20.00	40.00	75.00	100.00	100.00	75.00	40.00	20.00	10.00		
		Very Low	Low	Moderate	High	Very High	Very High	High	Moderate	Low	Very Low		
		Impact (Thearts)					Impact (Opportunities)						

Figure 5: Probability and Impact Matrix for Risk Ranking of Dasu Project

5.8 Reporting Format

This table describes the frequency and format of the outcomes of the risk management process will be documented, analyzed, and communicated.

Reporting Method	Description	Frequency
Risk Register	A document used to report results of risk identification, analysis & response planning.	It will be updated after every planning process.

Reporting Method	Description	Frequency
Status Reports	Status reports are generated in monitoring and controlling process.	Status reports are communicated to the project stakeholders after submitting/ achieving of every deliverables/ milestones as mentioned in deliverable/ milestone list.

Table 11: *Reporting Method and Its Frequency for DHTLP*

6.0 PRIMAVERA IMPLEMENTATION ON DHTLP

6.1 Primavera Introduction

Primavera P6 Professional Software is Project Management software which is used to assist a Projectile organization to organize multiple projects at a time. It helps us to understand that how a resource can be allocated to different projects to overcome the shortage of resources. Primavera P6 helps us to better attain our targets keeping in view the triple constraints and to manage and control the process of a project successfully and effectively. This Software is linked with other software's like Oracle and SAP's ERP systems. [6]

Primavera P6 and MS Project, both are scheduling tools but the flexibility and the control we get by using Primavera P6 cannot be achieved by MS Project. MS Project does not offer such relaxation of controlling multiple projects simultaneously. [6]

Different team members are working on a project and as a Project Manager, you can give access to each member as much as you like i.e. permitting access to a particular area. MS Project offers us to create limited number of baselines for a Project while unlimited baselines can be created using "Maintain baseline" option. [6]

Every Project carries some issues and risks which need to be identified and addressed accordingly by making specific plans. Primavera software has the ability to record the risks in a project. [6]

In a Project, every activity has some successor and predecessor except for the initial and the final activity. MS Project give only one relationship between activities but Using Primavera, we can assign multiple relationships among activities. To check the expense on a particular activity, Primavera gives the option to track it while MS Project misses this feature. [6]

6.2 Primavera Advantages over MS Project

The advantages of Primavera in comparison to MS Project are as given below:

6.2.1 Greater Visibility

Anything going on in the project can be observed and tracked at any time interval. We can report how much progress of the project has been done. [7]

6.2.2 Forecasting

In every Project, time comes when you need to overlook your available resources and remaining time for completion of Project and scope; hence accordingly you have to adjust for resources. [7]

6.2.3 Better and Fast Access

This Software helps us to track multiple projects through a laptop rather than using different tools for each project. [7]

6.2.4 Organized Network

Primavera helps us to sort out the resources, constraints and other needs in a better way. It gives us the edge to enhance the communication among different users in order to complete the project as a Success. [7]

6.2.5 Ease in schedule creation

Primavera provides every member to set the schedule for the activities of their part himself by sitting anywhere. This Schedule is available to all other users of the team and similarly other schedule is also visible to each other so a better collaborative environment is established. [7]

6.2.6 Risks identification

Expenses and risks are closely associated to each other. More number of risks gives rise to more reserves for that particular risk, as a result increasing overall budget of the project. Being aware of the risks in Primavera, you can plan better how a risk is to be tackled in the most effective way by keeping in mind the Constraints. [7]

6.2.7 Help Option

If you are facing a problem somewhere and are not aware of the solution, you can use the help icon to reach to the optimal solution. [7]

6.2.8 Different Currencies

This Software gives us the option to use the different currencies as required and eliminating the risk of limiting to only local currency. [7]

6.2.9 Cost Control

Tracking a project along with its activities reduces the chances of cost overrun in any project. This is fully facilitated in Primavera software. [7]

6.2.10 Global benefits

This is a global software used worldwide used in planning, monitoring and controlling of projects, activities and resources as per Project Management instructions. [7]

6.3 EPS (Enterprise Project Structure)

A company may be working on different projects at a time. EPS provides the platform to exhibit all ongoing projects in a hierarchy. EPS can be further divided into different levels depending upon the needs of the respective company and departments. These are the EPS levels which includes Projects in themselves. Project selected for a particular EPS level will be as per expertise of the department and its relevance.

6.3.1 How to create EPS

To create an EPS, following order to be observed.

- Click on Enterprise in the window and then select Enterprise Project Structure.
- Click the Add icon.
- New EPS can be located by using upward and downward arrows.
- Respective Responsible Manager can be assigned to EPS from OBS.

6.3.2 Company EPS

The EPS of EnMasse Private Limited is shown below:

6.4.2 Company OBS

The OBS of EnMasse Private Limited is shown below:

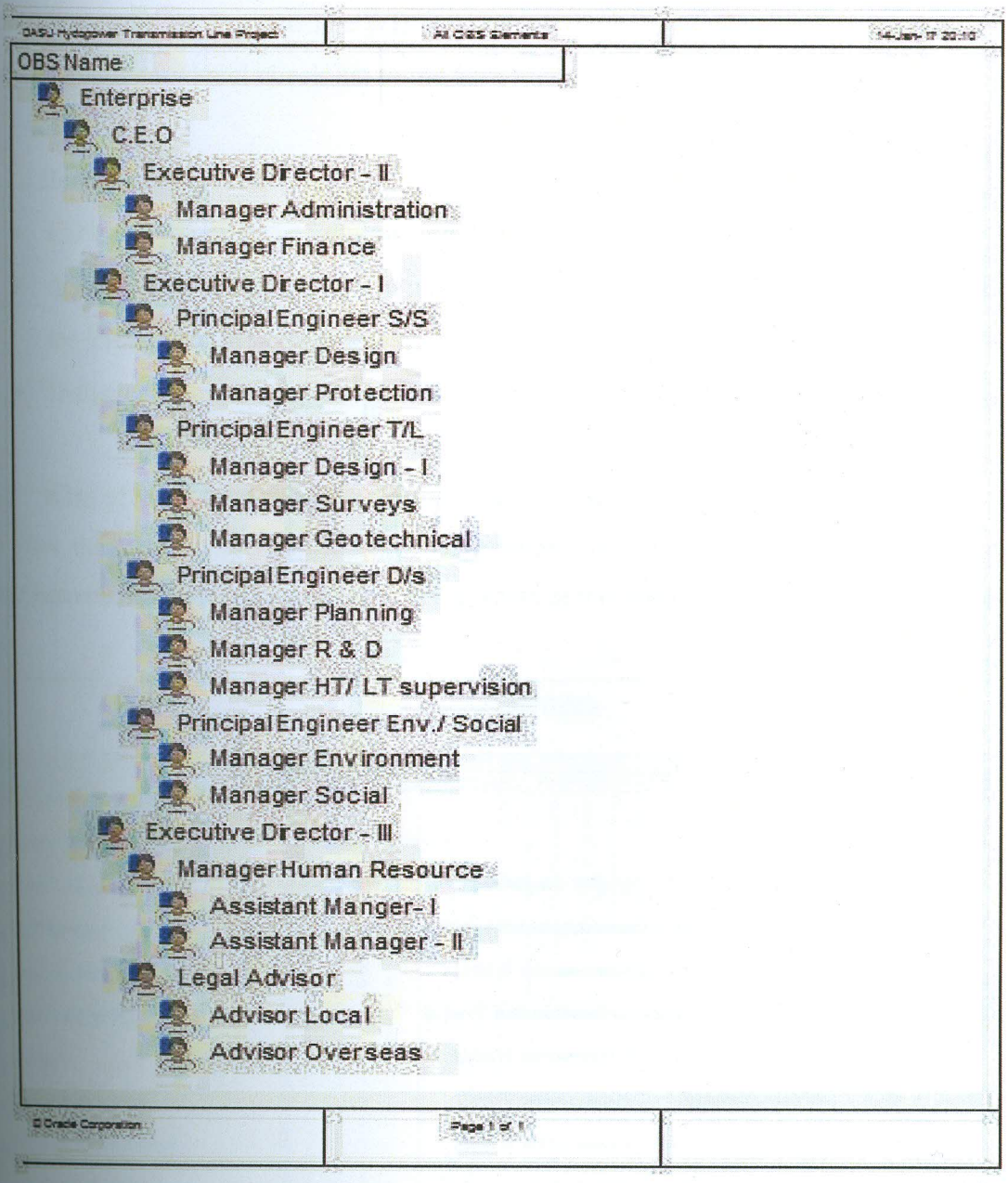


Figure 7: OBS of EnMasse Private Limited in Primavera P6

6.5 WBS (Work Breakdown Structure)

WBS is the lowest level of a Project. This is again a hierarchal structure representing different relative and relevant activities and their relationships. This reflects an organized order that activities related to each other are all under the same level. Activities can be added to a specific WBS through "+" sign on the left top of the window hence activities can be added to respective

WBS levels. This structured network gives us a framework for budgeting, scheduling, measuring and reporting a project status and its performance. It is important in a way that Project Manager is aware of all high and low levels of WBS and aware which area needs more attention to control the Project. The WBS provides a roadmap to plan the Project. A WBS also guides us a summary level check list to the activities that must be completed. [8]

6.5.1 How to create WBS

- Click on Project in the window and then select WBS.
- A new window will open, where you can add different WBS by using Add option in the left up side of the window.
- Different Layouts can be obtained by using display options.

6.5.2 WBS of Dasu Hydropower Transmission Line Project

The Work Breakdown Structure (WBS) of Dasu Hydropower Transmission Line Project is shown below; however, detailed WBS is attached in Appendix of this report.

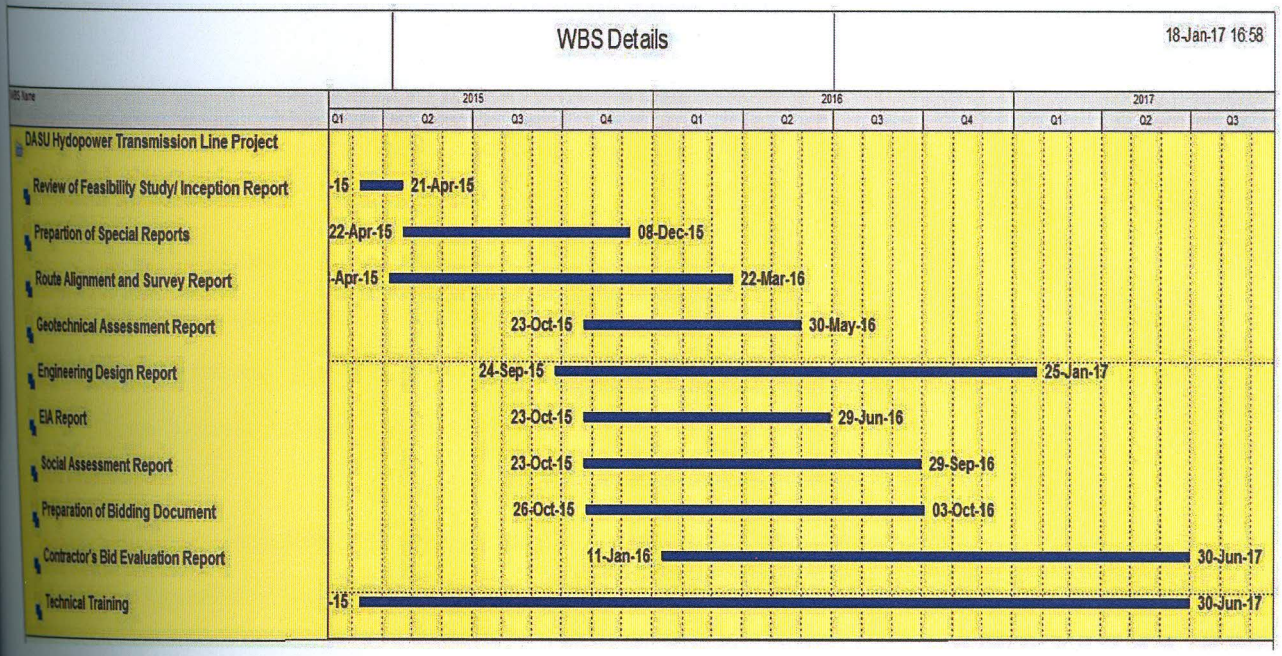


Figure 8: WBS of Dasu Hydropower Transmission Line Project

6.6 Activity Types

In Primavera, there are 6 types of Activities. When you have created the WBS, it's the time to assign the Activity types. It has impact on an activity duration i.e its start date and its finish date so it demands special attention while selecting an activity type. [9] [10]

6.6.1 Start Milestone & Finish Milestone

Milestone is defined as a point where a notable task has started or achieved. It may be the starting point or finish point. For a Start Milestone activity, there will be only a starting date and similarly a Finish milestone will be having only a finish date. In other words, you can say that a milestone is just a point which actually doesn't have any duration nor consume any resources. [9] [10]

6.6.2 Resource Dependent

This type of Activity is chosen when activity duration is dependent on the availability of resources. This happens when there are limited resources and more than one activity needs a particular resource. An example of this Activity type is any resource which can complete a task in 5 days, but if you are having two such resources, this task can be done in 2.5 days and vice versa. [9] [10]

Duration = Budgeted Units / Budgeted Units / Time

Where, Budgeted Units are numerical value of resource allocation.

So we can say that, in such Activity type, a resource calendar is followed rather than Activity Calendar. Duration of such activities depend upon the calendar type chosen. [9] [10]

6.6.3 Task Dependent

This Activity type is used where you have a specific time period and you can neither lack to that schedule nor surpass that irrespective of the number of resources available or assigned. In such Activities, activity calendar is used rather than resource calendar. [9] [10]

A person installing a window will take around 45 mints and a professional installing the same window will also take 45 mints. You have a better resource now, but the time taken remains same.

6.6.4 Level of Effort

This Activity type is chosen where the duration of a particular activity is depending on some Predecessor or Successor activity. If an Activity is 22 days long and its successor activity is in FS relationship with this activity, then the Successor activity is depending on the finish date of

Predecessor activity as when the Predecessor activity will finish, after 22 days of that the Successor will start. This is how duration is calculated in this type. [9] [10]

6.6.5 WBS Summary

This Activity duration is assigned to the overall length of the WBS which is actually depending on the Starting date of the first activity of the WBS and the Finish date of the last activity of the same WBS. Hence its duration is overall time, the activities take in a WBS. [9] [10]

6.6.6 How to Add an Activity

- Click on the Project in the window and then select Activities.
- Click the "+" on the top right side of the window.
- Select an appropriate WBS before putting an Activity in it.

6.7 Duration Types

Duration type is used to find out the exact duration of an Activity by keeping in view the triple constraints. Duration type is selected once you have assigned the resources to the respective activities. Duration types are as: [11]

6.7.1 Fixed Duration & Units

This activity duration type addresses the fact that Time and total units to be produced are fixed regardless of the number of resources assigned. The Units/ Time i.e. Productivity can be varied but ultimate units are fixed in amount. So, we can say that this type of activities is usually task dependent activities as they are bound to follow a calendar. [11]

6.7.2 Fixed Duration & Units/ Time

This activity duration type is selected when duration for achieving a target is fixed and units/ time is also fixed. The thing we are unaware of in this type is Units to be produced which is calculated by looking into the total units produced per day. This activity duration type is again Task dependent due to following a time schedule. [11]

6.7.3 Fixed Units

This activity duration type is an indication of fixed total number of units to be produced. This type follows a resource calendar as more resources available can help to get the target that is fixed amount, in less duration or may be by increasing the daily productivity. [11]

6.7.4 Fixed Units/ Time

In this activity duration type, the daily produced units are fixed regardless of the total duration of the task. This is resource dependent activity and it searches for the availability of resources through resource calendar. [11]

6.8 Percentage Complete Types

It simply gives a way to calculate the total completed work of an activity. It varies from company to company that how to report the progress of the activities. Different types of Percentage Complete are as: [11]

6.8.1 Duration Percent Complete

This type is utilized when we know the original duration of an activity that it may take for completion and the remaining duration at any stage. [11]

Percent Complete = Original duration – Duration remaining

An Activity having original duration of 10 days will be 50 % complete after 5 days of start. This is useful for level of effort type of activities where you are not looking for deliverables but for percentage complete based on duration of activity. Once you will select the start column, Primavera will automatically calculate the Duration percent complete. [11]

6.8.2 Physical Percent Complete

This percent complete type is used where you are setting the % complete manually. In this case, remaining duration is not calculated automatically by Primavera, but we have to either enter a guessed finish date or the exact finish date manually. This will help Primavera to understand that this is the finish date; hence actual duration will not be added to the remaining duration which may give rise to a problem and increasing the total duration of an activity. [11]

This type is preferred where personal judgment and performance monitoring is required. When there is a deliverable after a particular process, this type is used. This type is neither linked to resources nor duration within Primavera. [11]

6.8.3 Units Percent Complete

Units' percent complete type is a kind of a tool to calculate the performance of the activity. It gives an idea that how much units have been achieved and how much still to come so you clearly get an idea which resource to be placed where to mobilize the process, if required. In other words, it can be sued to track the units achieved. It can be calculated as: [11]

Unit Percent Complete = Actual Units/ Planned Units * 100

6.9 Baseline

A baseline acts as a bench marking tool to track the performance of the Project against Project plan and taking actions to get it back on track if deviated. Primavera gives us the flexibility to use multiple baselines at different time intervals. If you have not created any baseline for a project, the current data may serve as baseline. First a baseline is created and then it is assigned to the project to track the progress. [12]

6.9.1 To Add a Baseline

- Click to project and select Maintain Baselines.
- A new window opens where you can click on "Add" option to add a baseline.
- Click on "save a copy of the current project as a new baseline" and then select "OK".
- Baseline has been created.

6.9.2 Assigning a Baseline

- Click on Project and then select the Assign baseline option.
- A new window opens with Project baseline and User baselines.

Every project has a baseline, which is known as Project baseline. This is the baseline against which project is tracked. This creates a collaborative environment for all the users to check the performance and progress of the project at any given time. [12]

There are multiple baselines for a project. As a part of the project team, an individual selects a baseline which he will be using as a bench mark for his part of work. The baseline hence selected is called Primary baseline. Similarly Secondary and Tertiary baselines can also be selected depending upon the needs, if you want to refer to multiple baselines. [12]

6.10 Activity Calendar Settings

Setting for calendar is important to set the working and non-working days in a week, month or year. Similarly they are helpful in describing man hours per day hence making easy to make a schedule accordingly.

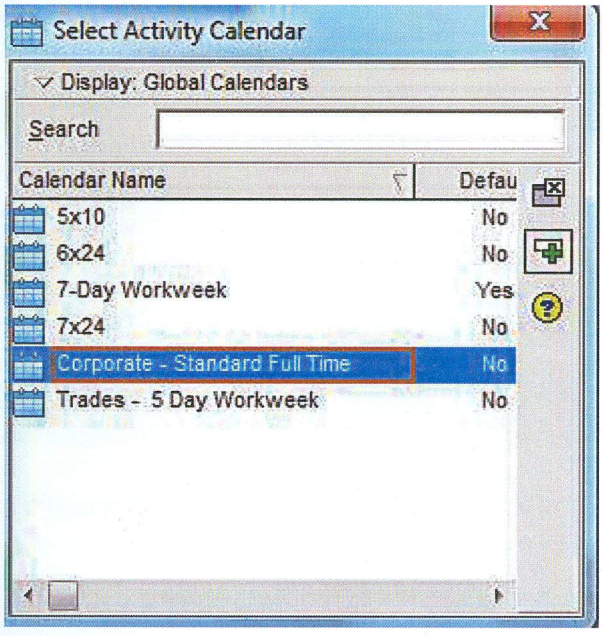


Figure 9: *Calendar Selection for Project/ Activities*

Different types of calendars are available and you can select as per your organization and working environment. For detailed setting of calendars:

- Click on Enterprise and then select Calendars.
- A new window with different options like Global, Resource and Project appears.
- Select your calendar and then select "Modify".
- Here you can select Total working hours/ day.
- Similarly calendar weekly hours option can also be set using "work weeks" option.

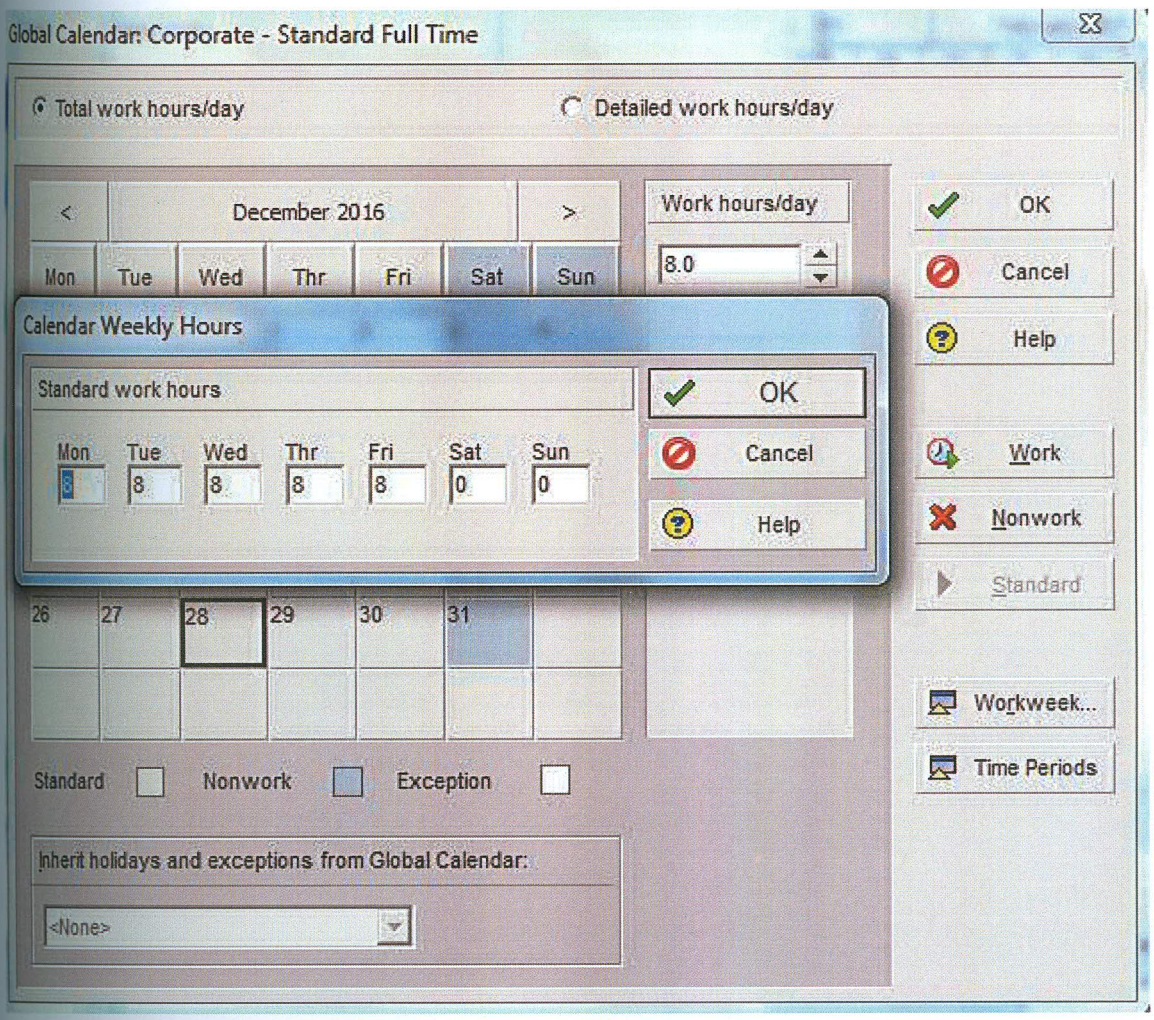


Figure 10: *Selection of Working Hours*

Similarly hours/ day or hours/ week can also be set by:

- Clicking on "Admin" and then selecting "Admin preferences".
- A new window opens where "Time period" option may be selected for desired setting.

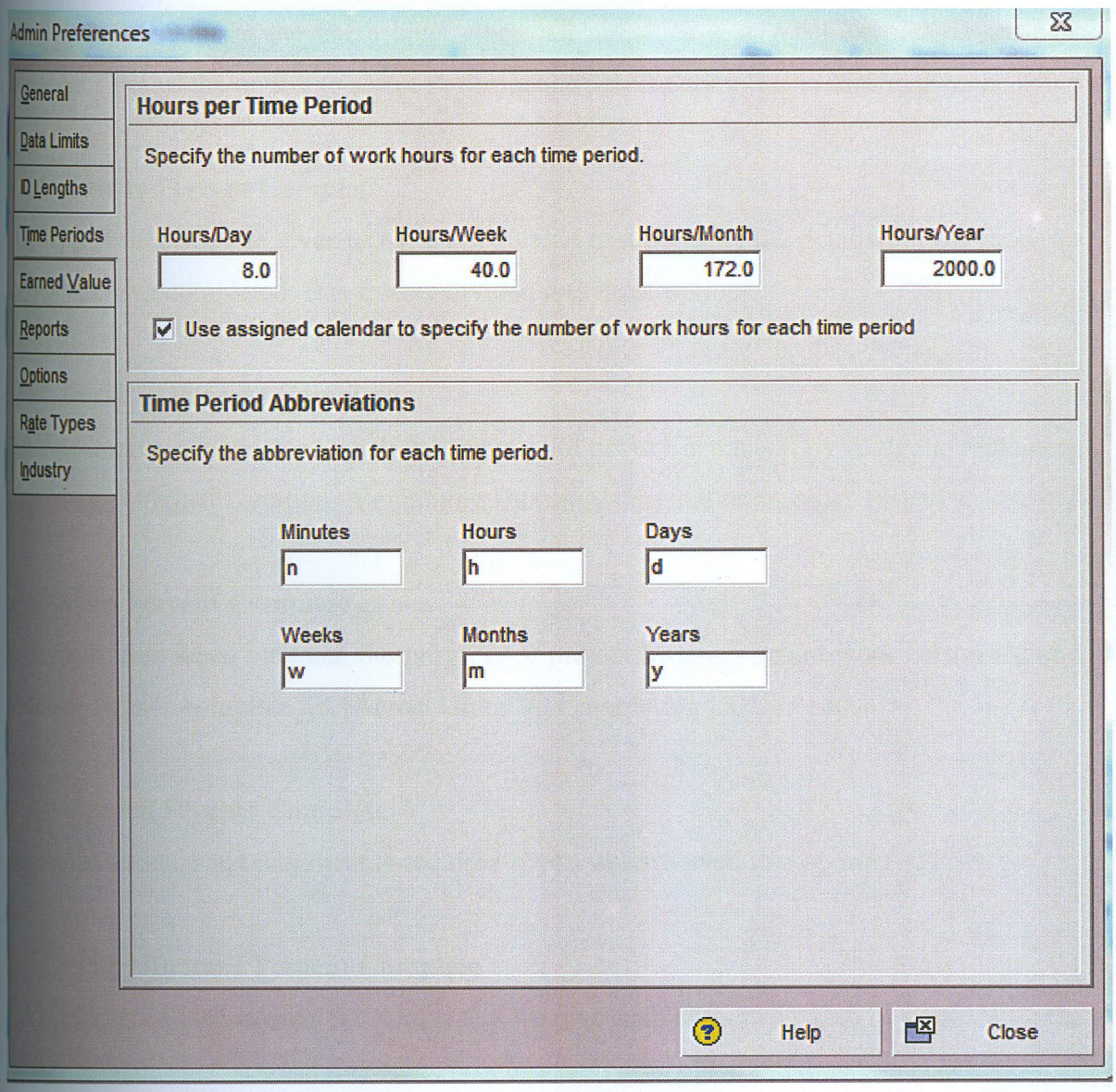


Figure 11: *Selection of Working Hours/Day, Hours/Week, Hours/Month, Hours/Year*

6.11 Earned Value Management (EVM)

In order to get success for your project, first step you need is to measure the performance both with respect to Time and Cost. In other words, you need to compare your actual cost with planned cost of task. Earn value management is the best technique used for this purpose. You become aware of the progress and plan accordingly that how to bring things back on track. We can also find cost and schedule variance through earn value concept. Earned value cost is the value of the work performed as of the data date and it can be calculated as: [13]

Earned value Cost = Budget at Completion * Performance % Complete

Earned value is made at the WBS level where all activities in a WBS have same settings. Primavera gives us the option to select Performance percent complete in different ways: [13]

6.11.1 Activity Percent Complete

Activity percent complete gives us the earned value cost by using the details of how much an activity has been completed. It is further divided into three options.

6.11.2 Duration Percent Complete

This type in earn value is used when the progress of project is tracked by using the remaining duration i.e. (Original Duration –Remaining Duration/ Original duration) * 100

6.11.3 Units Percent Complete

This type is used when we track the progress of project by using actual work performed and remaining units to complete i.e. (Actual Units/ At Completion Units) *100

6.11.4 Physical Percent Complete

Personal experience and judgment is required if you want to avail this option.

6.11.5 WBS Milestone Percent Complete

Milestones are defined at each WBS level and we give each of them a worth or value. With the passage of time, when you see that some progress has taken place and then you check those as complete and hence the performance at WBS milestone on all WBS is calculated. [13]

6.11.6 0/100 Percent Complete

Earned value is only calculated 100 % once the whole activity has been completed. You have to wait for completion of an activity to track performance. [13]

6.11.7 50/50 Percent Complete

When you choose the earned value type as 50/50 percent complete, as soon as the activity starts, it is marked as 50 % complete. When the activity finishes, only then earned value changes to 100 %. [13]

6.11.8 Custom Percent Complete

This earned value type is used when a user himself defines some percentage as soon as the activity starts. Its earned value is also taken as 100 % when activity finishes. [13]

6.11.9 Schedule Variance

It is an important parameter to analyze the Project progress. The main objective of every Project is to keep it on track by following the baseline schedule. Meanwhile, it also avoids the schedule to not get slipped from baseline and hence avoiding from cost overrun too. This tool gives us the idea that whether you are ahead of Schedule of behind the Schedule. [13]

$$SV = EV - PV$$

- If SV is positive, it means that you are ahead of Schedule.
- If SV is negative, it means that you are behind Schedule.
- If SV is zero, it means you are on Schedule.

6.11.10 Cost Variance

In order to make a project Successful, you need to complete it within approved budget. If you are exceeding the approved budget, it might be taken as a failure. Any deviation from cost baseline, may affect the profit that might come by completing it on time and within cost. It is informative in the sense, that whether we are going within cost limits or exceeding it. [13]

$$CV = EV - AC$$

- Positive Cost variance, gives you the indication that you are under budget,
- Negative Cost variance, indicates that you are over budget.
- Similarly if Cost variance is Zero, it gives the idea that you are following the cost baseline.

6.11.11 Schedule Performance Index

This is an effective tool which gives the indication that how efficiently you are going with respect to project progress in comparison to Project baseline Schedule. [13]

$$SPI = EV/PV$$

- If SPI > 1, It tells us that more than planned work has been completed.
- If SPI < 1, you are behind the planned Schedule.
- If SPI = 1, it means you are going exactly as per planned Schedule.

6.11.12 Cost Performance Index

It gives us the measurement about the ratio of the Earned value to Actual cost. You also get to know about how much you are progressing and meanwhile remaining on budget. [13]

$$CPI = EV/AC$$

- If CPI < 1, Earning is less than the amount spent.
- If CPI > 1, Earned amount is more than the spent amount.
- If CPI = 1, It gives you the indication that your spending on project and earning from project is exactly the same.

6.12 Scheduling

Scheduling option in Primavera P6 is used to organize the schedule of the Project. Scheduling option can be assessed by going into "Tools" and selecting Scheduling. Hence all activities of a project are applied the same settings. You can calculate multiple critical floats path which helps to get to know to the critical paths and hence taking certain measures for them. Actually it also depends upon the logic you select for particular activities in order to schedule them. These can be: [14]

6.12.1 Retained Logic

This logic is implemented when you will not have to make progress on an activity until all of its predecessor activities get completed. [14]

6.12.2 Progress Override

Progress override allows the activity to proceed until activity finishes. It is independent of the network logic what you are carrying so far. It focuses on completion of activity. [14]

6.12.3 Actual Dates

This logic emphasizes on the actual dates which are later on used to calculate forward and backward paths which are critical for scheduling. Both are used to find out the total duration.[14]

6.13 S-Curve in Primavera

S- Curve is a way to show cost, man hour, units against time in the form of a plot. Its shape is like alphabetic "S" as in the start of the project, let's say cost is very high and then in the middle stage, with the passage of time, you start controlling constraints in favor. At completion time of a project, again it starts increasing due to some unavoidable circumstances. [15]

Its significance can be realized with the fact that being the Project manager of a team you need quick review of the activities going around and whether some remedial action is required or not. S-Curve can be created in activities window, by going to resource usage profile options.

Types of S-Curve in Primavera is as follow:

- Man Hours versus Time S-Curve
- Costs versus Time S-Curve
- Baseline S-Curve
- Actual S-Curve
- Target S-Curve
- Value and Percentage S-Curves

6.13.1 Man Hours versus Time S-Curve

This S-curve is suitable for the projects where high labor rate is involved. Here it gives us the idea that how much man hours are working for project. In other words, it gives us the idea that how much man hours are resulting what accomplishments. They are helpful to keep the project on track by allocating more man hours in urgency. [15]

6.13.2 Costs versus Time S-Curve

Cost versus Time S-curve is used when there is a distinction between labor and non-labor activities. Some might be allocated resources while others might need to outsource for on time completion of project. Hence you can calculate the cost incurred over a period of time. [15]

6.13.3 Baseline S-Curve

Before start of any project, a prototype is made. A plan is originated and then this plan is taken into different phases of the project. This may be called as Baseline of the project. Similarly, baseline S-curve is made against project baseline and hence it assists us to monitor the progress of the project so far. Baseline may need to revise if you are making changes in proposed plan and resources. [15]

6.13.4 Actual S-Curve

When you revise a schedule with time, you get the % completion of each task. This information helps to generate an Actual S-curve. Its use is preferred with baseline S-curve and target S-curve, which make it easier for you to get the exact information and then take action accordingly as per requirement. This actual S-curve, at the completion of the project, meets target S-curve to indicate that you have achieved the target set by you. [15]

6.13.5 Target S-Curve

This S-curve is used where you want to compare your actual progress of the project with that of what you have revised over time, different from baseline schedule. It gives a real picture how to achieve your target by keeping in mind the constraints. [15]

6.13.6 Value and Percentage S-Curve

This S-curve is helpful when you want to know how much man hours have been used so far and how much cost has been incurred, and how much still need to be invested. This is done by Value S-curve. [15]

Percentage S-curve indicated the percentage of actual work been done against baseline S-curve and target S-curve.

6.13.7 Advantages of S-Curves

S-curves make it easy for us to track and monitor the project progress at any given time. As a manager, you can identify where you need to mobilize more resources and where you are paying more costs. Similarly, the areas which are less important and can be completed later are made predecessors due to limited availability of resources. It helps you to identify, where your budget grown and where it was less than expected budget. It gives us the information where

variations are incurring and hence you strive for their origin and ultimate solution to control the project scope and schedule. [15]

7.0 CONCLUSION/ FUTURE RECOMMENDATION

7.1 Conclusion

After going through this CBT (Computer Based Training) Course, Primavera P6 and then implementing this on a real time Project, I have no doubts in saying this that Primavera P6 is a good tool especially for Projectized organizations. It provides a platform where you can oversee many Projects going in your organization. It helped in letting us know that we are going as per planned Schedule, Cost and Scope after defined interval. In case of deviation from baseline, P6 showed us the status and eventually we assigned some extra resources to overcome the constraint. Primavera P6 assisted in providing a better visualization over Project Planning, Scheduling and Earned value Analysis. This Software made it easy for us to access information, generating reports and monitoring Project in a better way. Making forecasting through this program was much easy and efficient. In the end, S-curves was generated for different time intervals (Placed in Clause 9.3 of this Report), which provides a giant picture of project, where we are standing and how much we are focusing on schedule.

7.2 Recommendations

This Software tool is recommended for Projectized Organizations, to see over many projects and forecasts for all ongoing projects. Implementing this in your organization through PMO, can assure successful planning, monitoring, controlling and in the end, a safe handover of the project to its client. Being a Project manager, you can better visualize the status of your project at any time and accordingly mobilize your resources. Being a team member, you can have the required information all the time and thus as a project manager you can assign respective tasks to desired resources. Moreover, privacy option enhances the capability of this tool in a better way.

8.0 REFERENCES

[1] Usmani, A. (2011), EnMasse Private Limited. Available at: http://enmassepakistan.com/ (Accessed: 10 November 2016).

[2] TANVIR (2012), Islamic republic of Pakistan; Proposed Dasu Hydropower Transmission Line Project (DHTP) Consulting Services for National Transmission and Despatch Company (NTDC).
Available at: http://www.ntdc.com.pk/TendersPDF/DASU_TOR_Final_1_11_2012).pdf (Accessed: 20 November 2016).

[3] Gord Gibben, PMP (2015), Stakeholder Identification and Analysis Available at: http://members.shaw.ca/epo/Stakeholder%20Identification%20and%20Analysis.pdf (Accessed: 5 December 2016).

[4] Institute (PMI), P.M. (2013) A Guide to the Project Management Body of Knowledge (PMBOK Guide) - 5th edition. Available at: http://www.pmi.org/

[5] Rafele, C., Torino, D. and Hillson, D. (2005) Understanding Project Risk Exposure using the Two-Dimensional Risk Breakdown Matrix. Available at: http://risk-doctor.com/pdf-files/pmi-e-rbmpaper.pdf (Accessed: 20 December 2016).

[6] Davies, S. and Thales Training (2012), 'Benefits of using Primavera P6', Available at: http://www.trainingzone.co.uk/community/blogs/thalestraining/benefits-of-using-primavera-p6/ (Accessed: 10 November 2016).

[7] Collins, J. (2016), '10 Advantages of the Oracle Primavera P6 software', Available at: http://www.ims-web.com/blog/10-advantages-of-the-oracle-primavera-p6-software/ (Accessed: 10 November 2016).

[8] Oracle (1992) Understanding Work Breakdown Structures, Available at: https://docs.oracle.com/cd/E39583_01/fscm92pbr0/eng/fscm/fprc/concept_UnderstandingWorkBreakdownStructures-9f327c.html (Accessed: 12 November 2016).

[9] Scheduling, P. (2015) 3: Activity types, Available at: https://p6primavera.wordpress.com/topics/topic-3-activity-types/ (Accessed: 15 November 2016).

[10] SEO, Q. (2016), Activity Types and Milestones in Primavera P6 version 8.2, Available at: http://eastwoodharris.com/activity-types-and-milestones-in-primavera-p6-version-8-2/ (Accessed: 16 November 2016).

[11] Different Duration Types in Primavera P6R8.2, Available at: https://ccsspl123-Public.Sharepoint.com/Support%20Documents/Different%20Duration%20Types%20IN%20PRIMAVERA%20P6R8.pdf (Accessed: 25 December 2016).

[12] Lepage, M. (2015), Baselines, Available at: https://www.linkedin.com/pulse/primavera-p6-baseline-basics-michael-lepage-primavera-p6/ (Accessed: 03 November 2016).

[13] Ten Six Consulting LLC, 703.910.2600, (2013) Software services. Available at: https://tensix.com/2013/01/earned-value-management-explained/ (Accessed: 28 December 2017).

[14] Oracle, Scheduling Options, Available at: https://docs.oracle.com/cd/E17462_01/Web_Access/Help/en/Projects/Tasks/pm_scheduling_options.htm (Accessed: 30 December 2017).

[15] Ten Six Consulting LLC, 703.910.2600, (2015) Software services. Available at: https://tensix.com/2015/09/s-curves-in-primavera-p6-professional/ (Accessed: 19 January 2017).

[16] Fernans, A., Paul, S. and Professor, A. (2013) 'Project monitoring and control using Primavera', International Journal of Innovative Research in Science, Engineering and Technology, 2(3).

[17] Shaik, M. and Masood, H.H.N. (2008) 'An analysis on resource planning, cost estimation and tracking of project by earned value management', Certified International Journal of Engineering and Innovative Technology, 9001(4), pp. 2277–3754.

[18] Subramani, T., Sarkunam, A. and Jayalakshmi, J. (2014) 'Planning and scheduling of high rise building using Primavera', 4(5), pp. 134–144.

9.0 ANNEXURES

9.1 CBT LOG

Sr. No.	Date	Problems/ Issues	Details/ Lesson Learnt	Status	Source	Remarks
1	23/10/2016	How to save the data in P6?	In P6, data is automatically saved. For external storage in the form of a soft copy, you need to export file from 'file' option and save in the respective format. Later on that file can be imported to work on that or if the receiver have to work on that file.	Cleared	Sir Faisal Shahzad	
2	23/10/2016	Purpose of Gantt chart?	They are used for the open projects only. You are having the option to zoom in and out to check the variance.	Cleared	Sir Faisal Shahzad	
3	23/10/2016	What is the purpose of portfolio in P6?	All resource distribution is based on portfolio. It is the Hub of the projects and all strategic decisions are made at this stage. Priority is set either on time based or on strategic base (global vision).	Cleared	Sir Faisal Shahzad	
4	30/10/2016	Baseline changed by itself and was shifted to some other date	It was due to availability of fewer resources to that particular activity or extra man hours were added. Another cause of this problem may be duration of the activity which may not be correct.	Cleared	Sir Faisal Shahzad	

		which was not assigned by me.	EPS provides us hierarchy, helps us in decision making and it is driven by OBS. Linking OBS with EPS defines Authority and boundary. We give a starting date to the project and then duration to each activity; the schedule automatically finds the finish date. Critical path is having '0' float whereas longest path is the total duration of the project, from starts to finish.			
5	5/11/2016	How to change the Activity ID incremental detail like Activity ID Number?	Right click on Activity ID and we can change the incremental Value. Activity duration type is time or budget dependent while Activity measure type is unit based.	Cleared	Sir Faisal Shahzad	
6	5/11/2016	Where to use the recalculate option?	Recalculate option is used for Compression of Schedule. Support staff incorporation in p6 is done as per their skills.	Cleared	Sir Faisal Shahzad	
7	5/11/2016	How to update the progress of the activities?	Go to Tools bar and select Update program and then select activity type as per activity duration type, followed by Apply option and OK.	Cleared	Sir Faisal Shahzad	

			Physical % complete type is important in execution phase of the project and is strictly scheduled while duration type is depending upon working hours.			
8	5/11/2016	Can we place some activity without successor in Schedule?	No activity can be chosen without a successor in schedule. It is called open end activity. The late start of these activities will be at the end of the project without any logical reason causing flaws in schedule.	Cleared	Sir Faisal Shahzad	
9	12/11/2016	Difference between restoring and updating baseline?	Restoring a baseline from Assign Baseline and then selecting Current project as project baseline now go to maintain baseline and select baseline and then select option restore, now the baseline will be treated as a project in the project window. For updating baseline, Go to earn value option, from admin preferences and "at completion values with current dates", Now go for maintain baseline, where you create a baseline and then assign baseline, after doing this, you will notice that the baseline has been updated. Once you start the activity from status bar with % duration type, its % will automatically be calculated and remaining duration will also be shown.	Cleared	Sir Faisal Shahzad	

10	12/11/2016	What are different types of baseline and can we use them in different stages of project?	For baseline types, Go to admin categories, baseline types, here you will see different types of baselines. It depends on the time frame of the project and as per your need and requirement that which baseline type to be used, as customer sign-off baseline once chosen, cannot be changed.	Cleared	Sir Faisal Shahzad	
11	12/11/2016	Difference between Calendar based and resource based activities?	Calendar based activities are time bound and are chosen where Time constraint is present whereas resource based activities are chosen when you need resources that have to be managed.	Cleared	Sir Faisal Shahzad	
12	12/11/2016	What duration type to be used with an activity?	Duration type is assigned to an activity by keeping in mind the three factors, Duration, your target after a time period i.e units and your daily productivity i.e unit/time.	Cleared	Sir Faisal Shahzad	
13	19/11/2016	Concept of project slip and performance measurement?	Project slip is the concept when you are not going as per your planned schedule. It happens due to the delays in the project at different stages. Earn value analysis is used for this purpose to measure the performance and hence calculating the variance.	Cleared	Sir Faisal Shahzad	
14	19/11/2016	How to Assign new cost for a resource?	For this purpose, you have to first remove the resource and again add it in order to have a changed value.	Cleared	Sir Faisal Shahzad	
15	26/11/2016	I was giving activity duration of 10 days and expecting it to	The problem was hidden in the calendar setting. In Calendar modification, more than 8 hours were assigned to some days due	Cleared	Sir Faisal Shahzad	

		take 10 days for finishing but surprised to see that it was showing original duration in status bar as 27.	to which the total duration was changed. It was changed through work weeks.			
16	26/11/2016	What is the difference between retained logic and override logic?	If activities are going as per network logic what you have set early at start, you may go with retained logic as there is no difference or variance. Retained logic is used when activities are not following the network logic and some new sequence may be formed. Both of these are used in scheduling.	Cleared	Sir Faisal Shahzad	
17	26/11/2016	What is the difference between flag and milestone activity?	Both can be said as events but not activities. Flags are updated automatically by Primavera while milestone activity can be updated manually.	Cleared	Sir Faisal Shahzad	
18	3/12/2016	Is there a possibility that 'level of effort' activity type may be on critical path?	No, these activity types are not on critical path as they don't add any duration.	Cleared	Sir Faisal Shahzad	

19	18/12/2016	Why reflection of a program is made in Primavera P6?	Reflection is taken as a copy of the actual project. It is done for the purpose that if there are different team members who are making changes then after changes been done, you can merge all of them to the original one back. Hence whole team get aware with the changes incorporated.	Cleared	Sir Faisal Shahzad	
20	18/12/2016	When to use 50/50 Percent Complete in Earn value management?	This option in EVM calculates earned value cost as 50 % as soon as the activity starts and is 100 % only once the activity has been finished. This option can be used when we need the earn value of an activity at the starting.	Cleared	Sir Faisal Shahzad	

9.2 RESEARCH PAPERS

9.2.1 Project Monitoring and Control using Primavera

Abstract: Project monitoring and control is the process of collecting, recording, and reporting information concerning project performance. Project controlling uses the data from monitor activity to bring actual performance to planned performance. The present study deals with the project monitoring process of "Standard Design Factory", a four storeyed (G+3) factory building whose construction is in progress at Cochin, Kerala. A comparison between the planned progress of construction work and actual progress is performed in this study using project management software Primavera P6. Despite well-established principles and policies of project monitoring the process itself may not be efficiently accomplished in a project, because of those practical problems existing or arising in the project such an attempt in realizing the practical problems in implementation of project monitoring and control will contribute to proper recognition of the problem areas and putting in place the control process to rectify the deviations. [16]

9.2.2 An Analysis on Resource Planning, Cost Estimation and Tracking of Project by Earned Value Management

Abstract: Construction industry is the second largest sector in India. Many construction projects suffer from time and cost overruns due to a multiplicity of factors. Earned value management (EVM) is a project performance evaluation which has been adapted for application in project management. This technique helps in comparison of budgeted cost of work to actual cost. The present study deals with the scheduling and project monitoring process along with it also discusses main parameter's involving in the calculation of earned value analysis in cost and time management of civil construction project. Methodologies and analysis are demonstrated in this paper using an example of real time project. Primavera P6 software is used for project planning and EVM calculations. [17]

9.2.3 Planning and Scheduling of High Rise Building Using Primavera

Abstract: Although the long-introduced Industrialized Building System (IBS) has promised to solve and improve the current construction method and scenario in our country, but the IBS method has not gained enough popularity. One of the reasons is due to lack of research works done to quantifying the benefit of IBS especially in construction time saving. In lieu with such scenario, this study conducted to quantify evidence of time saving in IBS application. The

methodology adopted for this study is by modelling the construction process for high-rise residential building for both conventional and IBS with shared more a less the same nature and size of the structure. The model was developed using Primavera (P3) project planning software. The comparison was made by comparing selective building components for both method of construction. Different high-rise residential projects have been selected for this study. The result of the study clearly indicated that sufficient time saving can be archived. Also from this study shown not all IBS components can improved to the overall construction duration, however by adopting IBS components can improve and expedite the construction of 18 stories residential building from the point of departure of the project throughout of the whole of project's with a total 405 days or 42% the time saving. [18]

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology
Vol. 2, Issue 3, March 2013

Project Monitoring and Control using Primavera

Andrew Fernans Tom[1], Sachin Paul[2]

Lecturer, Department of Civil Engineering, M A College of Engineering, Kothamangalam, Kerala, India[1]

Asst. Professor, Department of Civil Engineering, M A College of Engineering, Kothamangalam, Kerala, India[2]

stract: Project monitoring and control is the process of collecting, recording, and reporting information concerning ject performance. Project controlling uses the data from monitor activity to bring actual performance to planned formance. The present study deals with the project monitoring process of "Standard Design Factory", a four storeyed -3) factory building whose construction is in progress at Cochin, Kerala. A comparison between the planned progress of struction work and actual progress is performed in this study using project management software Primavera P6. Despite l-established principles and policies of project monitoring the process itself may not be efficiently accomplished in a ject, because of those practical problems existing or arising in the projectSuch an attempt in realizing the practical blems in implementation of project monitoring and control will contribute to proper recognition of the problem areas putting in place the control process to rectify the deviations.

I. INTRODUCTION

struction industry is an integral component of a nation's infrastructure and industrial growth.Even though construction ustry is the second largest industry in India, the growth of this industry has been differential across the nation. The rural ions need tools for economic development, land use and environment planning to cope with the status of development in an areas. The time available to achieve this goal is shrinking. Here arises the need for effective project nagement.Many issues are being faced by construction industry that must be taken care of. Theyinclude time and cost erruns due to inadequate project formulation, poor planning for implementation, lack of proper contract planning and nagement and lack of proper management during execution. It has been estimated by analysts that average cost of a ject goes up by 30 percentage compared to the budgeted cost. Observations show that proper skilful management is erative for the timely completion of the project within estimated budget and with allocated resources. Projects with d planning, adequate organizational machinery and sufficient flow of resources cannot automatically achieve the desired ult. There must be some warning mechanism, which can alert the organization about its possible success and failures, off d on. Project monitoring is the process of collecting, recording, and reporting information concerning project formance that project manager and others wish to know. Monitoring involves watching the progress of the project inst time, resources and performance schedule during execution of the project and identifying lagging areas requiring dy attention and action whereas project controlling uses data from monitor activity to bring actual performance to ned performance.

main objectives of this study are

- To suggest the importance and purpose of monitoring the construction work.
- To suggest guidelines to contractors for updating the project.
- To present an ideal schedule for the factory construction process.
- To suggest a layout for updating the schedule.
- Earned value analysis and tracking for the Standard design factory construction work.

s study is mainly done using Primavera P6, project management software. All activities and their sequence of rrence, duration, resources required and costs involved are studied. The organizational breakdown structure of mpany and work breakdown structure of the project are noted. Tacking of the completed activities and earned value lysis are done. This gives an idea about the resources involved and financial aspect of the completed work."Project nagement is the application of knowledge, skills, tools and techniques to project activities to meet the project

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology
Vol. 2, Issue 3, March 2013

rements" (PMBOK, 2008). K KChithkara (1998) has defined project management as an art and science of mobilizing managing people, materials, equipment and money to complete the assigned project work on time within budgeted and specified technical performance standards.Mainly project management process comprises five process groups BOK, 2008). They are initiating, planning, executing, monitoring and controlling, andclosing. Monitor and control of ect workis the process of tracking, reviewing and regulating the progress to meet the performance objectives defined in ect management plan. Monitoring is an aspect of project management performed throughout the project. It includes ecting, measuring, and distributing performance information, and assessing measurements and trends to affect process rovements (PMBOK, 2008).

E STUDY:STANDARD DESIGN FACTORY PROJECT

ndard design factory is one of the leading projects undertaken by Kerala contracting company in Cochin. It involves truction of factory buildings of a typical design (plan) at various locations spread across Kerala. Total contract value e structural work project is 7crores with total built up area 5472 sq.m. Construction of G+3 (four storied) RCC framed ding to be used as Standard design factory at Cochin is expected to complete within 21 months.

TABLE I. CASE STUDY DETAILS

Owner	Kerala Industrial Infrastructure Development Corporation, Trivandrum
Project	Construction of Standard design factory building - civil and structural work, Small industries park, Cochin
Location	The proposed site is located at Small industries park, Cochin.
Nearest airport	Cochin
Rainfall details	a) Annual rainfall - 300 cm/ year b) Maximum intensity - 90 mm/day c) Period of rainfall during the year - June to October

n steps involved in factory construction work apart from initial planning are

- Mobilisation
- Piling
- Column& beam concreting
- Slab & stair concreting
- Post concreting works
- Masonry work
- Plastering
- Flooring, dadoing
- External wall plastering
- Finishing

II. METHODOLOGY OF MONITORING THE PROJECT WITH PRIMAVERA

e construction projects have become so vast and complex that the application of information technology has become vitable. Companies started developing softwares for project management such as Primavera P6, P3, Suretrack, Microsoft ject, etc.

is study involves monitoring and controlling the project using Primavera P6. The progress at site must be incorporated in e Primavera schedule and updated. These updates needs to be thoroughly monitored using Primavera. Tools and niques involved in this process are:

- Earned value management (EVM)

rned value management is a commonly used method ofperformance measurement. It integrates scope, cost, and schedule asures to help the project management team assess and measure project performance and progress. This technique uires the formation of an integrated baseline against which performance is measured for the duration of the project. This n be effectively done in Primavera.

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology
Vol. 2, Issue 3, March 2013

- Cost performance baseline

project performance baseline is used to measure, monitor, and control overall cost performance on the project.

- Work performance measurements

calculated cost variance, schedule variance, CPI, values for WBS components, in particular the work packages and rol accounts, needs to be documented and communicated to stakeholders.

s involved in monitoring and control of SDF project are

1) Creating an ideal schedule

reate a schedule for any project, first step is to collect data available for the project. Subsequently the following steps be followed in Primavera.

2) Enterprise project structure (EPS)

te the structure of the company with its branches, which is executing the project. This is known as Enterprise project ture (EPS).

3) Organizational breakdown structure (OBS)

r the EPS, OBS is created which is a hierarchy that reflects the persons responsible for the projects in the enterprise.

4) Creating new projects

roject is a set of activities and associated information that constitutes a plan for creating a product or service. The ct is created under the respective divisions in EPS and assigned the person in charge from OBS to it. The project can given planned start and must finish dates. The project is assigned a calendar which can be global, resource or project ndar.

5) Work breakdown structure (WBS)

S is a hierarchy of work that must be accomplished to complete a project. Each project has its own WBS hierarchy with level WBS element being equal to that of each EPS node or project. Each WBS element may contain more detailed S levels, activities, or both.

6) Defining activities

ities are the fundamental work elements of a project and form the lowest level of a WBS and, are the smallest ision of a project. An activity has the following characteristics like activity ID, name, start and finish dates, activity ndar, activity type, activity codes, constraints, expenses, predecessor and successor relationships, resources, roles etc.

7) Relationship between activities

rom a network, the activities should be connected to each other, which is done by assigning preceding and succeeding ities with significant relationship to the activities.

- Finish to start (FS) relationship.
- Finish to finish (FF) relationship.
- Start to start (SS) relationship.
- Start to finish (SF) relationship.

8) Determining activity duration

en planning the work, the duration is entered in the original duration field. The actual duration can only be entered for activities, which are completed.

9) Activity dates

following are the types of activity dates available in the primavera;actual start, actual finish, planned start, planned sh.

10) Activity cost

activity cost is the sum of all the cost incurred to complete the activity.

11) Creating baselines

mple baseline plan is a complete copyof the original schedule which provides a target against which a project's rmance is tracked.

12) 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.

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology
Vol. 2, Issue 3, March 2013

13) Tracking
cking window is used for monitoring a project's progress using different types of layoutssuch as labour costs, project t, resource forecasting, resource allocation unit wise and cost wise.

14) Earned value
rned value is a technique for measuring project performance according to both project cost and schedule. The technique mpares the budgeted cost of the work to the actual cost.
15) Claim digger
e claim digger is a schedule analysis tool that enables a company to generate a report that compares selected data fields revised project and a corresponding baseline.
16) Project thresholds
ject thresholds consist of parameters assigned to WBS elements; they are used to monitor projects and generate issues
17) Project issues
ject issues are the problems within a schedule that must be addressed before the project can be completed. They can be created by thresholds or manually.

liminary steps to be done in updating

ose *project. Maintain baseline.* Then add and save a copy of current project as a new baseline B1. Then choose project seline as B1 and assign primary baseline as B1.
ily updates to be made:
a) Start date and end date
ose the activity to be updated. Then in the activity details window, select *status* tab. Then tick mark *started* if the ivity has been started and select the date. Tick mark *finished* if the activity has been finished and select the finish date.
b) Resource
ctivity details window, select *resource* tab. Then select the resources which are to be added to the particular activity
c) Code
ctivity details window, select *code* tab. Then select the activity code for each resource.
d) Notebook
ctivity details window, select *notebook* tab. Select the topic which we want to note and write the details in notebook c.
e) Steps
ctivity details window, select *steps* tab. Then if the activity has any steps update the activity in percentage complete and tick mark if the activity has been completed.
f) Feedback
ctivity details window, select *feedback* tab. Then the details for the resources have to be mentioned in feedback.
g) Work products and documents (WPs & Docs)
ctivity details window, select the *WPs & Docs* tab. Then the drawings, documents, specifications have to be uploaded e.

ekly updates to be made:
a) Threshold
rectory bar choose *threshold* tab. Then 3 variances are to be monitored regularly; finished date variance, start date nce and cost variance.
b) Issues
rectory bar choose *project issues.* The values which fall outside the threshold values are indicated in the issues. ntractor also has to add issues if there are any.
c) Reports
se *tools.* Then choose the data date which we want to update the progress. All the activities done in that week has to lected. Then select *update progress.*

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology
Vol. 2, Issue 3, March 2013

hedule analysis and forecasting

hedule variance (SV)
etermines whether a project is behind or ahead of the schedule. It is calculated by subtracting planned value from the ned value.

Schedule variance = Earned value (EV) -Planned value (PV)

e Schedule Variance can be expressed as a percentage by dividing the schedule variance (SV) by the planned value (PV):

SV% = SV / PV

hedule performance index (SPI)
ndicates efficiency with which the project team is using its time.

Schedule performance index = Earned value / Planned value

me estimate at completion {EAC(t)}
e can generate a rough estimate of when project will be completed

Estimate at complete {EAC(t)} = (BAC/SPI)/ (BAC/months)

AC = Budget at completion

t analysis and forecasting

st variance (CV)
hows whether a project is under or over budget.

Cost variance (CV) = Earned value (EV) - Actual cost (AC)

is number can be expressed as a percentage by dividing the cost variance (CV) by the earned value (EV).

CV% = CV / EV

st performance index (CPI)
s one of the clearest indicators of the cumulative cost efficiency of the project.

Cost performance index (CPI) = Earned value (EV) / Actual cost (AC)

III. RESULTS AND DISCUSSIONS

nagement process in factory project
e management team including project manager, planning manager, construction manager, quality and safety incharges rk as a whole for all the activities. .

l baseline for Standard design factory
ideal baseline B1 was created in Primavera for the SDF case study. The work breakdown structure, activities and steps activities are being discussed here. The structure for the baseline is presented from the WBS levels. In WBS a level may again sub divided. Activities come under the WBS.

ntt chart
The time scale of the gantt chart should be weekly basis.
All relationships should be clearly given in the gantt chart.

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology
Vol. 2, Issue 3, March 2013

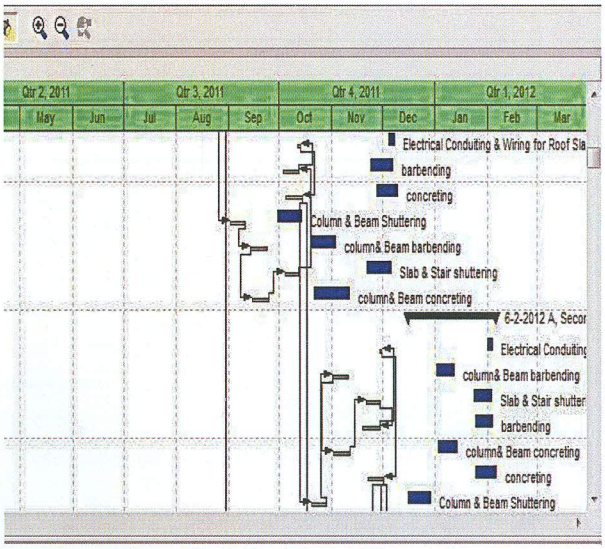


Fig.1 Gantt chart window

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. Break of one hour is given in the afternoon.

Activity usage spreadsheet and resource usage spreadsheet

These two spreadsheets reflect the usage of resources and progress of activities at any stage of the construction project. This is based on classic WBS layout

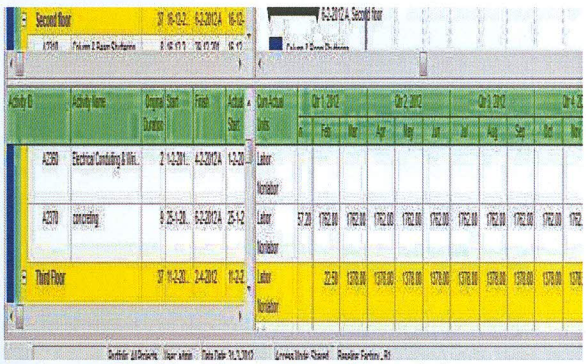


Fig. 2 Activity usage spreadsheet window

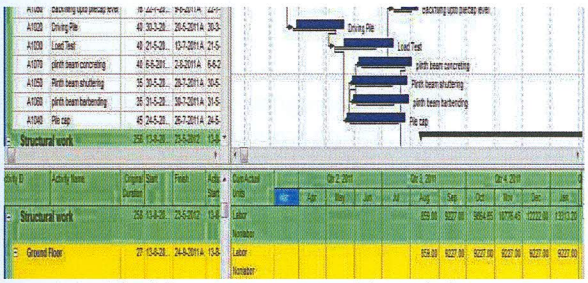


Fig. 3 Resource usage spreadsheet window

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology
Vol. 2, Issue 3, March 2013

ity usage profile and resource usage profile
e show graphical representation of cumulative values activity usage and resource usage at any stage of the construction ct. This is based on classic WBS layout.

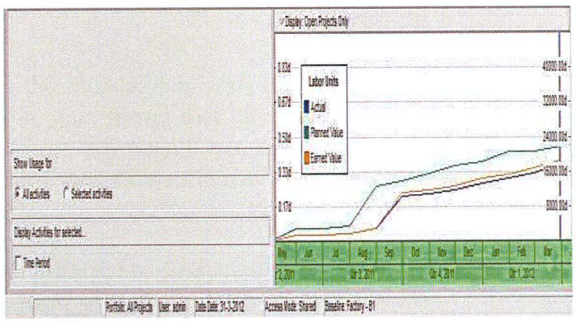


Fig.4 Activity usage profile window

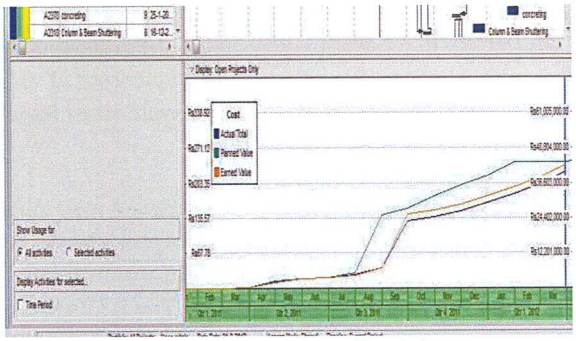


Fig. 5 Resource usage profile window

sed on the guidelines from literature review and methodology described, it was possible to monitor the progress of SDF nstruction project. Till now we have gone through step by step procedure followed in monitoring the project using rimavera P6. The numerical results obtained after following the previously mentioned methodology is discussed in the llowing sections.

ster schedule with key dates
schedule is being created using the key dates of the activities. The baseline project start date is on 15th March 2011 and seline project finish date is on 20th August 2012. The actual start of project was on 15th March 2011. It shows that the tual start of project was as per baseline schedule. After knowing the dates of all key activities, all the constituent activities e arranged sequentially and logically to form a schedule. This schedule shows a slow and ever increasing gap between seline schedule and actual work progress. The actual progress started shifting from planned schedule, from the second tivity *mobilisation of resources* itself.

source assignments and usage
e resource assignment window shows all the resource assignments, grouped by resource for the project. An approximate e analysis was done to arrive at rates of individual resource groups, considering the various component resources. Most the resources are taken as *material*. Machines are taken as *non–labour* and human involvement is listed as *labour*.
e resource usage profile obtained using Primavera P6 shows that there has been a slight variation in the quantity of each source used during the project life cycle.

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology
Vol. 2, Issue 3, March 2013

king of the Standard design factory project

king a project is very important in mega projects. While updating the schedule time to time, it was reviewed and the ed allocation of resources and the budgeted cost is estimated. All the associated resources of a project are tracked and record.

shold calculation

parameter which is checked in the threshold is *start day variance* and *finish day variance* for the started activities. shold calculation of the factory project shows that 88 activities show start date variance and 88 activities show finish variance. All these thresholds which fall outside are reported as issues. Hence 88 issues are identified for finish date nce and 88 issues are identified for start date variance.

y analysis

following reasons were observed during this thesis work, which can be held responsible for delays;

- Lack of knowledge about advanced tracking methods and softwares.
- Insufficiently skilled staff.
- Lack of proper fund flow throughout the project progress
- A major portion of labour force was from West Bengal and Orissa. Regional festivals in these areas cause sudden delays in work progress.
- Even though delay due to monsoon rain was already accounted in the baseline schedule, unexpected extension of monsoon caused further delay in project progress.
- Sand unavailability due to legal restrictions.
- Late delivery of resources.

parison of revised project schedule with baseline using claim digger

revised project is compared with the baseline of the project. The output of Claim digger shows that 43 WBS have been ed to and 45 WBS have been deleted from the project.

ned value analysis

earned value of the work has been calculated after including the actual cost of each activity inclusive of expenditures. following details were obtained from calculations using data obtained from Primavera P6

TABLE II. RESULTS OBTAINED FROM PRIMAVERA

Project budget (BAC)	Rs. 6,07,81,495
Planned value (PV)	Rs. 4,79,17,756
Earned value (EV)	Rs. 4,26,24,087
Actual cost (AC)	Rs. 4,05,63,038
Schedule variance (SV) = EV-PV	Rs. 52,93,669
SV % = SV/ PV	- 11.05 %
Schedule performance index (SPI) = EV/ PV	0.89
Total duration	21 months
Estimate at Complete {EAC(t)}= (BAC/SPI)/(BAC/months)	23.6 months
Cost variance (CV) = EV- AC	20,61,048
CV % = CV/ EV	4.84 %
Cost performance index (CPI) = EV/AC	1.05
Estimate to complete	Rs.1.82 crores

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology
Vol. 2, Issue 3, March 2013

urve
graphical representation of financial cash flow of a project. It is derived from activity usage profile, and it shows an 'S' shape, flatter at the beginning and end and steeper in the middle. This shows that costs involved in the project is low in beginning as well as in the end, whereas it increases at a rapid rate when the project is in its middle stage.

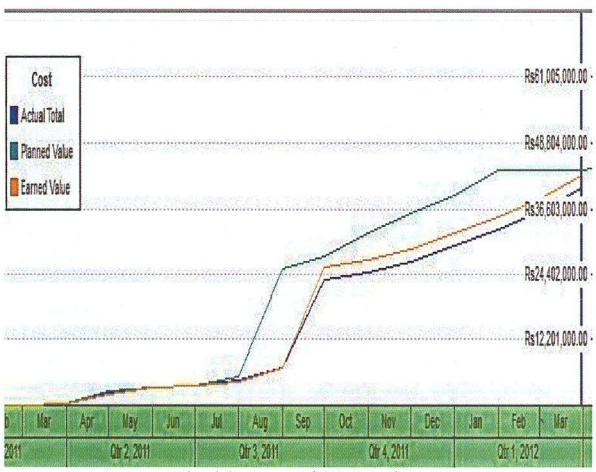


Fig.6 S-curve of SDF project

IV. CONCLUSIONS

main objective of this study was to understand the role of monitoring and control in the progress and timely completion construction project. This objective was achieved through revision of literatures and methodologies involved in nitoring and control. The case study proved to be a guideline in understanding the progress of Standard design factory nstruction work and also to identify the specific problems arising during the process. Results of this study show the wbacks of the present project management system in SDF project and the importance efficient planning, monitoring and ntrolling, as well as the need and effectiveness of a project management software like Primavera P6 in a construction ject.

mmary of the results obtained from the case study lead to following conclusions.

- Project progress is 51.73% of the total work after consuming 62.48% of the total estimated project duration.
- The project has a negative value for schedule variance (SV) which means that the project is behind schedule.
- Schedule variance percentage is -11.05% therefore the project is 11.05 percent behind schedule.
- A SPI of 0.89 would tell us that the project is only progressing at 89 % of the rate originally planned.
- The originally estimated completion time for the project was 21 months, so the project manager now knows that if work continues at the current rate the project will take 2.6 months longer than originally planned as time estimate at completion is 23.6 months.
- The project has a favourable cost variance of 20,61,048. A positive value of CV means that the project is over budget.
- Cost variance percentage is 4.84% therefore the project is 4.84 % below budget for the work performed till 31st March 2012, excluding penalties applicable due to delays.
- A CPI of 1.05 would tell us that the project is currently running within budget.
- Estimate to complete shows that Rs.1.82 crores is the expected cost required to finish all the remaining work.
- 88 issues in finish date variances and 88 issues in start date variances are reported when the finish date variance threshold and start date variance thresholds are monitored.
- Comparison of revised project schedule with baseline of shows that 41 WBS have been added and 43 WBS have been deleted.

nerally it can be concluded that

- Inadequacy in implementation of monitoring policies has been observed.

- Primavera 6 proves to be an efficient tool in monitoring and controlling any construction project as the time and effort in updating is reduced drastically by this specific layout.

REFERENCES

Alan Griffith., and Paul Wilson., "Construction Management, Principles and Practice." Palgrave Macmillan. pp115-180. 2004
Anthony, C.L., Patricia, E.M., and Robert, W.W., "The Kaizen Blitz."John Wiley and sons. 1999
Burke, R., "Project Management, Planning and Control Techniques." Chichester, John Wiley and Sons.Inc. 2003
Chan, J.P., JuHyung Kim, Jae-Jun Kim, and Yong, C.Y., "Management of Daily Progress in a Construction Project of Multiple Apartment. 2007 Buildings."*Journal of Construction Engineering and Management.*,133(3), pp242-253.
Chithkara, K.K., "Construction Project Management."Tata McGraw Hill. 1998
Daniel, C.L., Gursel, A.S., Julian Gonzalez, and Yates, J.K., "Construction Project Scheduling with Time, Cost, and Material Restrictions Using Fuzzy Mathematical Models and Critical Path Method." *Journal of Construction Engineering and Management.*, 135(10), pp1096–1104. 2009
Gary, H.R., "Project Management", McGraw Hill. 2002
George Alukal., and Anthony Manos., "Lean Kaizen."ASQ quality press. 2006
Hans Sommer., "Project Management for Building Construction."*Springer-Verlag*Berlin Heidelberg, London.
Harold Kerzner. "Strategic Planning for Project Management using a Project Management Maturity Model." John Wiley and sons, Canada,pp 109-139. 2001
James, L.P., "Mastering Project Management." McGraw Hill,pp269-355. 2008
Jason Westland., "The Project Management life Cycle."Cambridge university press, Great Britain. 2006
Jeffrey, S.R., Edward, J.J., and Samuel, P.L., "Continuous Assessment of Project Performance."*Journal of Construction Engineering and Management.*,123(1), 64-71. 1997
KauraMohinder, N., "Management Control and Reporting Systems", Sage Publications India Private Ltd., Kolkata. 2002
KLG Systel Ltd., "Course Material on Primavera Enterprise Project Management (P6)"
Koushki, P.A., "Project Management for Building Construction." *Springer Verlag Berlin Heidelberg,* London.2005
Majid. "Mastering Project Management." McGraw Hill., pp269-355. 2006
Masaok Imai. "Kaizen."ASQ press. 1998
Martin, R.M., and Chris, T.H., "Expert Systems for Construction Project Monitoring." *Journal of Construction Engineering and Management.*,I 1 l(3),pp 293-307. 1985
Ndekugri.,Braimah., and Gameson., "International Journal of Project Management." *Elsevier Ltd and the International Project Management Association (IPMA).*,volume 28. 2008
PMI., "Practice Standard for Earned Value Management", Project Management Institute, USA. 2005
PMI., "Practice Standard for Scheduling." Project Management Institute, USA. 2005
PMI.,"Practice Standard for Work Breakdown Structures." Project Management Institute, USA. 2005
PMI., "A Guide to the Project Management Body of Knowledge (PMBOK)." 4th Edition, Project Management Institute, USA. 2008
PMI., "A Guide to the Project Management Body of Knowledge (PMBOK)."3rd edition, Project Management Institute, USA. 2004
PMI.,"Practice Standard for Earn Value Management." Project Management Institute, USA. 2008
Primavera Systems.,"Oracle PrimaveraP6 Project Management, Reference manual." volume7, Oracle corporation. 2010
Turner, J.R., "The Handbook of Project-Based Management." 2nd edition., McGraw-Hill., New York. 1999

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 4, Issue 4, October 2014

An Analysis on Resource Planning, Cost Estimation and Tracking of Project by Earned Value Management

SHAIK MOHAMMAD MASOOD, DEVANAND.R, HARSHA H.N
PG Student, Department of Civil Engineering, G.E.C, Hassan
Assistant Professor, Department of Civil Engineering, G.E.C, Hassan
Assistant Professor, Department of Civil Engineering, G.E.C, Hassan

bstract- Construction industry is the second largest sector in a. Many construction projects suffer from time and cost runs due to a multiplicity of factors. Earned value agement (EVM) is a project performance evaluation which been adapted for application in project management. This nique helps in comparison of budgeted cost of work to actual The present study deals with the scheduling and project itoring process along with it also discusses main parameter's ving in the calculation of earned value analysis in cost and management of civil construction project. Methodologies analysis are demonstrated in this paper using an example of time project. Primavera P6 software is used for project ning and EVM calculations.

eywords – **Earned Value Management, Resource Planning, Estimation, Performance Index, Variances, Primavera**

I. INTRODUCTION

Construction industry is important at both global and nal level. It provides huge employment to the people plays very significant role in country economy. Project y is most common problem in construction industry. ct overruns due to time and cost result in delays during ct execution. In developing countries project overrun is us problem where implementation of project faces y uncertainties. It result in wastage of scare financial rce, delays in providing facilities, development and makes construction costlier [4]. EVM is the process of suring performance of project work against a baseline EVM application helps in providing performances hard for the evaluation of progress report project and it acts as a control device to take care of time and cost dule by responsibility defined Organization Breakdown ture (OBS). It provides better performance picture of ct and gives better forecast of the final completion Earned value is an enhancement over traditional ss of cost accounting [9]. Traditionally budgeted cost uated by computing the difference between planned and actual cost incurred in a project. The focus was on ed expenditures and actual cost. Earned value reveals opportunities and it also examines actual mplishment. With help of EVM, project managers get ient help to have deep intuitive understanding into ial risk areas. So that with help of clearer picture of ct performances, managers can create risk mitigation plans based on actual cost, schedule and technical progress of work [1, 9].

II. RESOURCE PLANNING

In planning resource requirement the following points to be considered:

a) The total resource requirements for a project over its duration.
b) Minimum delay in completion of the project when insufficient resources are available.
c) Most efficient utilization of resources to carry out the project in a fixed time.

Resource planning is the process of making sure resources are available as required to execute the project according to schedule. Two types of resource planning problems exist while preparing schedule. In one, the project faces a scarcity of resources and the activities on network must be arranged in such a way that the requirement of resources does not exceed availability. In case such an arrangement is not feasible, the one which gives the minimum additional requirement of resources is chosen. The resources are allocated among competing activities in the order of importance. In other type of resource planning problem the scarcity condition is relaxed and what is needed is to level up the highly fluctuating demand for resources at different times, primarily to facilitate project supervision and enhance efficiency.

III. COST ESTIMATION

Cost estimating is the process of calculating the cost of the identified resources needed to complete the project work. One doing estimating must consider the possible fluctuations, conditions and other causes of variances that could affect the total cost the estimation. There is distinct difference between cost estimating and pricing. A cost estimate is the cost of the resource required to complete the project work. Pricing however includes a profit margin. During the actual execution of the construction, detailed analysis of costs are required to be made. The cost estimates prepared during the design stage may not be sufficient or applicable during the execution stage. During the execution stage, the control estimation system serves two useful purposes.

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 4, Issue 4, October 2014

- It develops the production information for materials, labour and equipment that can be used as inputs for future estimates.
- It generates information so that one may study to take corrective measures to minimize the cost at any step.

ST ESTIMATE INPUTS

a) Using the Work Breakdown Structure
b) Relying on the resource Requirements
c) Calculating Resource Rates
d) Estimating Activity Duration
e) Historical Information

TIMATING PROJECT COSTS

a) Analogous Estimating
b) Parametric Modeling
c) Bottom-up Estimating
d) Computerized Tools

TPUTS FROM COST ESTIMATION

a) Cost Estimates
b) Supporting details
c) Cost management plan

IV. CONCEPTS OF EVM

rned value analysis is a method of performance surement. Earned value is a program management nique that uses "work in progress" to indicate what will en to work in future. EVM is system for planning and olling the project cost performances. EVM establish k packages earned value baseline by integrating project e, time and cost objectives [6, 8]. This baseline is called st control and is used for performance evaluation of ct on a given date. Analysis of variance from the line provides the cost related information's for problem ification, trend analysis and corrective actions such as nning and revising budget. Earned value analysis s two main purposes, it analyses cost changes which is ing in time and cost over-run or under-run so that corrective actions are taken such as modification of flow, updating financial forecast and project ability expectations. Analysis of variance from ine using earned value management systems given ty of variances which are analyzed to provide current s of project, to initiate corrective actions and to forecast e trends [6].

V. CASE STUDY

e case study is a Duplex Apartment of "Windmills of Mind" at Whitefield, Bangalore. The useful mation's has been taken from actual project. Tender document, Bill of Quantities and abstract sheets provides necessary data for project cost and scheduling activities. Total area is 7881 sq.ft. The work should be completed within 160 working days. The project was schedule from 27th January 2014 to 10th July 2014 and four sets of tracking are done at different intervals and final tracking was till 30th June 2014. The main objective of study is to understand the role of EVM for monitoring and control in progress and timely completion of construction project goals are achieved through literature review and methodology involved in Earned Value Management.

VI. METHODOLOGY AND ANALYSIS OF EVM

The construction projects are so vast and complex in nature and therefore for simplification of work, use of software's came into existence. The project was scheduled and monitored using Primavera P6 software. Primavera is the Project Management software use for Planning, Scheduling and Controlling the Construction Project. The steps involved in Duplex Apartment are as follows: Brickwork, Plastering, Flooring, Cabinetry, False Ceiling and Terrace works. The WBS for the project is created and several activities are identified. The durations of the activities are estimated on basis of Historical data, interviews with project manager, applying labour productivity factor formulae and application of analysis of rates. The relationships are examined and applied to the activities. The following procedure involved in scheduling and monitoring projects.

Table 1 PROCEDURE IN PRIMAVERA

1	Create Project
2	Define WBS
3	Creating Calendars
4	Define Activities
5	Appoint Activity Durations
6	Assign Logic Links
7	Perform Scheduling
8	Allocating Resources/Budgeting
9	Creating Baselines
10	Updating schedule
11	Earned Value Analysis
12	Publishing Reports

SCHEDULE ANALYSIS: Earned value is a technique for measuring project performance according to project cost and schedule. The comparison between budgeted and actual performance is performed. There are three earned value parameters as shown below.

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 4, Issue 4, October 2014

nned Value (PV): It is the cost of the project ding to the schedule of the project. It is also called eted Cost of Work Schedule (BCWS).

rned Value (EV): It is the Budgeted Cost of the Work rmed (BCWP) till date. It is cumulative budgeted cost ed in activities that have been completed on the due

ual Cost (AC): It is the actual cost that has spent on oject till date. It is also called as actual Cost of Work rmed (ACWP).

e variances are used to check deflection or deviation of t from the path of original schedule. It is also used to e the extent and cause for the delays of works or tasks project. Following re two variances:

t Variances (CV): It is used to check the difference en the proposed planned project and present project e specific date. It shows the variation of project in of cost. The formula used for calculating cost nces is

Cost Variance = Earned Value – Actual Cost

hedule Variance (SV): It is used to examine the tion of present project in from the planned project. If derable change appears than the project objectives be revised. The formula for calculating the schedule nce is

Schedule Variance = Earned Value – Planned Value

hedule Performance Index (SPI): SPI can be used to ate the projected time to complete the project. It is ulated as follows,

SPI = Earned Value / Planned Value

SPI = 1 means Project is on Schedule

SPI < 1 means Project is behind Schedule

SPI > 1 means Project is ahead of Schedule

Cost Performance Index (CPI):

CPI can be used estimate the project cost to complete the project based on performance to date. It is calculated as follows,

CPI = Earned Value / Actual Cost

CPI = 1 means Planned and Actual cost are same

CPI < 1 means Project is under Budget

CPI > 1 means Project is over Budget

Estimate at Completion (EAC): The Estimate at Completion is the actual cost to date plus an objective estimate of costs for remaining authorized work. The most common is

EAC = Actual cost + Estimate to Complete

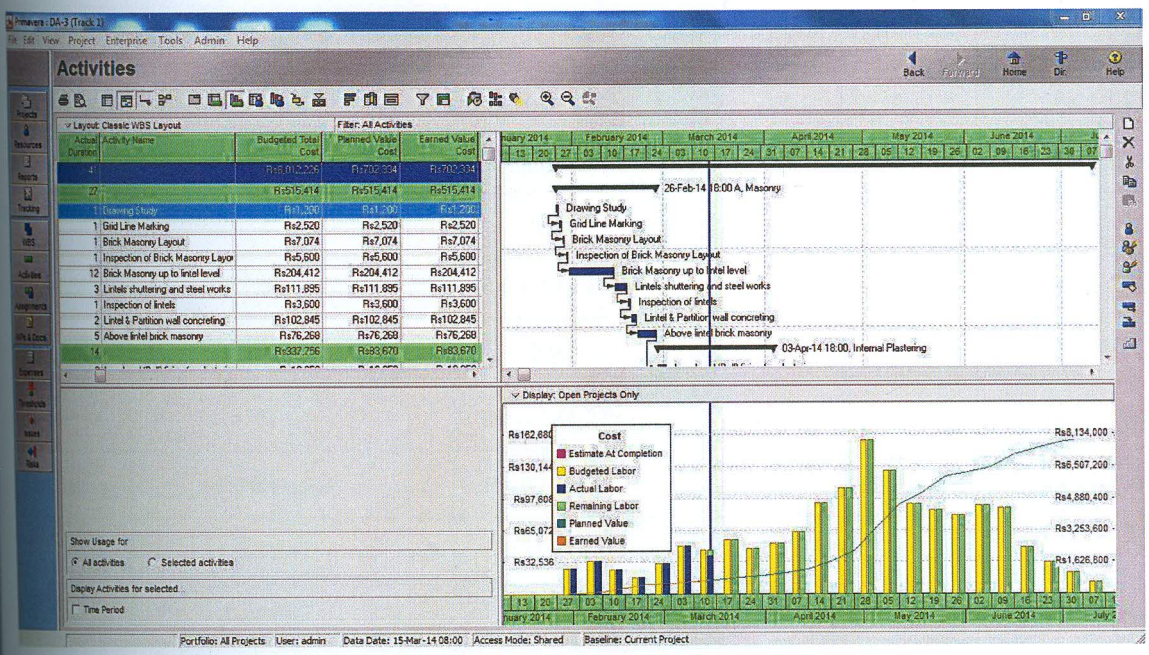


Fig. 1: EVM Parameters, Gantt chart view and S-curve in Primavera

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 4, Issue 4, October 2014

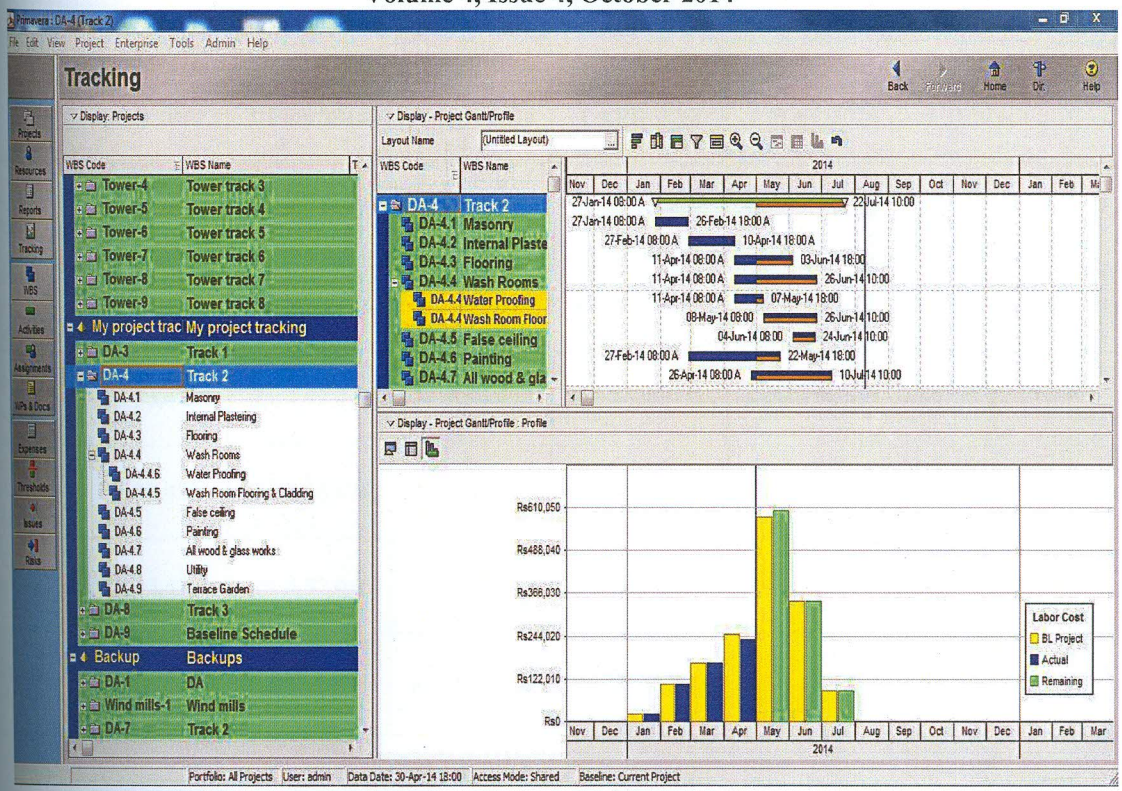


Fig. 2: Tracking process in Primavera

VII. RESULTS

Table 2 RESULTS OBTAINED FROM PRIMAVERA P6

M Paramater	Tracking 1	Tracking 2	Tracking 3	Tracking 4
ted at Completion	Rs. 80,12,225	Rs. 80,12,225	Rs. 80,12,225	Rs. 80,12,225
anned Value	Rs. 7,02,334	Rs. 27,68,881	Rs. 61,94,005	Rs. 77,29,472
arned Value	Rs. 7,02,334	Rs. 25,54,523	Rs. 56,13,448	Rs. 68,17,173
ctual Cost	Rs. 7,02,334	Rs. 28,15,802	Rs. 64,51,565	Rs. 80,36,983
dule Performance Index	1	0.92	0.90	0.88
edule Variance	0	Rs. – 2,14,358	Rs. – 5,80,557	Rs. – 9,12,299
rformance Index	1	0.90	0.87	0.84
st Variance	0	Rs. – 2,61,279	Rs. – 8,38,117	Rs. – 12,19,810
te at Completion	Rs. 80,12,225	Rs. 82,73,504	Rs. 88,50,342	Rs. 92,32,035
ed Schedule % Complete	8.77%	34.5%	77.3%	96.4%
ual Schedule % Complete	8.77%	32%	70%	85%

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 4, Issue 4, October 2014

Table 3 CUMULATIVE COST AFTER TRACKING 4 FROM PRIMAVERA P6

	1JAN 2014	1 FEB 2014	1 MAR 2014	1 APR 2014	1 MAY 2014	1 JUN 2014	1 JUL 2014
ned Value Cost	Rs. 33,428	Rs. 4,97,046	Rs. 4,33,150	Rs.18,05,257	Rs. 34,25,124	Rs. 15,35,467	Rs. 2,82,753
mulative ned Value Cost	Rs. 33,428	Rs. 5,30,474	Rs. 9,63,624	Rs. 27,68,881	Rs. 61,94,005	Rs. 77,29,472	Rs.80,12,225
rned Value Cost	Rs. 33,428	Rs. 4,97,046	Rs. 3,34,898	Rs. 16,89,151	Rs. 30,58,925	Rs. 12,03,725	-
mulative rn Value Cost	Rs. 33,428	Rs. 5,30,474	Rs. 8,65,372	Rs. 25,54,523	Rs. 56,13, 448	Rs. 68,17,173	-
tual Cost	Rs. 33,428	Rs. 4,97,046	Rs.3,89,548	Rs. 18,95,780	Rs. 36,35,763	Rs. 15,85,418	-
mulative tual Cost	Rs. 33,428	Rs. 5,30,474	Rs. 9,20,022	Rs. 28,15,802	Rs. 64,51,565	Rs. 80,36,983	-

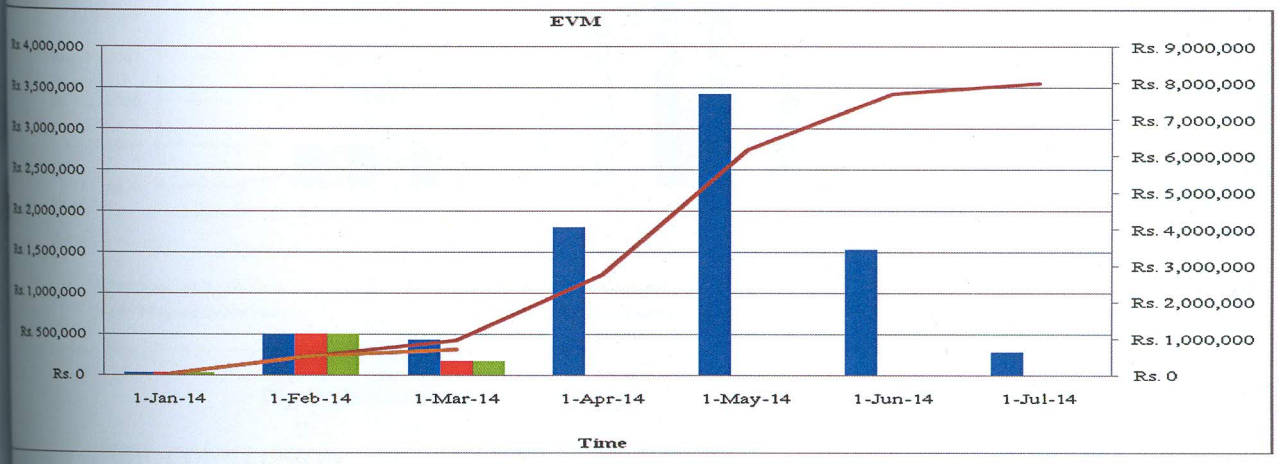


Fig. 3: Earned Value Analysis Graph after First Tracking

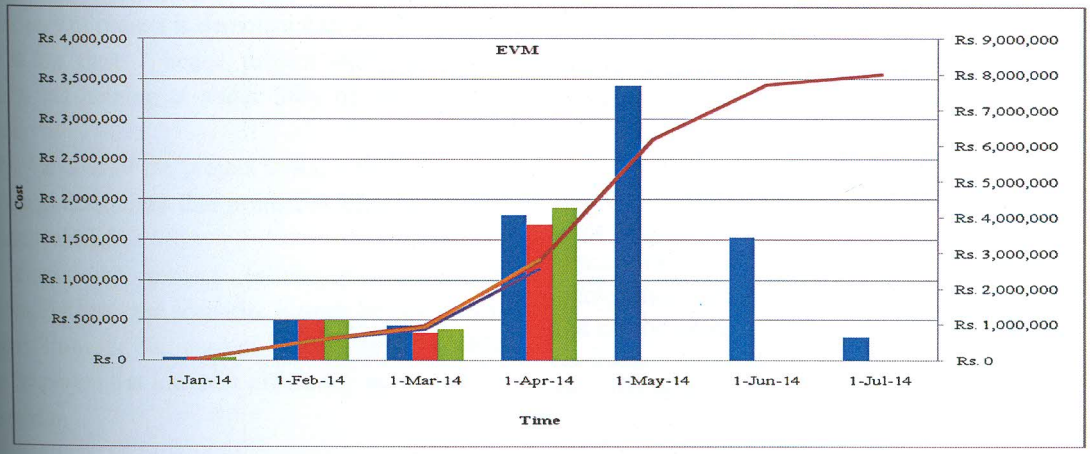


Fig. 4: Earned Value Analysis Graph after Second Tracking

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 4, Issue 4, October 2014

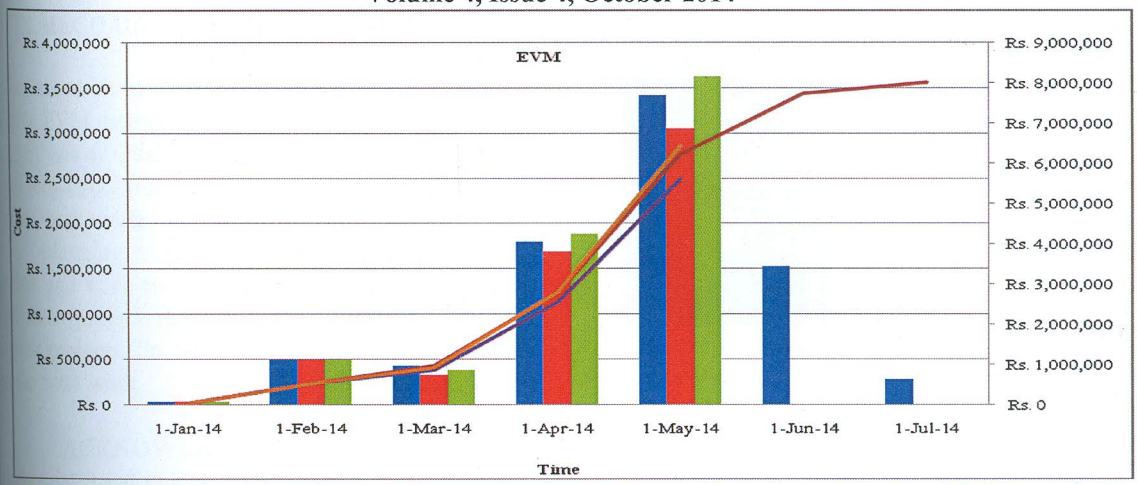


Fig. 5: Earned Value Analysis Graph after Third Tracking

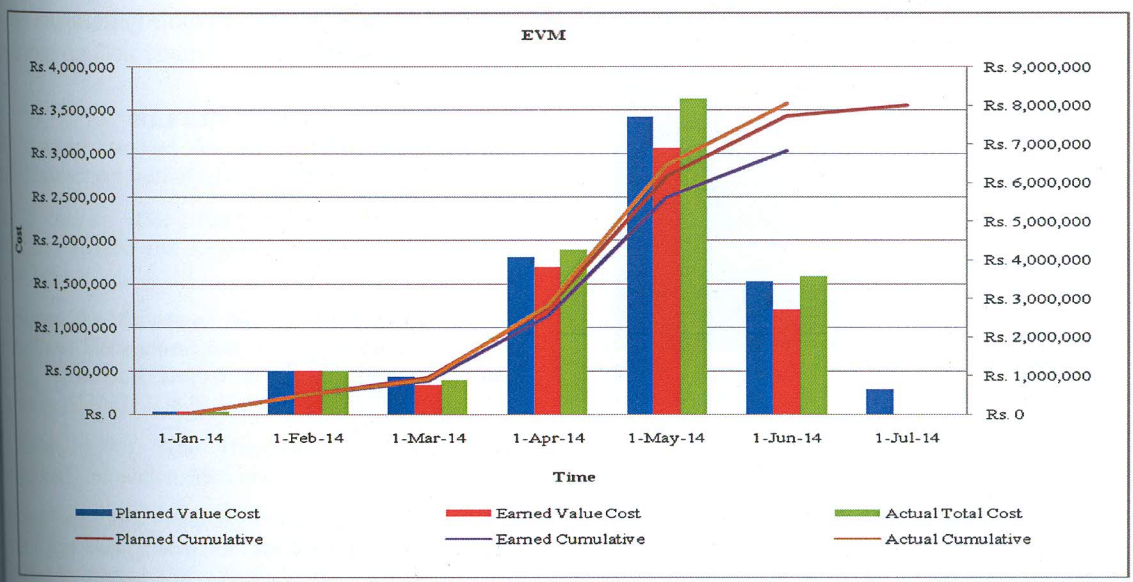


Fig. 6: Earned Value Analysis Graph after Fourth Tracking

VIII. CONCLUSION

VM provides important information for project work ckage decision making.

he efficiency of project is demonstrated by SPI is 0.88 hich is less than 1 hence project performed less fficiently and running at about 88% of the planned chedule.

chedule Variance of the project is Rs. – 9, 12,299 the egative sign determines that project is lagging behind e original schedule.

I indicates the project efficiency of project fficiation. For best case scenario, it must be equal to 1 higher. However for current project is 0.84, this ows that project has low cost efficiency as compared o its spending.

- Cost Variance of the project is Rs. – 12, 19,810 the negative value which depicts an unfavorable scenario. The project is over budget by 16% of overall cost.
- The study shows important, implementation and unique features of EVM that benefits project managers and ultimately results in project success.

The key point here is that Earned Value Analysis enables you to spot a potential problem early in the project and do something to correct the situation. Earned Value Management is a remarkable method of project management because it integrates cost, schedule and scope and can be used to forecast future performances and project completion dates. It allows projects to be managed better on time and in budget.

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 4, Issue 4, October 2014

IX. RECOMMENDATION for FUTURE RESEARCH

future research in general will include probably new s in the EVM methodology to take into account issues sk Analysis or Quality and technical performance for ficient project control. Implementation of EVM creates extra work where it is difficult to integration of ny's planning, scheduling, budgeting, work ization and cost accumulation processes with each All these project management constrains likely to n most projects. So future research should be aimed ce the extra work.

ACKNOWLEDGEMENT

project data used in this study was made available by noj Kumar General Manager at Total Environment g System Pvt Ltd and Dr. Karisiddappa Principal ment Engineering College, Hassan. I am indebted to gentleman for their contribution to this study.

REFERENCES

MI. "Practice Standard for Earn Value Management", oject Management Institute, USA 2005.

nk T Anbari (Dec 2003), Earned Value Project nagement Method and Extensions, Project Management rnal, Vol-3.

N Weerasinghe Mohottige,(Nov 2013) Standard Practice Earn Value Management and its Impact on Construction dustry, International Journal of Recent Technology and gineering ISSN:2277-3878, Volume-2.

R. Turner, (1999) "The Handbook of Project-Based nagement", 2nd edition, McGraw, New York.

tanand Patil, Akshay Patil and Pramila Chavan,(Jun 2012) rned Value Management for Tracking Project Progress, ternational Journal of Engineering Research and plication. Vol-2.

K Chithkara, (2006) "Construction Project Management", ta McGraw Hill, 10th edition.

arma V.K (May 2013), Earned Value Management: A Tool r Project Performance Advances in Management Journal, l-6.

A. Lakade and A.K. Gupta, "A Project Management proach using Primavera in Construction Industry", ternational Journal of Mechanical and Civil Engineering, SN: 2278-1684.

gar K. Bhoesekar, Gayatri Vyas, (Apr 2012) Cost ntrolling Using Earned Value Analysis in Construction dustries, International Journal of Engineering and novation Technology, Vol-1.

P Prabhakar, (Aug 2008) "Projects and their Management: Literature review", International Journal of Business and nagement, Volume 3.

AUTHORS PROFILE

Mr. Shaik Mohammad Masood has obtained his Bachelor of Engineering (Civil Engineering) from Islamia Institute of Technology Bangalore and Master in Technology (Construction Technology) from Government Engineering College, Hassan. He secured College Second Rank in B.E. He has worked at Total Environment Building System Private Limited and has gain experience in civil construction works of luxury Apartments and Villa's.

Mr. Devanad.R has completed his B.E (Civil Engineering) from Sir. MVIT, Bangalore and M.Tech (Construction Engineering and Management) from Manipal Institute of technology (MIT), Manipal. Has immense industrial/site experience having worked at Gammon India Limited and Nagarjuna Construction Company (Urban) Limited. Presently he is working as an Assistant Professor in the Department of Civil Engineering at Government Engineering College, Hassan.

Mr. Harsha H.N has completed his B.E (Civil) degree from Bangalore Institute of Technology and M.E (Construction Technology) from UVCE Bangalore. Has immense Industrial/site experience having worked at Gina Engineering Company Private Limited, Nitesh Estates Private Limited and Bharathiya Reserve Bank Note Mudran Private Limited. Has teaching Experience at East Point College of Engineering, Bangalore. Presently he is working as an Assistant Professor in Department of Civil Engineering at Government Engineering College, Hassan.

RESEARCH ARTICLE OPEN ACCESS

Planning and Scheduling of High Rise Building Using Primavera

T. Subramani[1], A. Sarkunam[2], J. Jayalakshmi[3]
Professor & Dean, Department of Civil Engineering, VMKV Engg. College, Vinayaka Missions University Salem, India.
PG Student of Construction Engineering and Management, Department of Civil Engineering, VMKV Engg.College,Vinayaka Missions University, Salem, India.
PG Student of Structural Engineering, Department of Civil Engineering, VMKV Engg. College, Vinayaka Missions University, Salem, India.

ABSTRACT
Although the long-introduced Industrialized Building System (IBS) has promised to solve and improve the current construction method and scenario in our country, but the IBS method has not gained enough popularity. One of the reasons is due to lack of research works done to quantifying the benefit of IBS especially in construction time saving. In lieu with such scenario, this study conducted to quantify evidence of time saving in IBS application. The methodology adopted for this study is by modelling the construction process for high-rise residential building for both conventional and IBS with shared more a less the same nature and size of the structure. The model was developed using Primavera (P3) project planning software. The comparison was made by comparing selective building components for both method of construction. Different high-rise residential projects have been selected for this study. The result of the study clearly indicated that sufficient time saving can be archived. Also from this study shown not all IBS components can improved to the overall construction duration, however by adopting IBS components can improve and expedite the construction of 18 stories residential building from the point of departure of the project throughout of the whole of project's with a total 405 days or 42% the time saving.
KEYWORDS: Planning, Scheduling, High Rise Building, Primavera

I. INTRODUCTION

Due to an increasingly competitive environment, construction companies are forced to be more efficient and achieve competitive operational advantage. Companies are always looking for improvements in equipment features, communication tools, efficient management techniques, and training human resources. Construction companies are also narrowing their focus, becoming specialists in certain types of construction projects. This specialization requires more focused project planning and controlling techniques that prove to be better for certain type of projects while providing specialized construction services. The benefits of effective planning, scheduling and control of construction projects are: reduced construction time, reduced cost overruns and the minimization of disputes.

These benefits accrue to the contractors, owners, suppliers and workers in the form of improvements in productivity, quality and resource utilization. (Mattila and Abraham, 1998) been applied to highway type construction projects by the transportation departments in most states. The ability of CPM to these kinds of projects raises questions (Selinger, 1980; Reda, 1990; and Russell and Wong, 1993). Line of Balance (LOB) and its variations are developed to search for a better solution for highway type projects, such as tunnel construction, high rise building, pipe line projects, and even utility projects. Some researchers declare that LOB software is ready for commercial usage (Arditi, Sikangwan, and Tokdemir, 2002).

However utility projects have their own features. The application of LOB and Linear scheduling techniques in utility projects are questioned by industrial professionals. For the underground utility project, the layouts of several utility lines are diverged. But on some locations, these utility lines intersect with each other, one over another. The construction of each utility line must be sequenced in this situation to avoid workspace conflicts, or lines with higher elevation are constructed ahead of the ones with lower elevation, and to provide work continuity for crews or resources.

This study will focus on the comparison of construction scheduling technique application in utility projects, such as Gantt chart, CPM, and LOB, and indicate advantages and disadvantages of each technique. It develops the modified LOB method which uses a group of linear equations to identify the construction interference locations of utility lines, estimate the interference time based on the historical production rate, and adjust the construction schedule to satisfy the construction constraints. It helps to avoid the construction interruption, keep the

continuity of crew work, and avoid the delay of construction and cost overruns.

1.1 CURRENT SCHEDULING METHODS IN CONSTRUCTION INDUSTRY

The most common scheduling method used in the construction industry is the Gantt chart (Bar Chart) and Critical Path Method (CPM). Gantt chart (Bar chart) has gained wide acceptance and popularity because of its simplicity and ease of preparation and understanding. No "theory" or complicated calculations are involved. CPM network can show logic dependencies of activities, and estimate and predict the completion date of the project based on mathematical calculations. But both Gantt chart and CPM are unable to accurately model the repetitive nature of linear construction. This includes the inability of CPM to provide work continuity for crews or resources, to plan the large number of activities necessary to represent a repetitive or linear project (Harris, 1996), and the inability of Gantt chart (Bar chart) and CPM to indicate rates of progress, and to accurately reflect actual conditions. (Mattila and Abraham,1998). The consequence of this is that there have been many attempts to find an effective scheduling technique for linear construction. These include, but not limited to, the Line of Balance (LOB), the vertical production method (VPM), the linear scheduling method, the repetitive project modeling (RPM), the linear scheduling model (LSM), and the repetitive scheduling method (RSM). (Mattila and Abraham,1998). All of these concepts and methods are the variations of LOB, which is originally developed in the manufacturing industry. This section discusses the popular scheduling methods in construction industry, such as Gantt chart and CPM, review current application of LOB and its variations, and indicates the inability of LOB in solving the construction interferences of two or more utility lines.

1.2 GANTT CHART SCHEDULING METHOD

The bar chart was originally developed by Henry L. Gantt in 1917 and is called a Gantt chart. A bar chart is "a graphic representation of project activities which are shown in a time-scaled bar line with no links shown between activities" (Popescu and Charoenngam, 1995). It quickly became popular in construction industry because of its ability to graphically represent a project's activities on a time scale. A bar chart has become a vehicle for representing many pieces of a project's information. A project must be broken into smaller, usually homogeneous components, each of which is called an activity or task. Bar charts basically use the x-axis to depict time, and the y-axis is used to represent individual activities. (Fig.1.1& Fig.1.2)

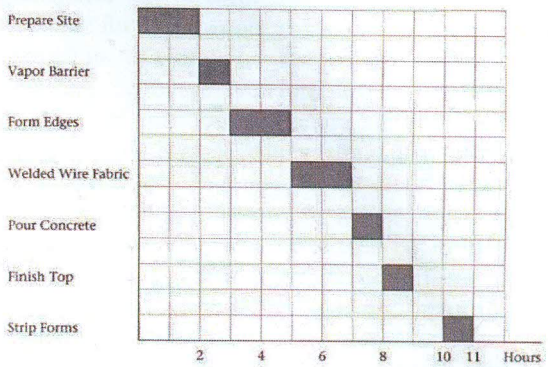


Figure1.1Bar Chart for Placing a Slab on a Grade (Mubarak, 2003)

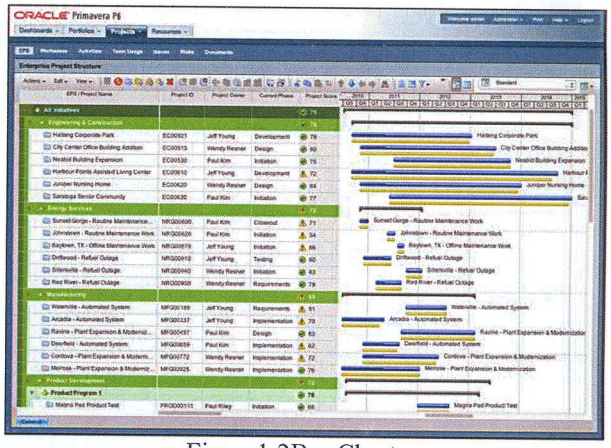


Figure1.2Bar Chart

1.3 Advantage of Bar Chart

Bar charts have gained wide acceptance and popularity mainly because of their simplicity of and ease of preparation and understanding. No "theory" or complicated calculations are involved. Anyone can understand them. Bar charts particularly appeal to persons who do not have a technical background. For example, some clients and upper-level managers may better understand the plan for carrying out a construction project by looking at a bar chart than by looking at a schematic of logic network. The advent of the critical path method (CPM) and the evolution of powerful computers, bar chart did not perish or lose importance. Instead, they evolved to a different supporting role that made them more valuable and popular. (Mubarak, 2003). The advantage of bar chart can be concluded as:

- Bar charts are time scaled, the length of the activity bar represents the time duration of the activity). Both the node, in the node networks, and the arrow, in the arrow networks, are not time-scaled.
- Bar chart are simple to prepare
- Bar chart are easy to understand

- Bar chart are acceptable for presentation, especially for field people and people who are unfamiliar with the CPM
- Bar charts can be loaded with more information, such as cash-flow diagrams and man-hours.

Limitation

The main limitation of bar chart is lack of logical representation. Bar charts do not reveal the answers of relationship. Although some software programmers tried to depict logical relationships on bar charts, the result was not always clear. The logic lines would get tangled, and unlike networks, bar charts do not allow the length of the bars to be changed or moved around to make items clearer or look better. (Mubarak, 2003). While applying the bar chart to linear construction project, a huge diagram would repeat *n* times in scheduling linear and repetitive project. And the bar chart is unable to indicate progress rate and actual location.

1.4 Network Scheduling Method

One of the major network scheduling methods which have been used in the construction industry is CPM (critical path method). This method involves the use of a geometric representation of flow chart which depicts the precedence between activities. The critical path method (CPM) is a duration-driven technique in which the basic inputs are project activities, their durations, and dependence relationships. Activity durations are functions of the resources required (rather than available) to complete each activity. The CPM formulation assumes that resources are not restricted in any sense (Ammar and Mohieldin, 2002). The use of network techniques and CPM by construction companies has reached a steady level after the enthusiastic boom of the early 1960's. Computer programmes eliminate the need to prepare a network, but the network notation provides an easily understood output format for management personnel. (Lutz and Hijazi,1993)

1.5 Advantages of Network Scheduling Method

When comparing bar charts with networks, three advantages over bar charts(Mubarak, 2003):

- Network show logic, the relationships among the activities. Bar charts do not
- Networks can better represent large and complicated projects.
- Networks can estimate, or predict, the completion date of the project, or other dates, on the basis of mathematical calculations of the CPM

Limitation of Network Scheduling Method

Comparing to bar charts, network scheduling is not time scaled. It requires practitioners to be trained to understand the CPM. From the authors' experiences, the presentation of CPM is not as acceptable for field people as bar chart. And resource information can not be loaded in CPM. Some scheduling software vendors tried to take the advantage of time-scaled feature of bar chart and impose it on network which some persons called time-scaled logic diagrams. On the other hand, there is evidence that contractors do not use networks in highly repetitive jobs because of their belief that high repletion would reduce the chances of successful scheduling and control by networks (Arditi and Albulak, 1986).

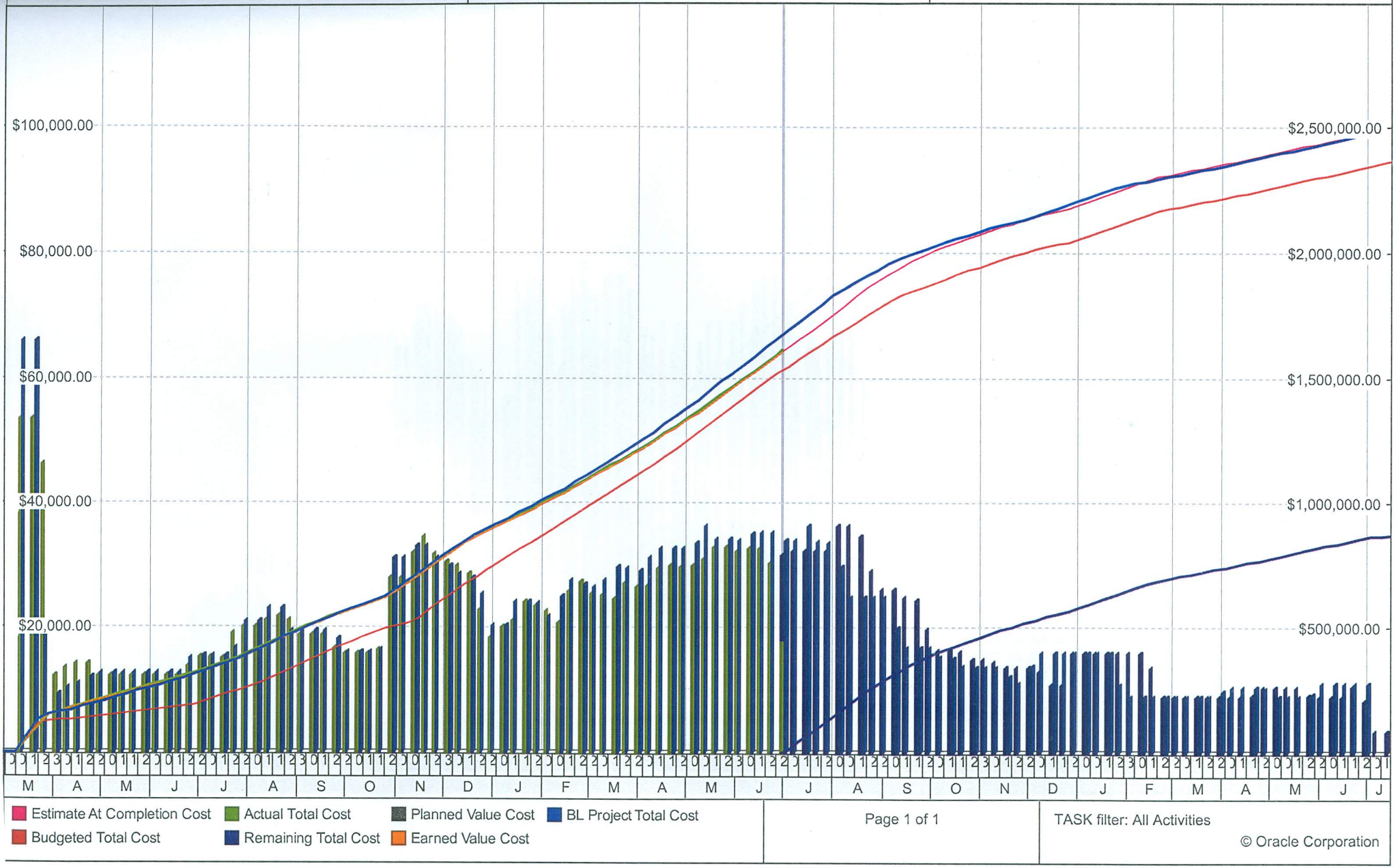
For example, network method presents complications in projects of repetitive nature such as high rise building construction. CPM-based techniques have been criticized widely in the literature for their inability to model repetitive projects (Russell and Wong, 1993). The first problem is the sheer size of the network. In a repetitive project of n units, the network prepared for one unit has to be repeated *n* times and linked to the others; this results in a huge network that is difficult to manage.

This may cause difficulties in communication among the members of the construction management team. The second problem is that the CPM algorithm is designed primarily for optimizing project duration rather than dealing adequately with the special resource constraints of repetitive projects. The CPM algorithm has no capability that would ensure a smooth procession of crews from unit to unit with no conflict and no idle time for workers and equipment. This leads to hiring and procurement problems in the flow of labor and material during construction (Arditi, Sikangwan, and Tokdemir, 2002).

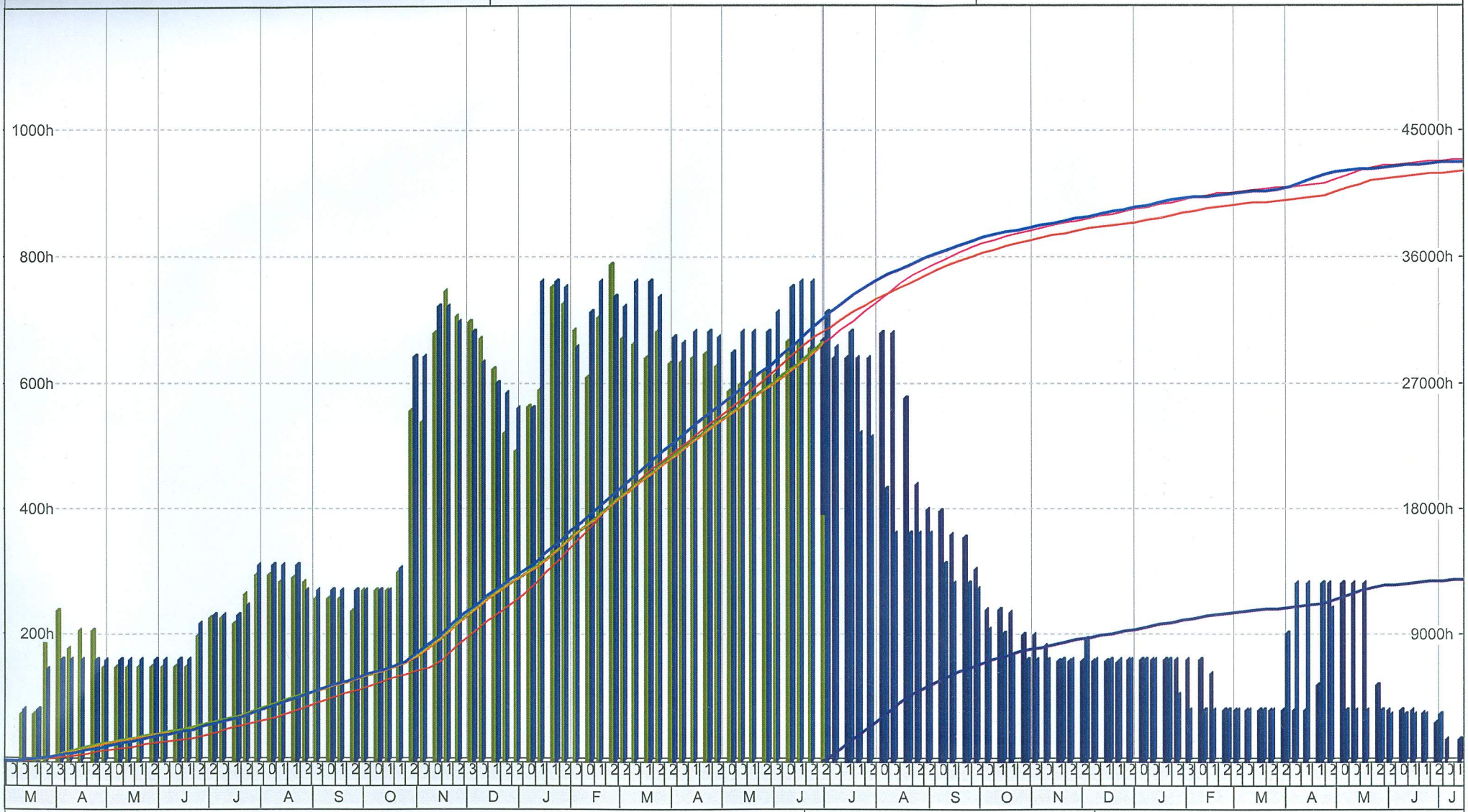
A new format was developed for work of a repetitive nature, such as work on floors in a high-rise project, or work on sections in underground pipe line or utility line project. In the pipe line or utility line instance, the use of basic CPM was laborious; the input for work on a typical section was duplicative and tedious. Further, once the schedule had reached the typical section, it was possible to predict a result through basic arithmetic without the use of a computer. This suggested that there were ways of graphing the result other than network presentation; this realization resulted in the development of some methods for use in linear and repetitive projects. Line of balance (LOB) method is one of them using a unit network to portray repetitive activities.(Fig.1.3)

Activity ID	Budgeted Total Cost	Actual Cost	Planned Value Cost	Earned Value Cost	Cost Variance	Cost Variance Index	Remaining Total Cost	Estimate At Completion Cost	Variance At Completion	Budget At Completion
A1500	$5,984.00	$0.00	$0.00	$0.00	$0.00	0.00	$5,984.00	$5,984.00	$0.00	$5,984.00
A1510	$5,984.00	$0.00	$0.00	$0.00	$0.00	0.00	$5,984.00	$5,984.00	$0.00	$5,984.00
Dasu Jun-1	$108,384.00	$49,807.60	$57,216.00	$48,865.60	($942.00)	-0.02	$59,518.40	$109,326.00	($942.00)	$108,384.00
A1520	$11,968.00	$12,410.00	$11,968.00	$11,968.00	($442.00)	-0.04	$0.00	$12,410.00	($442.00)	$11,968.00
A1530	$36,000.00	$36,500.00	$36,000.00	$36,000.00	($500.00)	-0.01	$0.00	$36,500.00	($500.00)	$36,000.00
A1540	$5,984.00	$897.60	$5,984.00	$897.60	$0.00	0.00	$5,086.40	$5,984.00	$0.00	$5,984.00
A1550	$5,984.00	$0.00	$3,264.00	$0.00	$0.00	0.00	$5,984.00	$5,984.00	$0.00	$5,984.00
A1560	$2,992.00	$0.00	$0.00	$0.00	$0.00	0.00	$2,992.00	$2,992.00	$0.00	$2,992.00
A1570	$5,280.00	$0.00	$0.00	$0.00	$0.00	0.00	$5,280.00	$5,280.00	$0.00	$5,280.00
A1580	$5,280.00	$0.00	$0.00	$0.00	$0.00	0.00	$5,280.00	$5,280.00	$0.00	$5,280.00
A1590	$12,496.00	$0.00	$0.00	$0.00	$0.00	0.00	$12,496.00	$12,496.00	$0.00	$12,496.00
A1600	$2,400.00	$0.00	$0.00	$0.00	$0.00	0.00	$2,400.00	$2,400.00	$0.00	$2,400.00
A1610	$2,400.00	$0.00	$0.00	$0.00	$0.00	0.00	$2,400.00	$2,400.00	$0.00	$2,400.00
A1620	$17,600.00	$0.00	$0.00	$0.00	$0.00	0.00	$17,600.00	$17,600.00	$0.00	$17,600.00
Dasu Jun-1	$929,792.00	$534,610.00	$531,552.00	$534,364.00	($246.00)	0.00	$395,428.00	$930,038.00	($246.00)	$929,792.00
A1630	$2,992.00	$2,788.00	$2,992.00	$2,992.00	$204.00	0.07	$0.00	$2,788.00	$204.00	$2,992.00
A1640	$7,200.00	$7,650.00	$7,200.00	$7,200.00	($450.00)	-0.06	$0.00	$7,650.00	($450.00)	$7,200.00
A1900	$919,600.00	$524,172.00	$521,360.00	$524,172.00	$0.00	0.00	$395,428.00	$919,600.00	$0.00	$919,600.00

TASK filter: All Activities



TASK filter: All Activities



TASK filter: All Activities