The McGraw-Hill Companies

Project Management Handbook

For Engineers, Construction Professionals and Business Managers

The McGraw-Hill Companies

Project Management Handbook

For Engineers, Construction Professionals and Business Managers

Dr. Uddesh Kohli Lt. Col. (Retd) KK Chitkara, AVSM

Tata McGraw-Hill Publishing Company Limited

NEW DELHI

McGraw-Hill Offices

New Delhi New York St Louis San Francisco Auckland Bogotá Caracas
Kuala Lumpur Lisbon London Madrid Mexico City Milan Montreal
San Juan Santiago Singapore Sydney Tokyo Toronto

The McGraw-Hill Companies

Tata McGraw-Hill

Published by Tata McGraw-Hill Publishing Company Limited,
7 West Patel Nagar, New Delhi 110 008.

ISBN 0-07-062105-5

Head—Professional and Heathcare*: Roystan La'Porte*
Publishing Manager—Professional*: R Chandra Sekhar*
Editorial Executive: *Souvik Mukherjee*
Senior Copy Editor*: Sandhya Iyer*

Asst General Manager—Production: *B.L. Dogra*
Junior Manager—Production: *Sohan Gaur*

Typeset at Bharati Composers, A-1/402, Sector-VI, Rohini, Delhi 110 085, and printed at Sai Printo Pack Pvt. Ltd., A-102/4, Okhla Industrial Area, Phase II, New Delhi 110020

Cover design: Kapil Gupta

Cover Printer: SDR Printers

RCZYCRDYDRRYR

The McGraw-Hill Companies

On the 60th Year of India's Independence

Dedicated to the martyrs
who sacrificed their lives to free the Indian Sub-continent from the colonial rule

Let us resolve to perform with devotion and

to strive towards excellence in all spheres of individual and collective activity, so that the nation constantly rises to higher levels of endeavour and achievement

requires general management, technical and interpersonal skills. Commendable work on the development of the body of knowledge for managing modern projects has been done by the Project Management Institute (PMI), The International Project Management Association (IPMA), International Standards Organisation (ISO), and many other management education and training institutes/agencies in project management.

Project Management Handbook briefly describes project management techniques and practices as applicable in engineering and construction related projects. These projects employ vast resources of men, materials, machinery, money and management to build a facility. Perhaps no other industry in the world can provide such a large scope for cost and time reduction, at micro-level as in the engineering and construction industry. However, these techniques and practices, with some pluses-minuses, can be applied to all types of business related projects.

Project Management Handbook covers the state of the art knowledge areas for learning and practicing project management. It is illustrated with live case studies. Each chapter of this book can be expanded into a volume, but its scope has been restricted to a manageable size by making trade-offs between technique elaboration and their application. Due to limited printing space, large size illustrations and detailed explanations are omitted. In this book, the words like chairman, foreman, tradesman, he and his, are used to refer to persons of either gender. This does not eliminate or downgrade the importance of women in project management. This book presupposes that the readers possess basic engineering knowledge and familiarity with the general management processes and practices.

Projects are risky by definition. It is a project manager and the project team, who skillfully accomplish the assigned mission of achieving the specified project objectives. The crises, uncertainties, risks and pitfalls in project work, continually test the mettle of these managers. Clearly this is not the field for the timid and the untrained. The success of a project hinges on the competency of the project manager and the project team. This book is designed for use by:

- Engineering and construction project managers and their team members,
- Managers in corporate office dealing with the management and execution of engineering and construction projects,
- Academician, trainers and trainees connected with project management,
- Consultants and specialists like architects, engineers, quantity-surveyors, accountants, and other managers associated with projects.

- Practising engineers and students studying project management and those new to the concept and techniques used in project management.

This book is a collation of the authors' rich experience of over 35 years at senior levels in the management of projects, both in national and international arenas. Despite the best efforts by the publishers and authors, the possibility of some errors or misinterpretation cannot be ruled out. Authors welcome readers' comments to make improvements in this book. For in-depth study in project management techniques, the readers may also refer to K K Chitkara's book titled *Construction Project Management: Planning, Scheduling and Controlling* and CD-ROM on *Construction Project Management: Techniques and Practice*; both published by McGraw-Hill Education.

It is hoped that the subject covered in this book will stimulate discussions and enable further development of this subject.

Dr Uddesh Kohli
uddeshkohli@yahoo.com

Lt Col (Retd). K K Chitkara, AVSM
chitkara@nda.vsnl.net.in

The authors express their sincerest thanks to Engineering Council of India, for permitting to reproduce their 'Code of Ethics' for the professional engineers in India and the support extended in writing this book.

Authors thank R. Chandra Sekhar, Publishing Manager, and the team at McGraw-Hill Education (India) for their untiring efforts in bringing this book to its present form.

Last but not the least, we are thankful to our family for their understanding and continued support which saw us through the extended working hours.

Dr Uddesh Kohli
uddeshkohli@yahoo.com

Lt Col (Retd). K K Chitkara, AVSM
chitkara@nda.vsnl.net.in

Disclaimer: Despite their best efforts, the author, supporters and contributors, accept no responsibility for any inaccuracy, errors or omissions in the contents of this book.

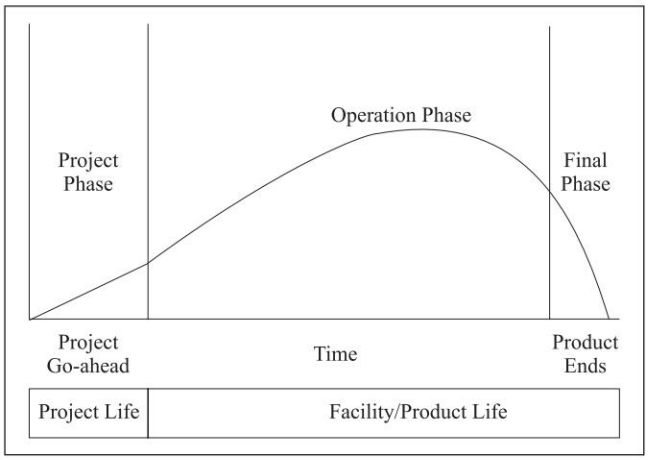
1

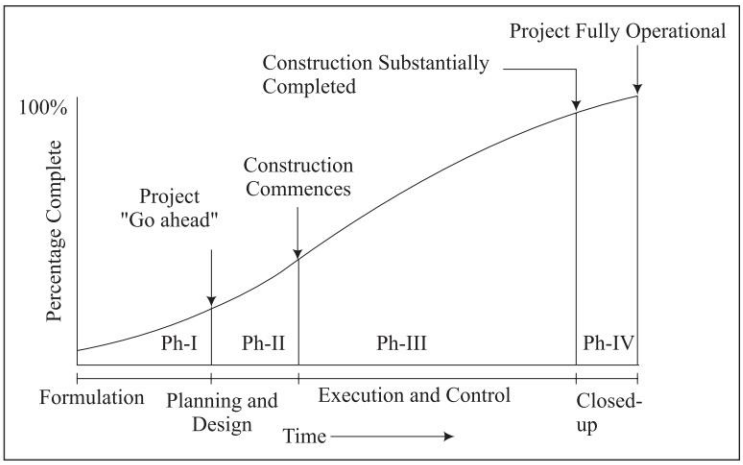
1. INTRODUCTION AND SCOPE

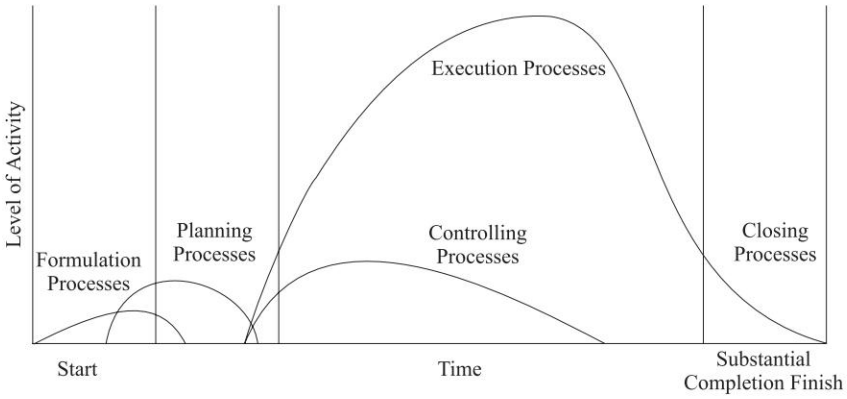
Project activity has been in existence since cavemen began building their dwellings. Over the years man has created architectural marvels which are now regarded as wonders of the world. These include the Pyramids of Egypt, the Great Wall of China and the Angkor temples of Cambodia. The medieval times witnessed the creation of marvels like Taj Mahal in India and the Leaning Tower of Pisa in Italy. A more recent example of man's achievement in this direction is the Eiffel Tower in Paris.

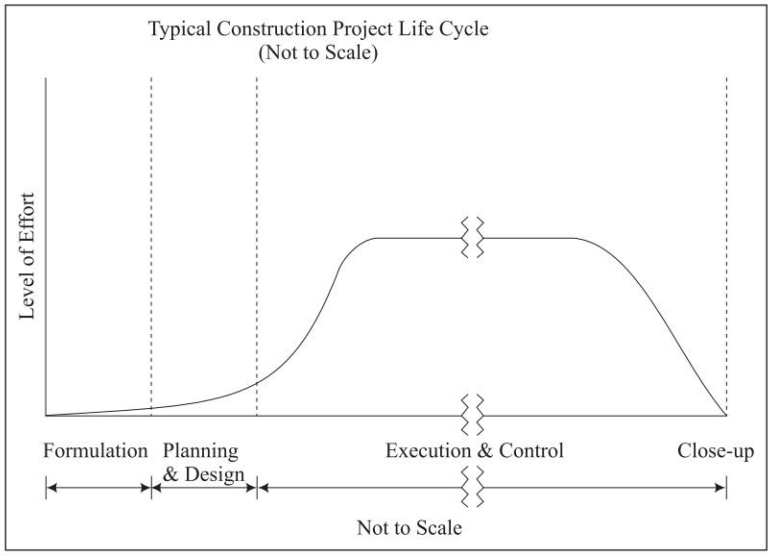
In today's world, technical breakthroughs have revolutionised project activity. Modern project areas include high-rise buildings, dams and irrigation networks, energy conversion and industrial plants, environmental protection works and infrastructural facilities like roads, bridges, railways, airports and seaports, satellite launching stations, onshore and offshore oil terminals.

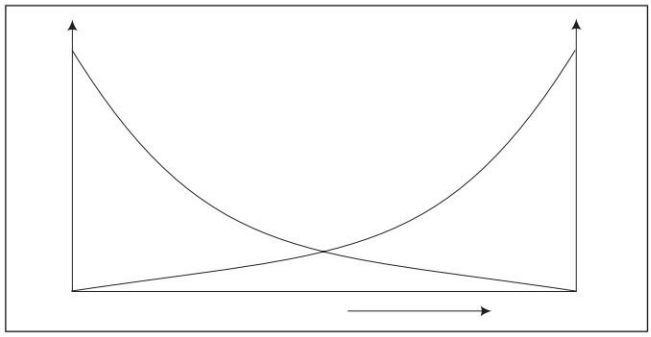
Modern projects and practices differ from those of the past. The fast changing environments of the present era impose numerous time, cost, financial, legal, ethical, and

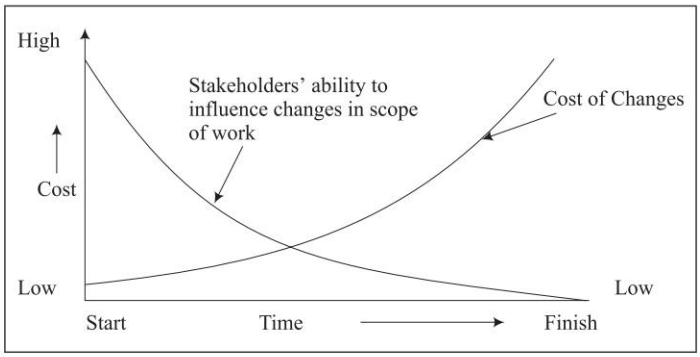


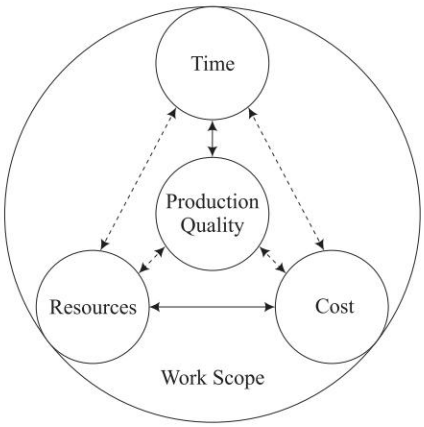

Project Fully Operational
Construction Substantially Completed
100%
Percentage Complete
Construction Commences
Project "Go ahead"
Ph-I
Ph-II
Ph-III
Ph-IV
Formulation
Planning and Design
Execution and Control
Closed-up
Time

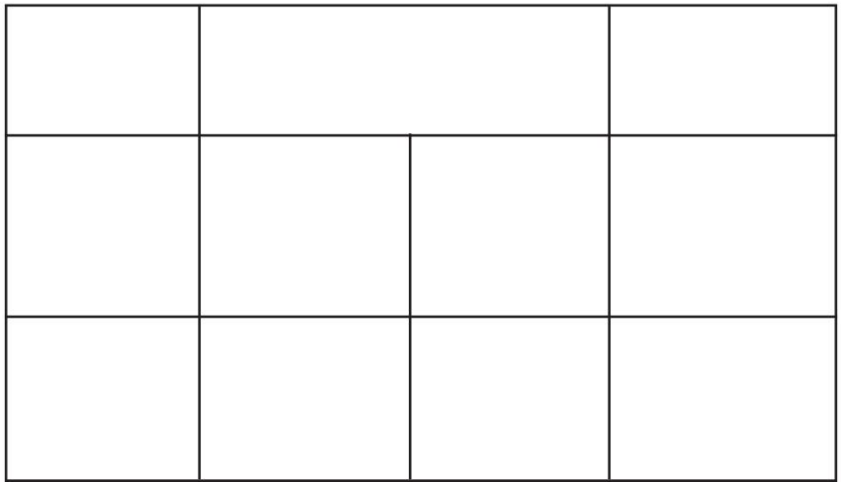

Level of Activity
Execution Processes
Planning Processes
Controlling Processes
Closing Processes
Formulation Processes
Start
Time
Substantial Completion Finish

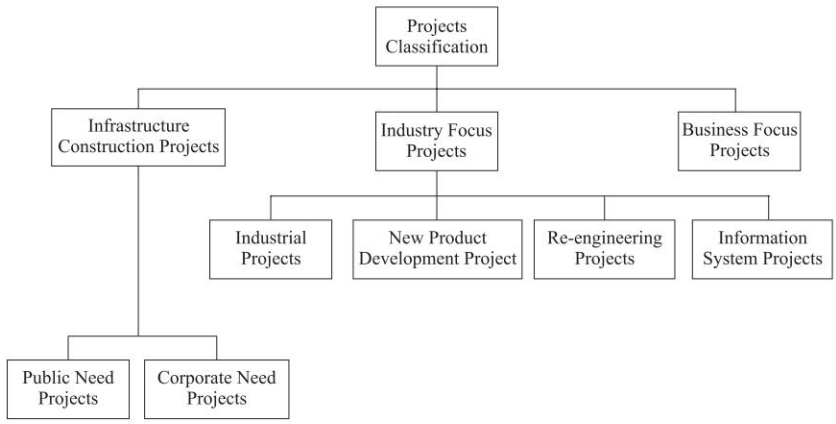

Typical Construction Project Life Cycle
(Not to Scale)
Level of Effort
Formulation
Planning
& Design
Execution & Control
Close-up
Not to Scale

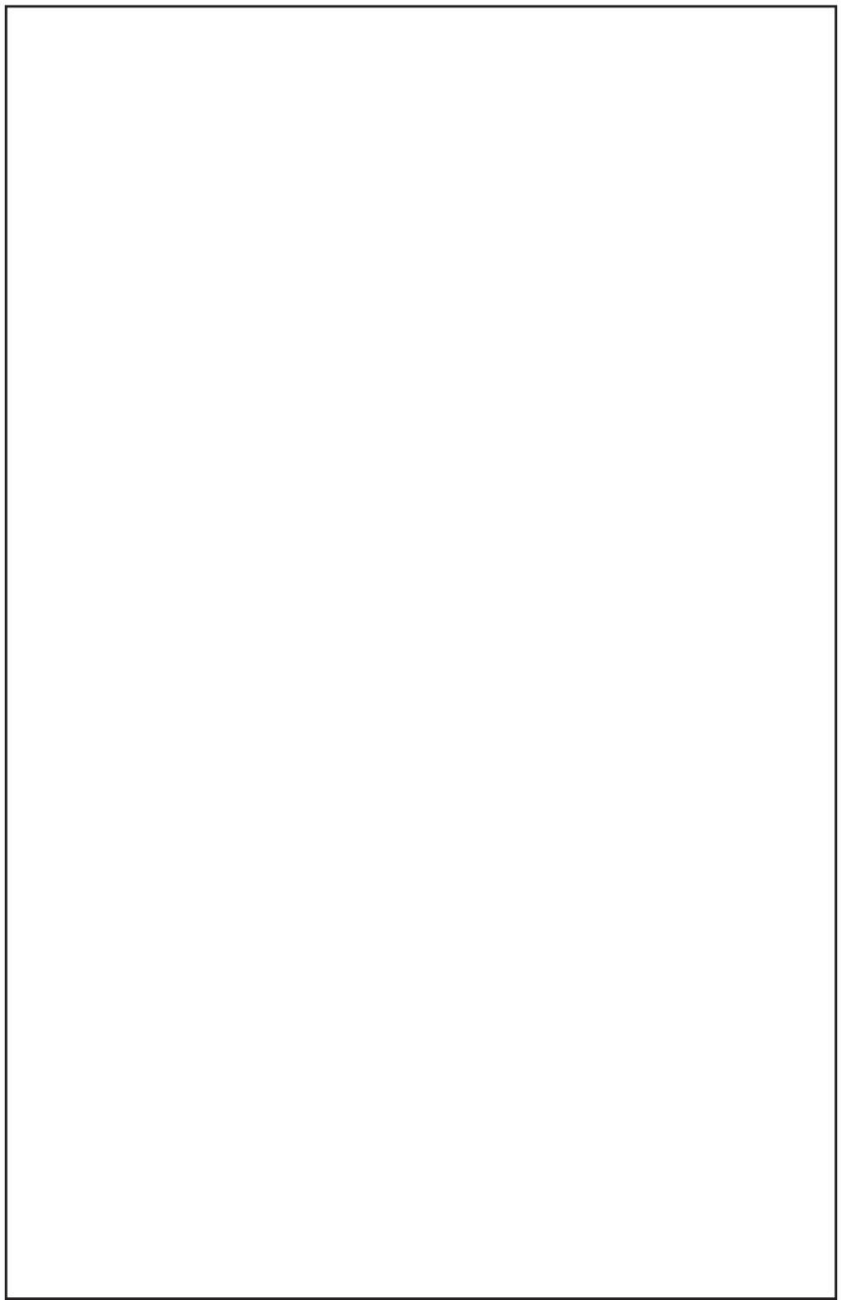


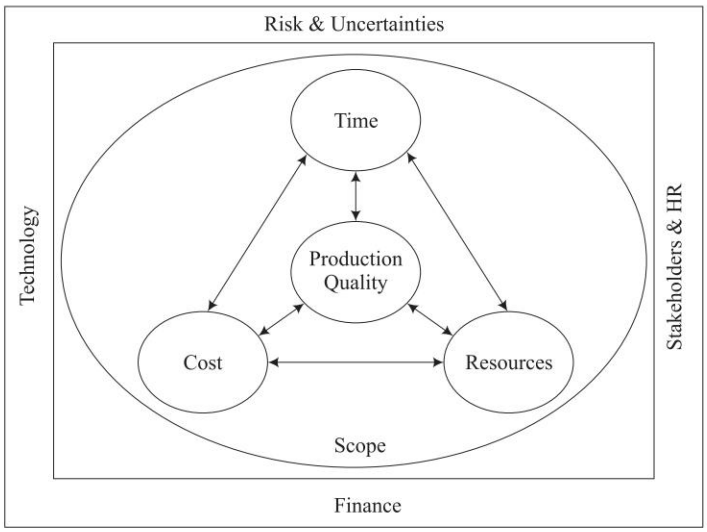

High
Stakeholders' ability to influence changes in scope of work
Cost of Changes
Cost
Low
Low
Start
Time
Finish

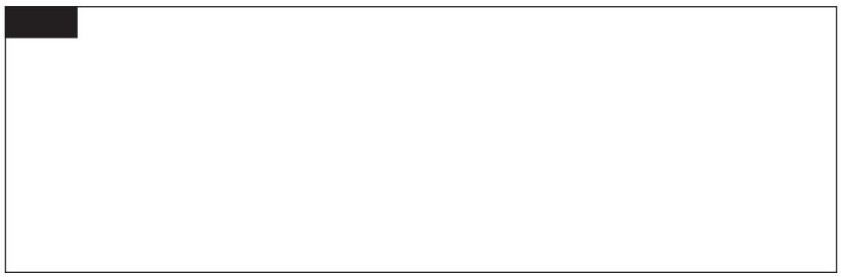

Time
Production
Quality
Resources
Cost
Work Scope

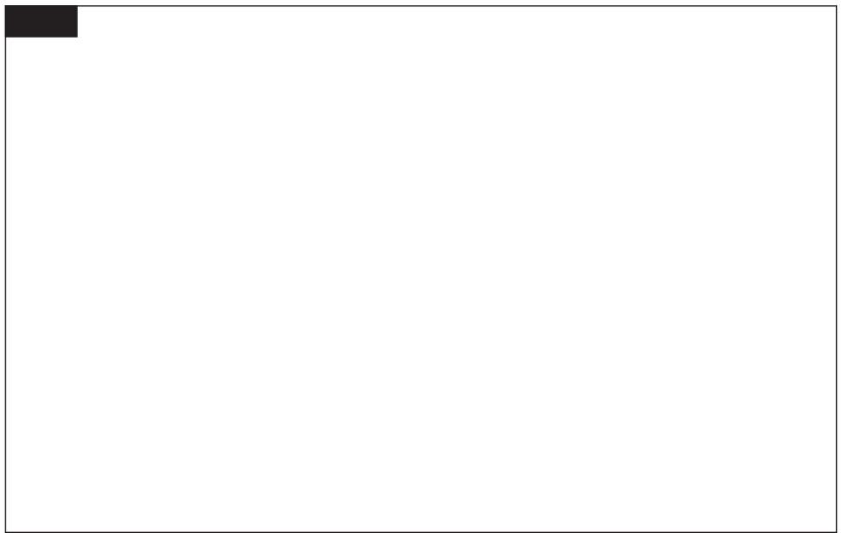


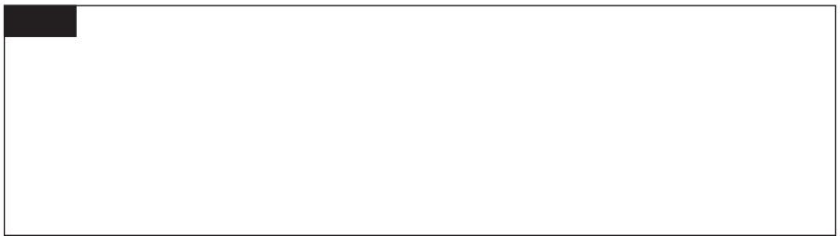

Projects Classification
Infrastructure Construction Projects
Industry Focus Projects
Business Focus Projects
Industrial Projects
New Product Development Project
Re-engineering Projects
Information System Projects
Public Need Projects
Corporate Need Projects

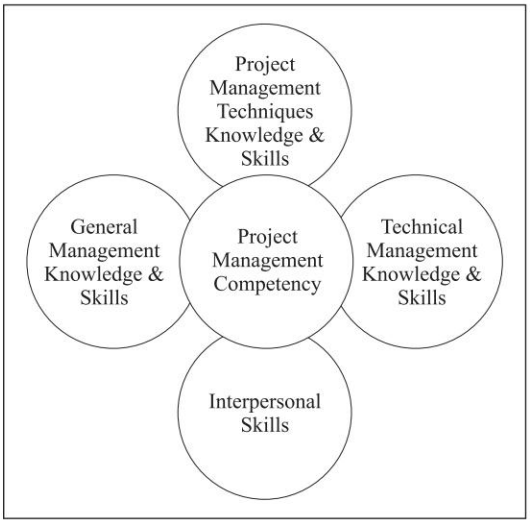



Risk & Uncertainties
Time
Production
Quality
Cost
Resources
Scope
Technology
Stakeholders & HR
Finance







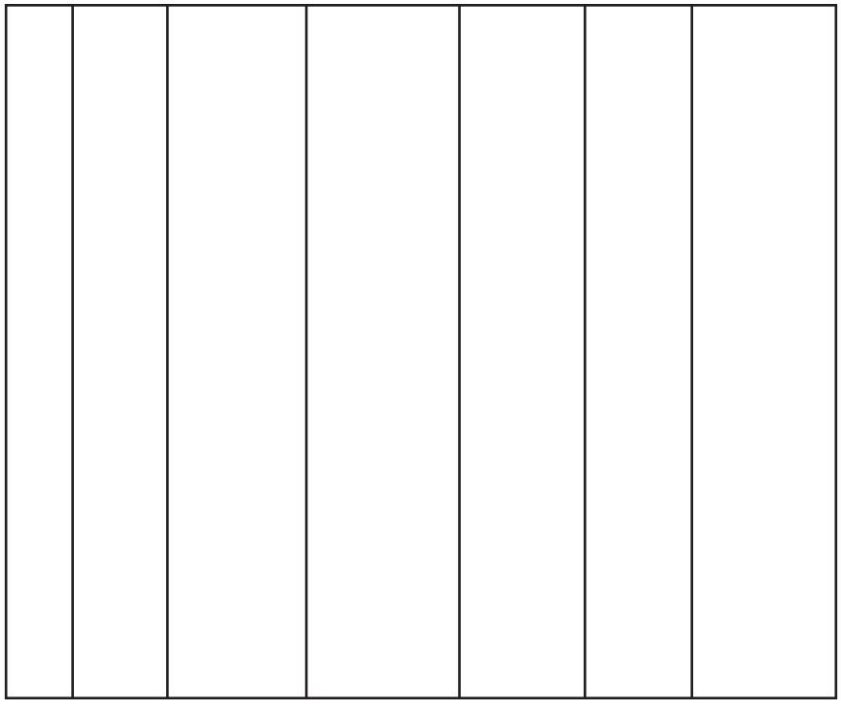

Project Management Techniques Knowledge & Skills
General Management Knowledge & Skills
Project Management Competency
Technical Management Knowledge & Skills
Interpersonal Skills

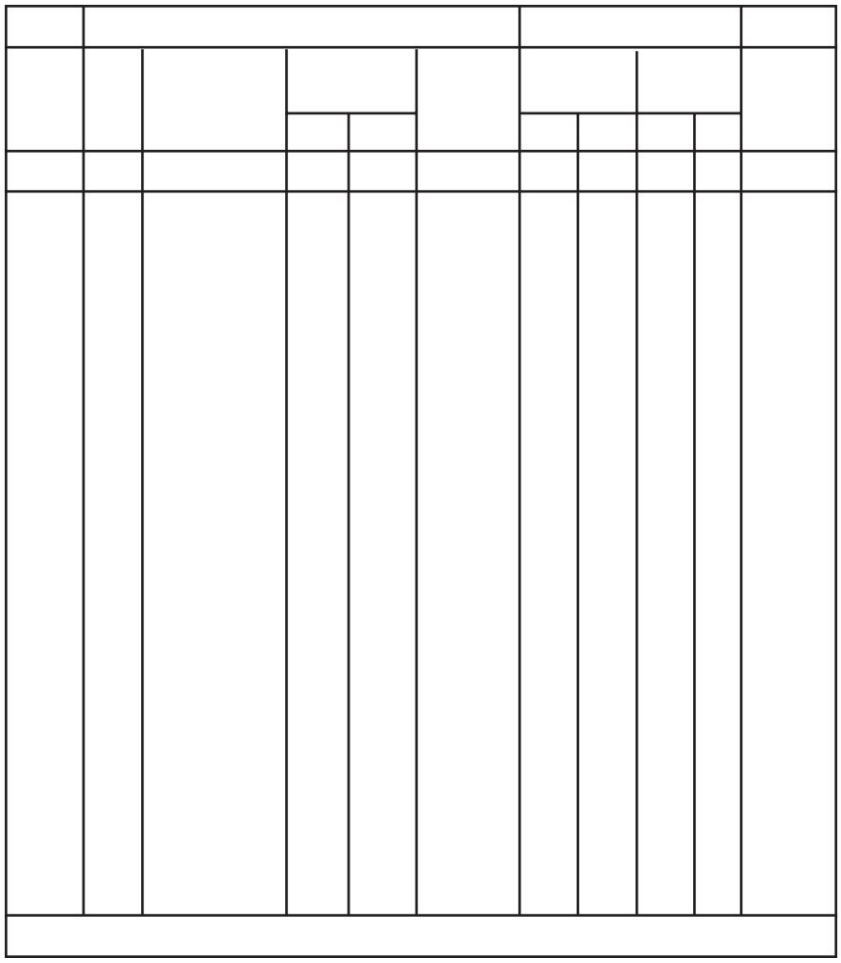
2

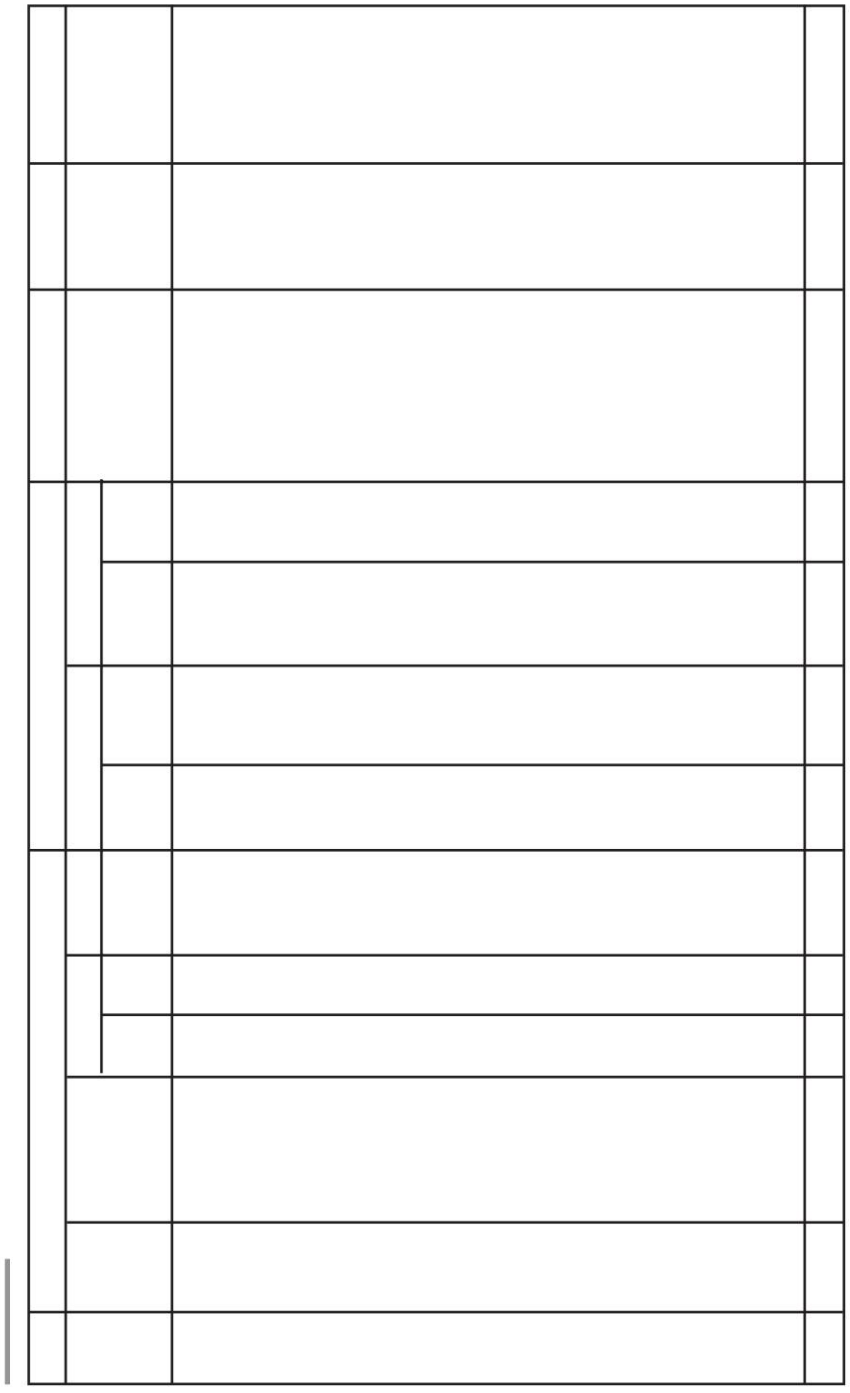
1. INTRODUCTION

Project formulation involves the development of the concept of the project, defining its various parameters, conducting feasibility study, undertaking investment appraisal and making the decision to invest in the project.

The main aspects which need to be covered for developing the project concept and conducting the feasibility study include salient features, need and justification,







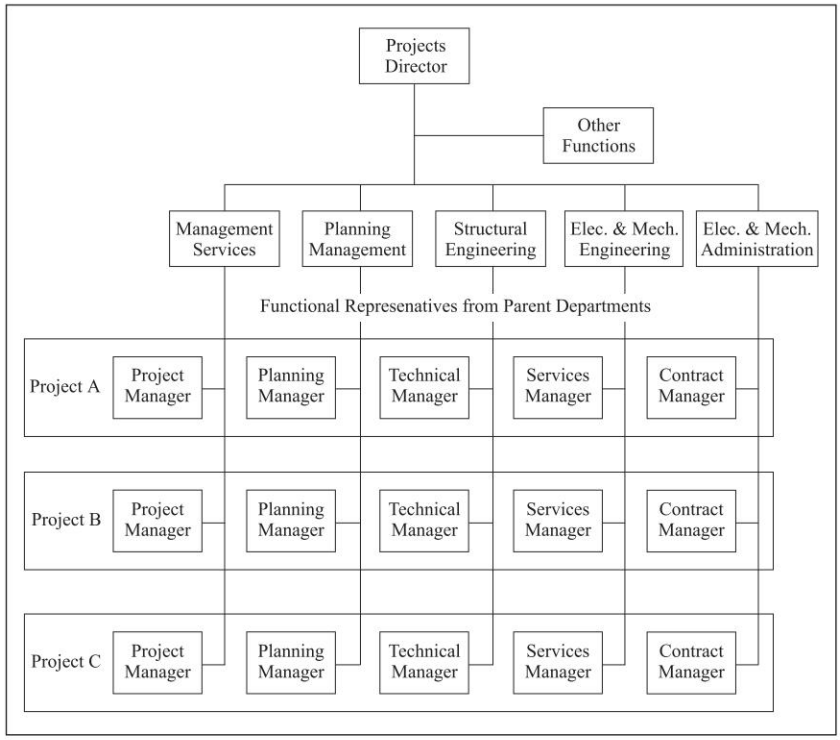
3

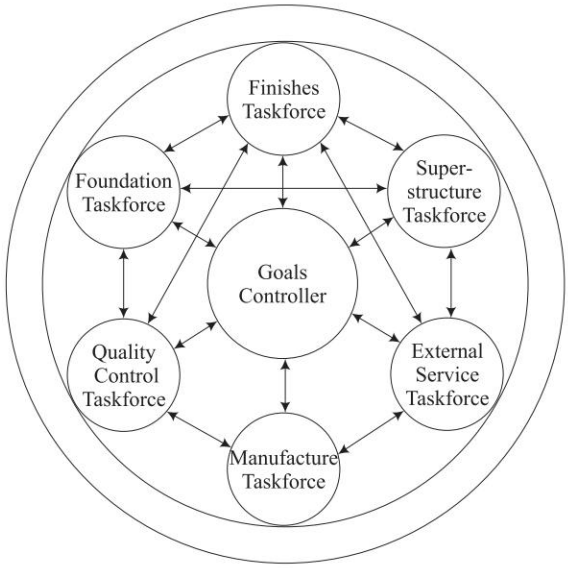
Introduction and Scope
Project Organisation Concept
Project Management Organisation
Project Performing Organisation Structure
Responsibility Assignment Matrix (RAM)Chart
Code of Ethics
Leadership in Project Management

1. INTRODUCTION AND SCOPE

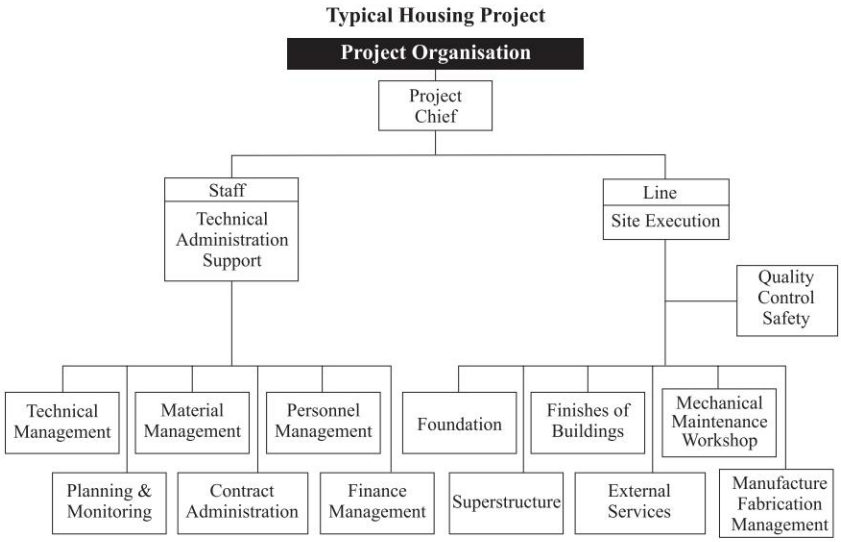
Organisation enables a group of people working together with divided tasks and responsibilities, to coordinate their activities harmoniously in order to achieve a common goal. In today's competitive world, the crossing of many boundaries—functional, geographic, organisational—is becoming a way of life. The corporate world is undergoing a silent revolution in organisational changes. Emerging organisations have many forms. These include grouping of activities by functions, products, processes, location, countries, or a combination of these. Project-driven corporate, who manage their operations by projects, are generally organised in matrix form as shown in Fig. 3.1.

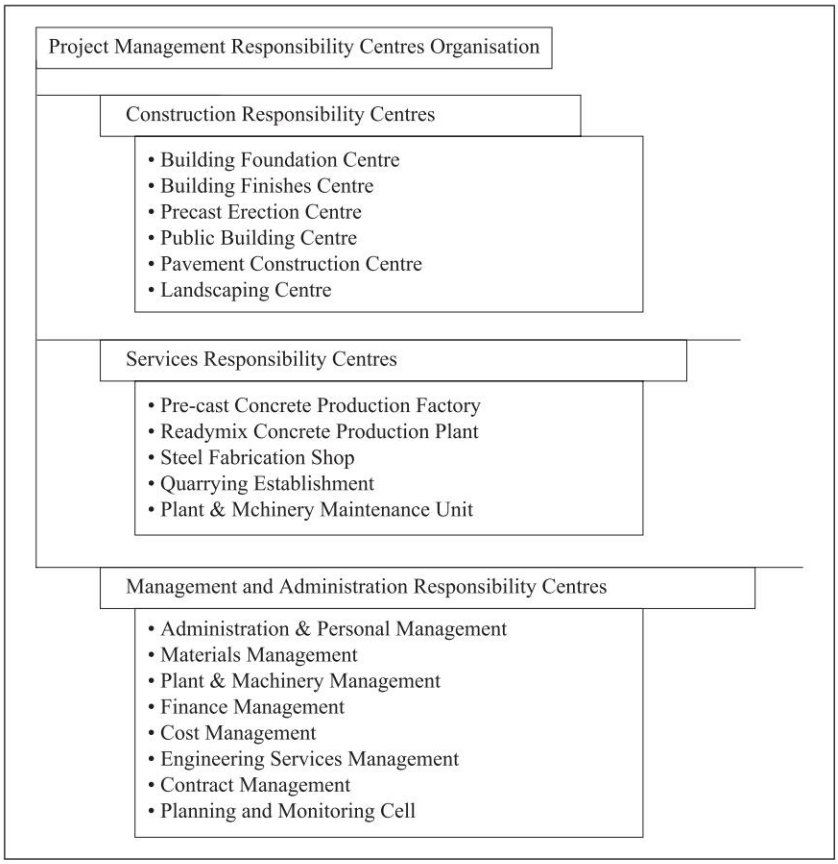
In the project management matrix structure, the key staff is derived from their respective parent departments in a corporate office and their interfaces and communication links are clearly defined. It has a single project manager accountable for the whole project. Project management, working as a team, performs basic management functions of planning, organising, staffing, directing, controlling and coordinating the assigned project work. All managers owe their allegiance to the project manager and not to their parent departmental heads.

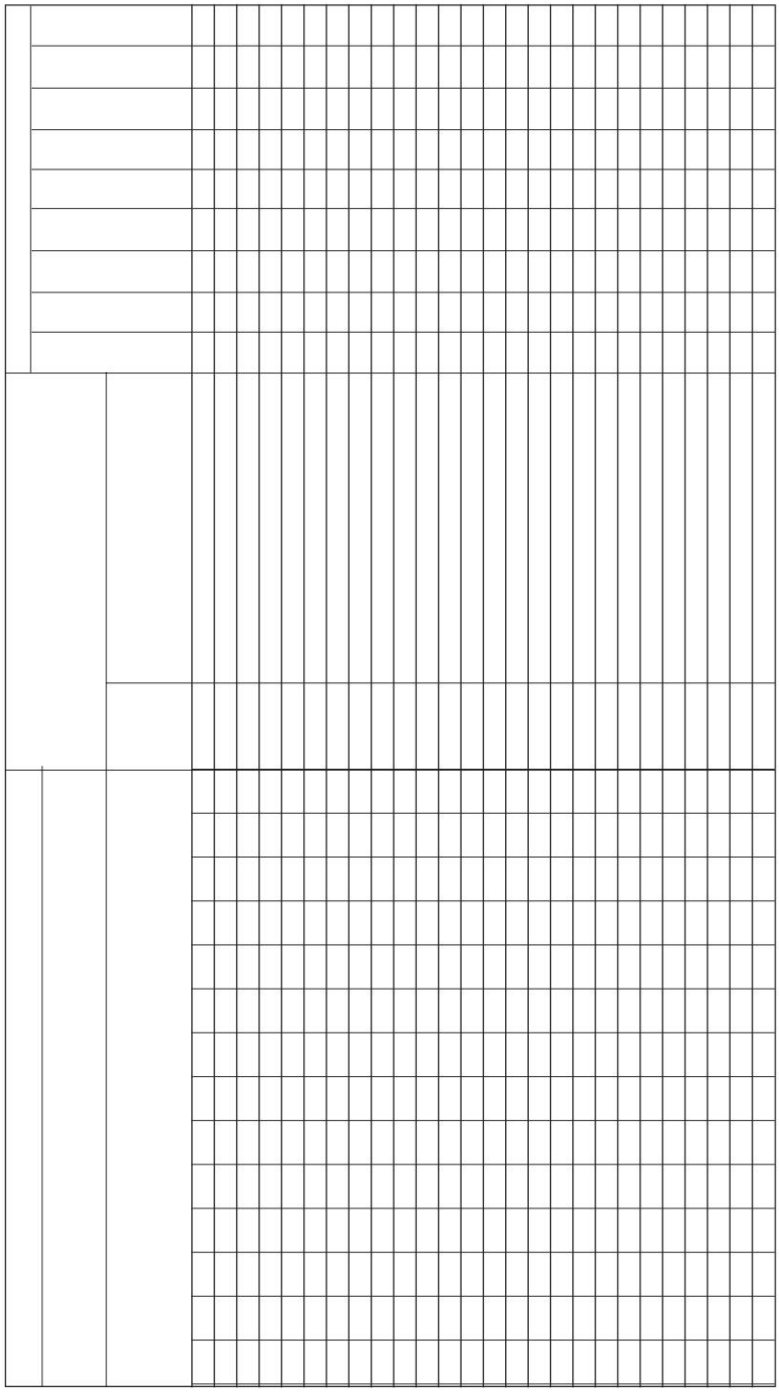

Projects Director
Other Functions
Management Services
Planning Management
Structural Engineering
Elec. & Mech. Engineering
Elec. & Mech. Administration
Functional Represenatives from Parent Departments
Project A
Project B
Project C
Project Manager
Planning Manager
Technical Manager
Services Manager
Contract Manager

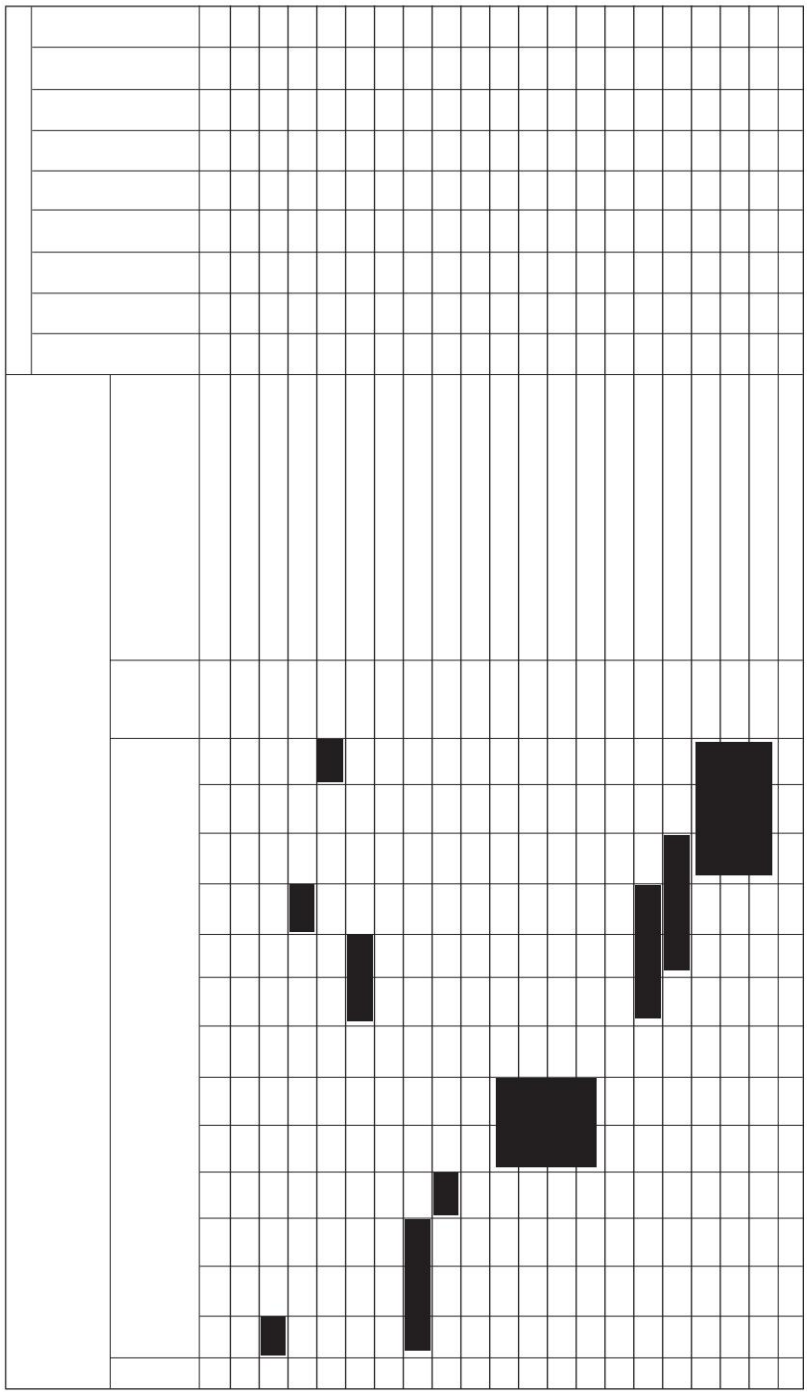


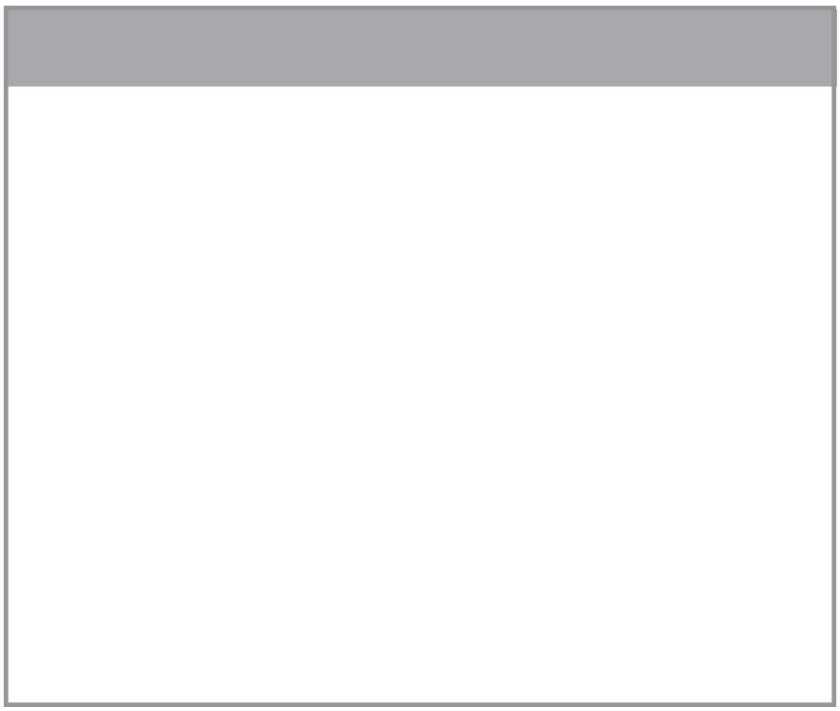
Project Management System

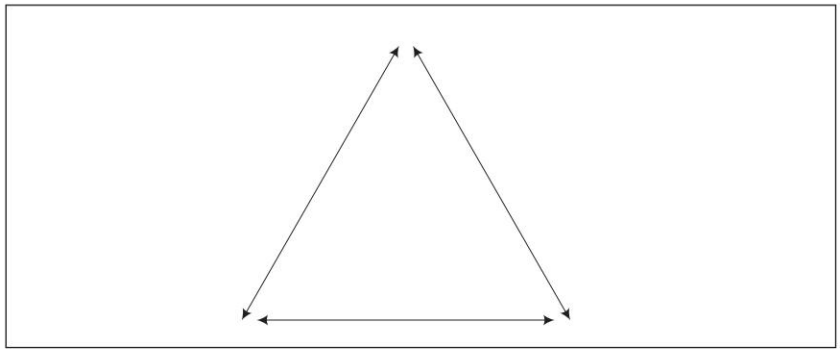












4

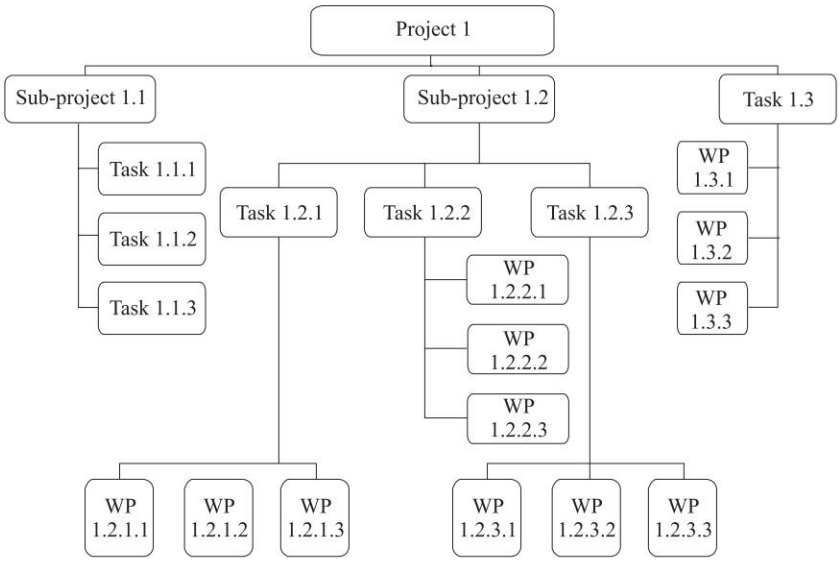
Introduction and Scope
Work Scope Definition Processes
Project Work Scope Integrated Planning Process
Project Work Scope Control System
Project Close Up
Importance of Project Work Breakdown Structure

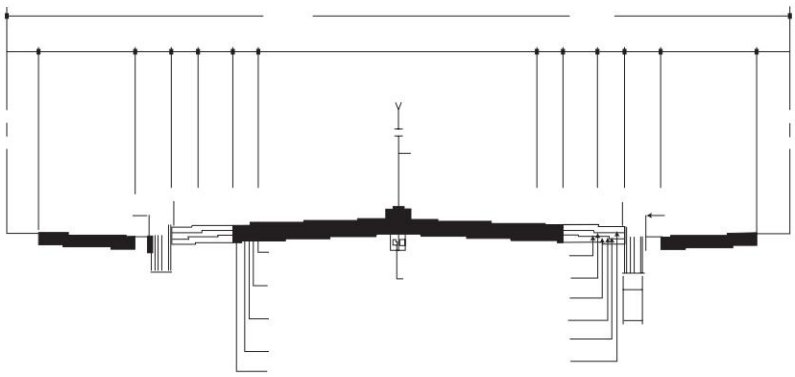
1. INTRODUCTION AND SCOPE

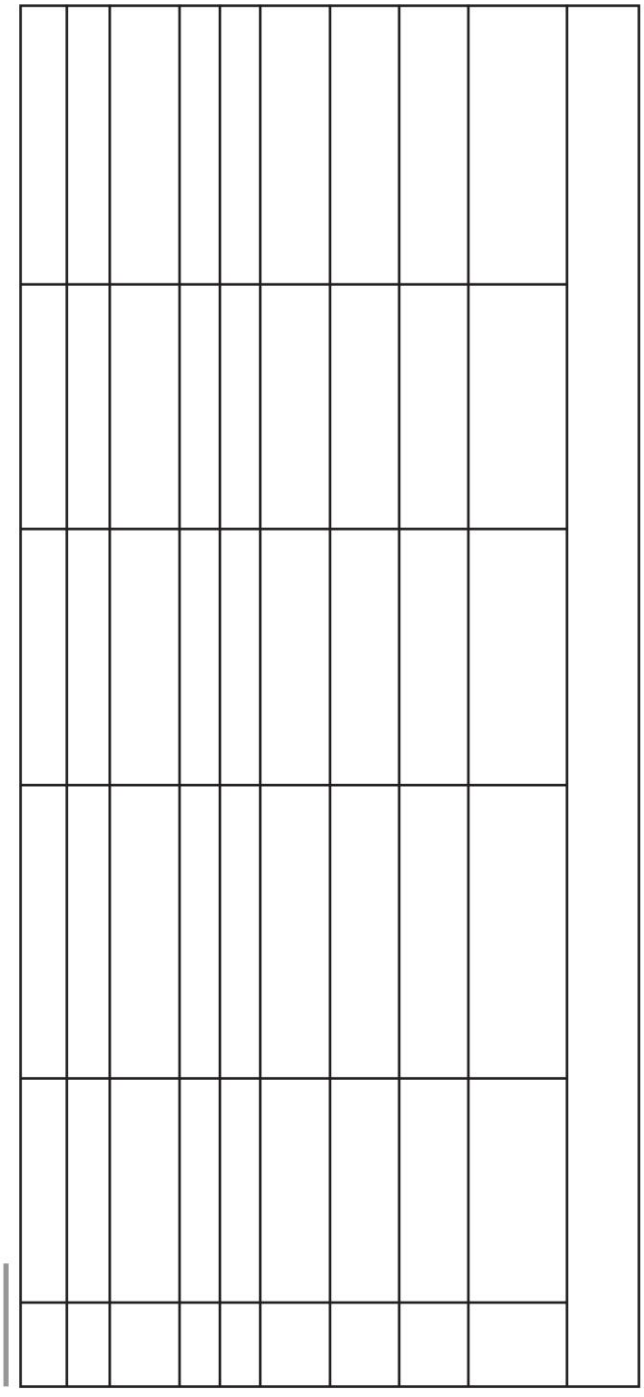
If the project is approved for implementation the project scope formulation phase concludes with the documentation of the project charter or work operation order and the selection of the project manager. The project charter includes a statement of the broad scope of the work, its objectives, an outline execution methodology, a milestone time plan, major resource forecasts, cash flow forecast, outline organisation and potential risks and problem areas. The scope statement provides the justification for undertaking a project; it outlines the project purpose, features of the project product, broad scope of the work, and the project time, cost and quality objectives.

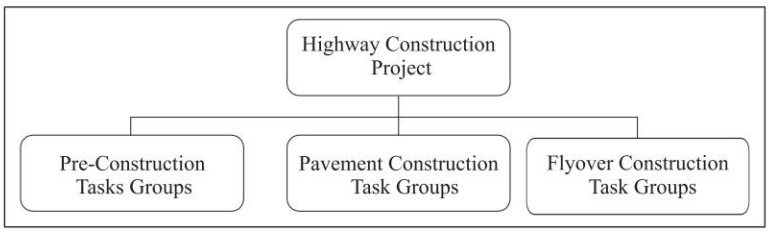
The project scope defines the works that must be undertaken in order to deliver a facility, a product or a service with the specified features and functions. These attributes and characteristics may include specified quantity, completion time, budgeted cost, and project–product quality specifications.

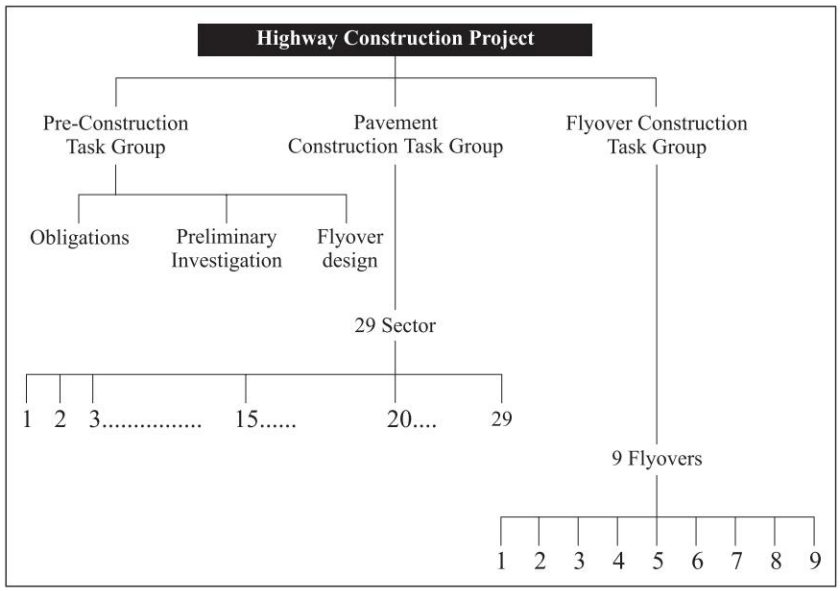
Project scope management focuses only on the works to be executed. It aims at ensuring that the project includes all the works required with specified attributes

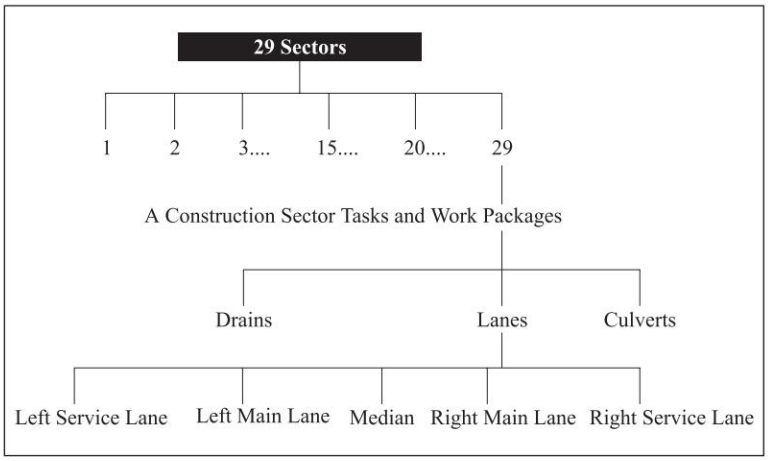


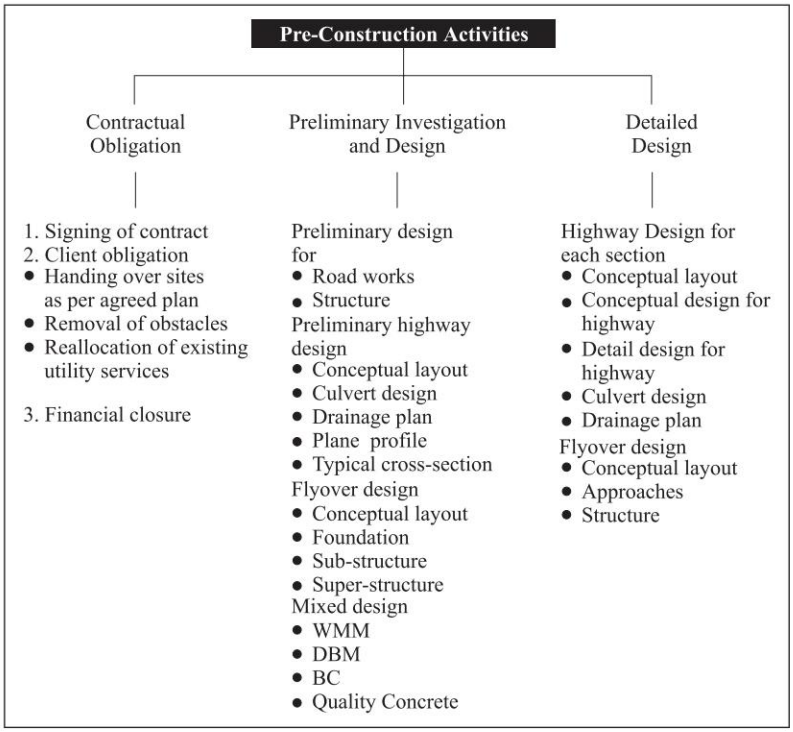


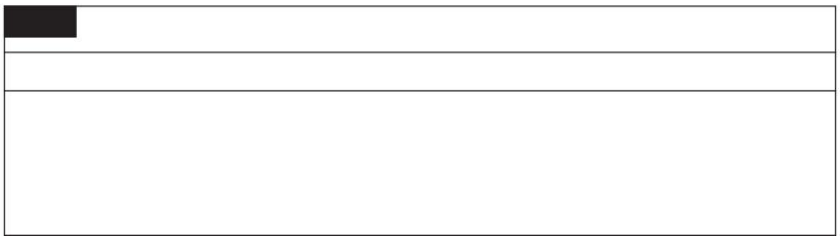


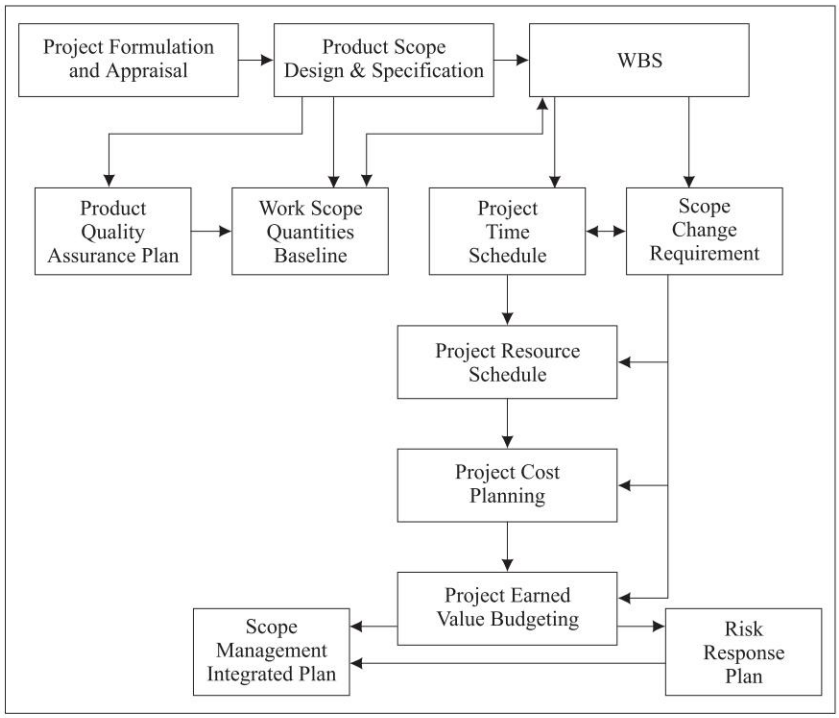

Highway Construction Project
Pre-Construction Tasks Groups
Pavement Construction Task Groups
Flyover Construction Task Groups

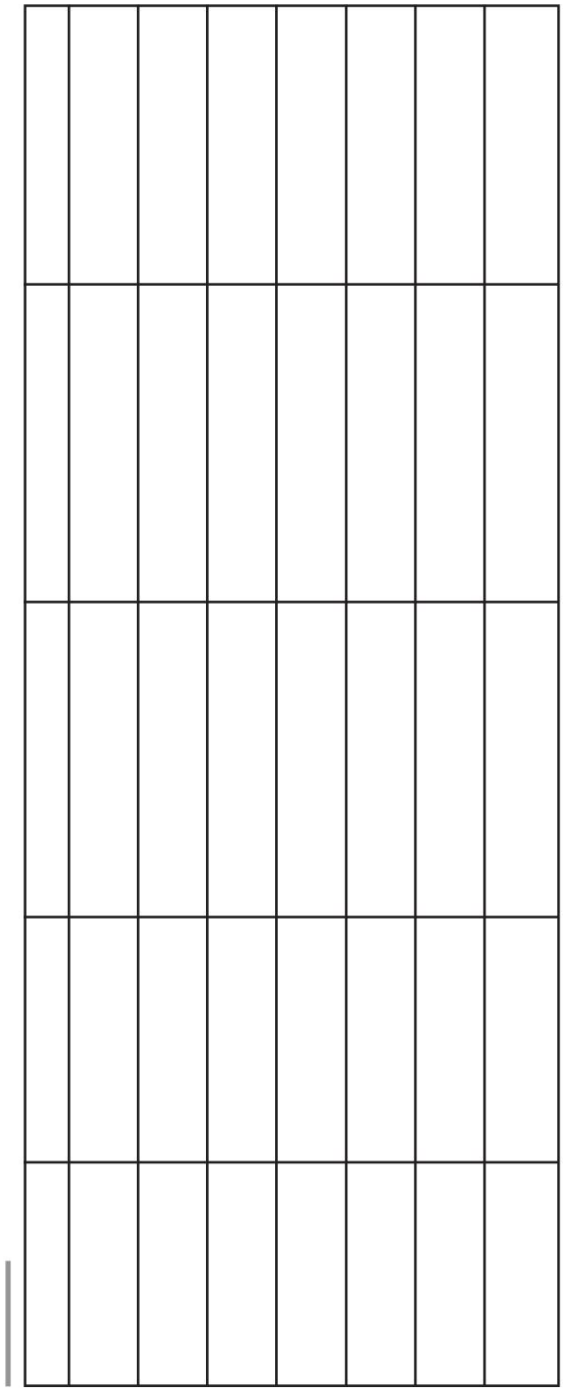


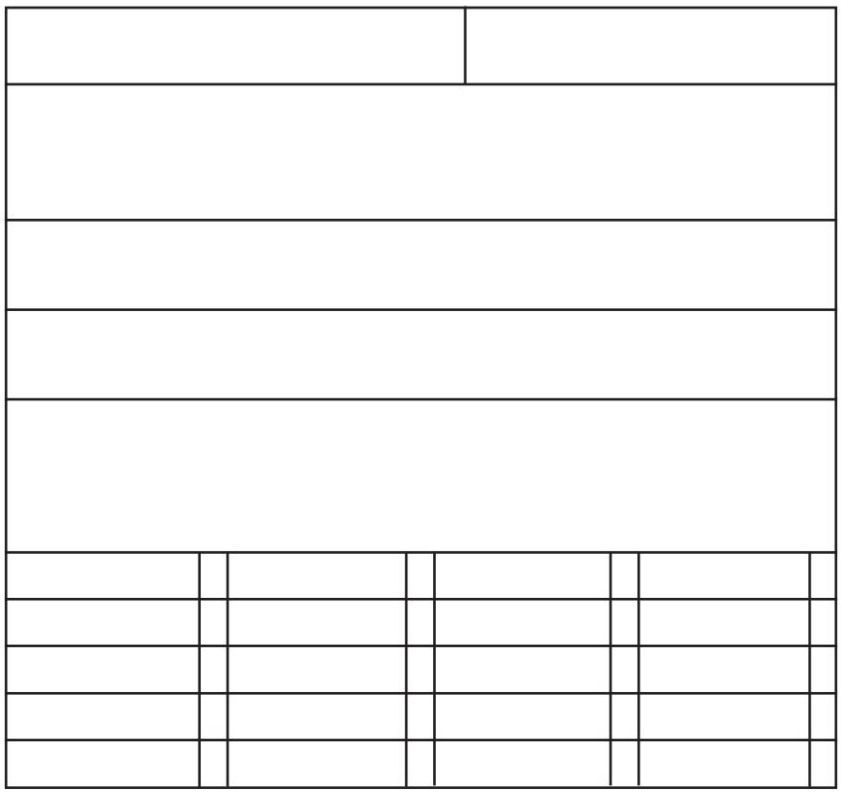


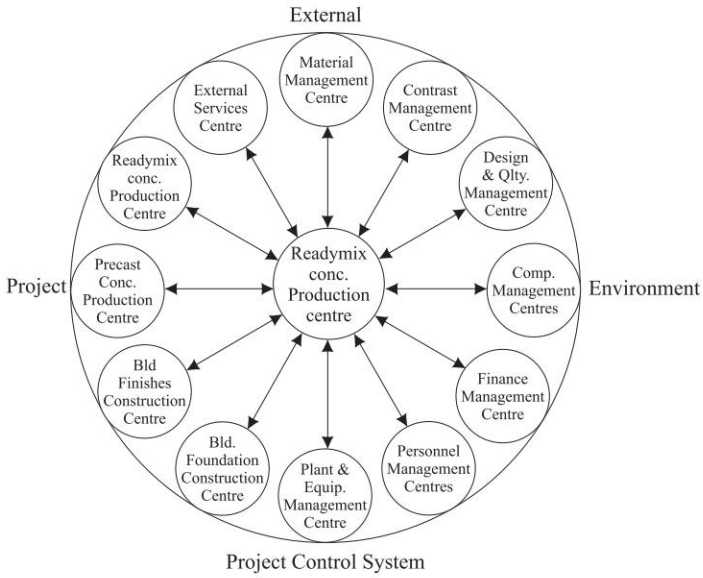


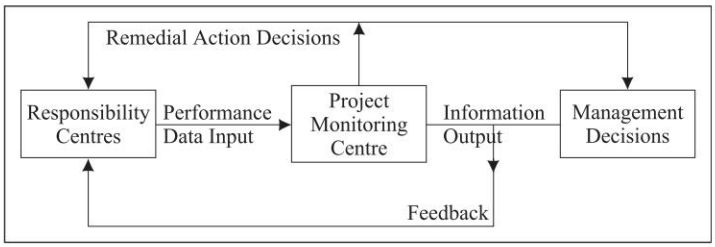


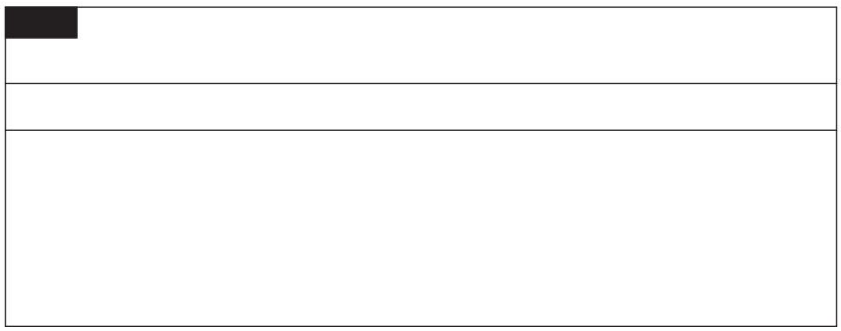

Project Formulation and Appraisal
Product Scope Design & Specification
WBS
Product Quality Assurance Plan
Work Scope Quantities Baseline
Project Time Schedule
Scope Change Requirement
Project Resource Schedule
Project Cost Planning
Project Earned Value Budgeting
Scope Management Integrated Plan
Risk Response Plan

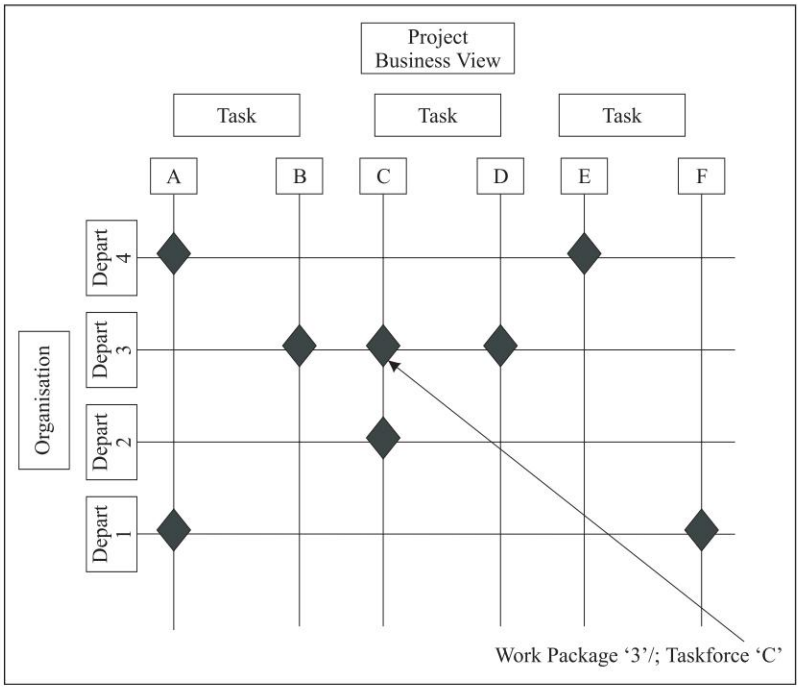


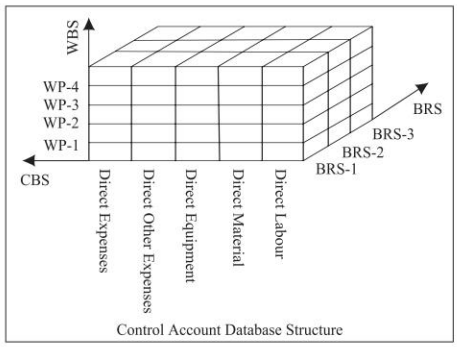




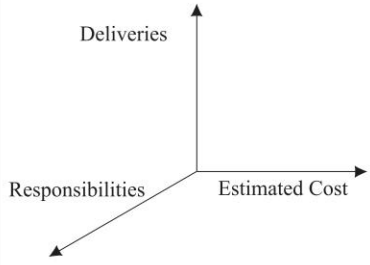

Remedial Action Decisions
Responsibility Centres
Performance Data Input
Project Monitoring Centre
Information Output
Management Decisions
Feedback




Project
Business View
Task
Task
Task
A
B
C
D
E
F
Organisation
Depart 4
Depart 3
Depart 2
Depart 1
Work Package '3'/; Taskforce 'C'



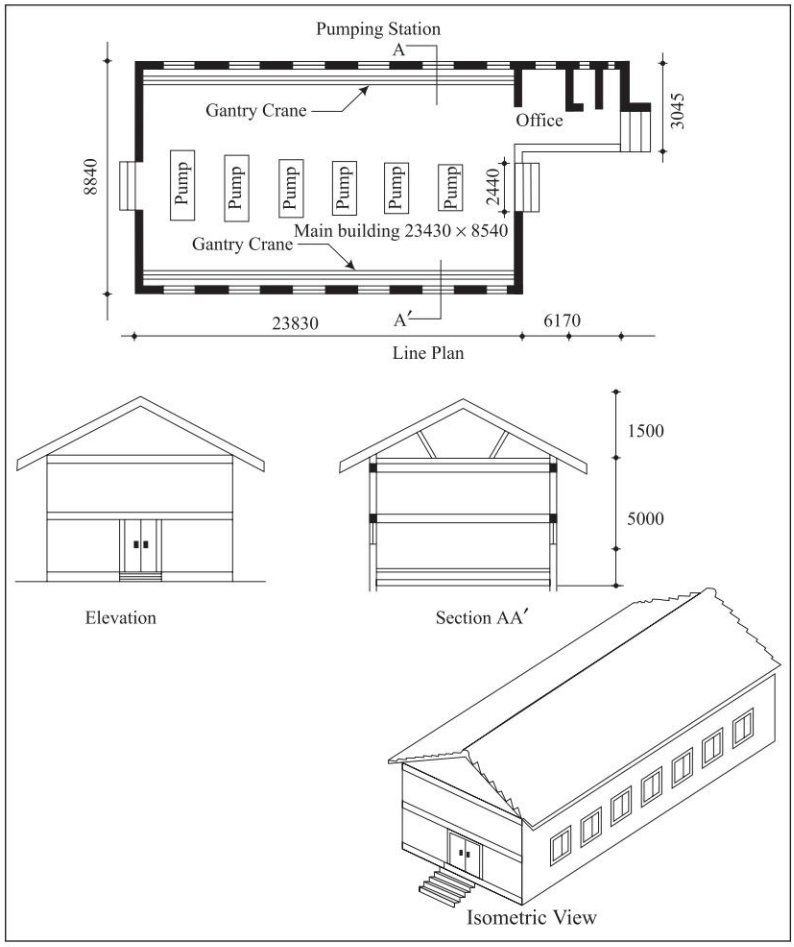
Control Account Database Structure

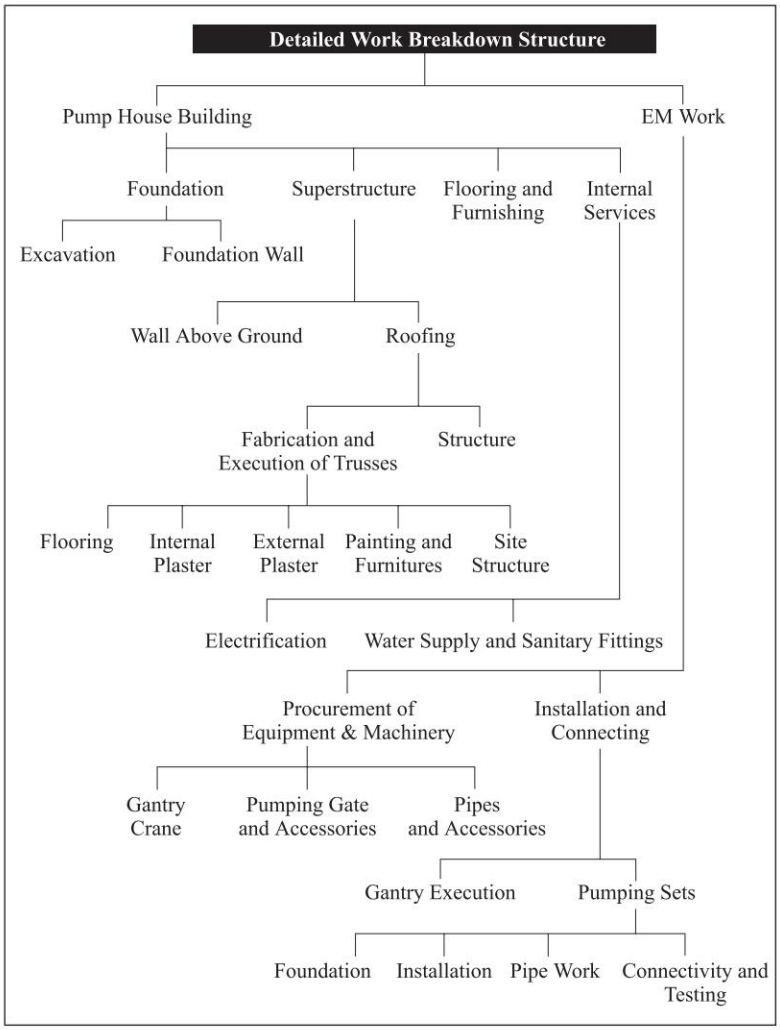


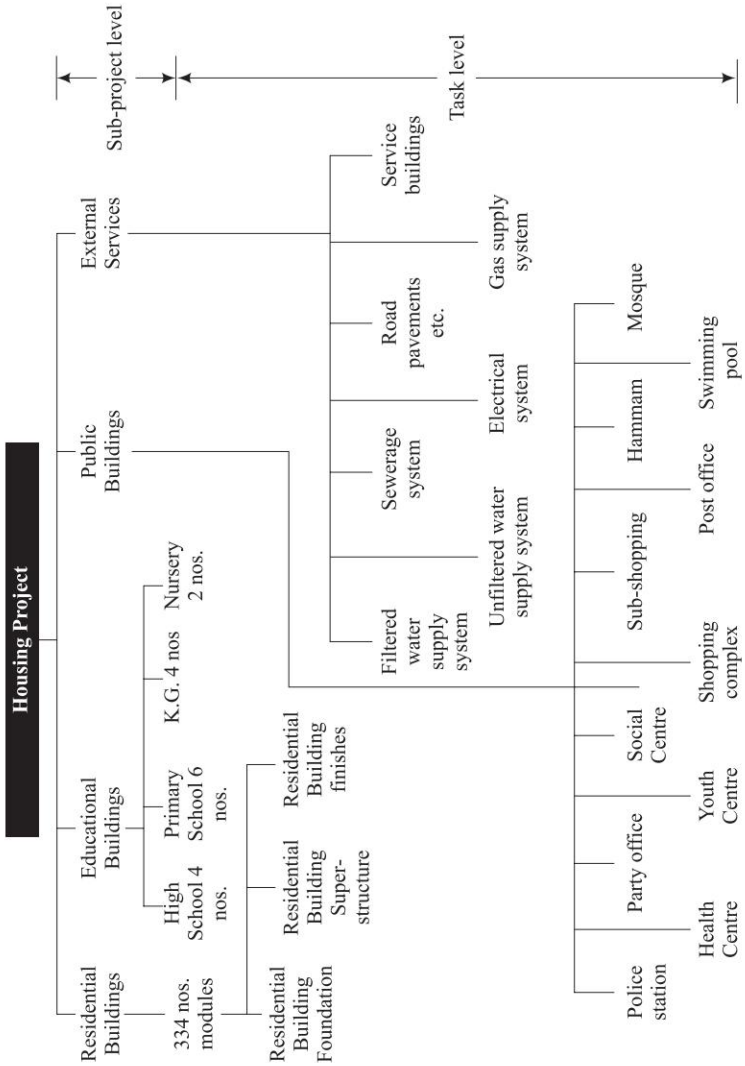
5

1. INTRODUCTION AND SCOPE

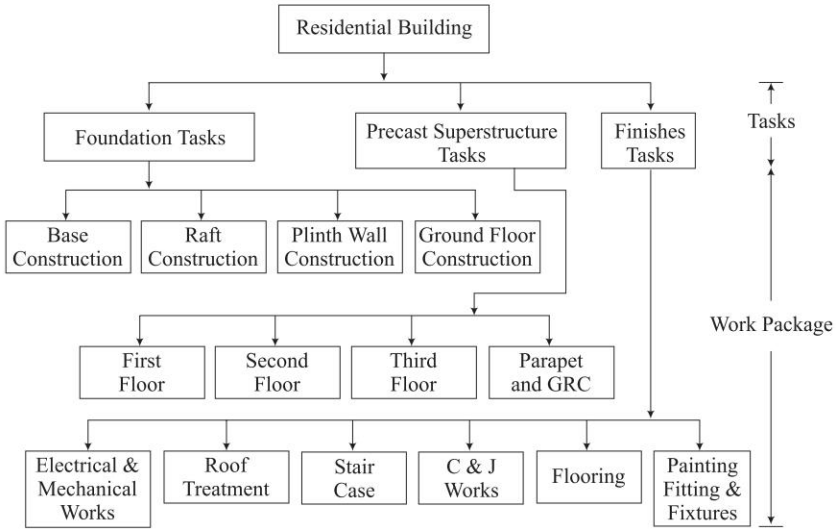
All projects are time-bound. Time is the essence of all contracts. The project time objective specifies the project completion time and all the project activities are directed towards achievement of the project time objectives. The project time and cost objectives are correlated—it is the time factor that determines the project cost. However, in spite of best efforts to complete a project on time, changes to the original time plan do sometimes occur. In a complex project, where a large number of activities are performed at different places by different agencies or task forces, with each having its own scheduled targets, a small delay in a critical activity can affect many schedules. Delays can alter the planned level of resources and their mobilisation. Time overruns increase overheads, reduce planned revenue from sales and create cash inflow problems. The project cost due to time delays can increase


Pumping Station
A
Gantry Crane
Office
3045
8840
Pump
Pump
Pump
Pump
Pump
Pump
2440
Main building 23430 × 8540
Gantry Crane
23830
A′
6170
Line Plan
1500
5000
Elevation
Section AA′
Isometric View

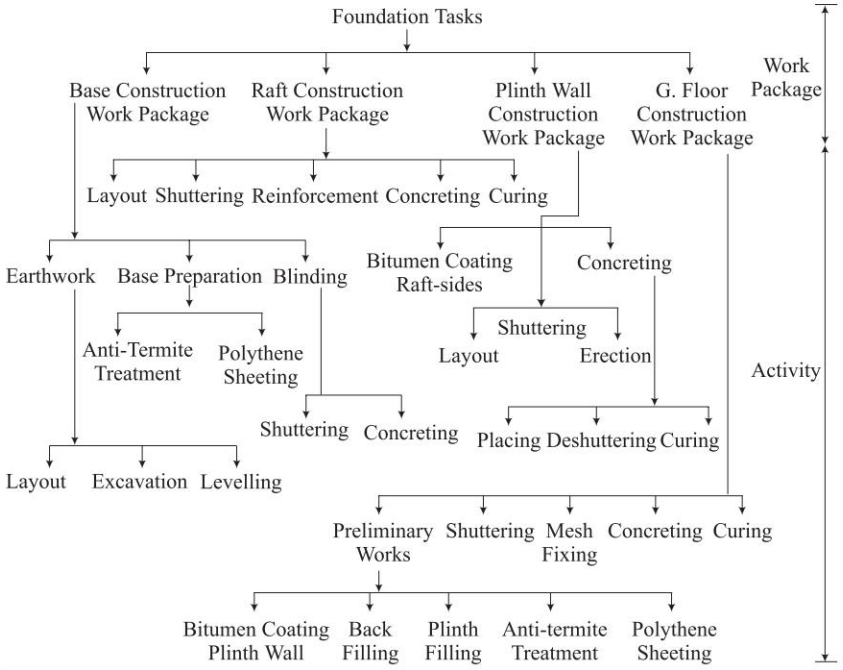


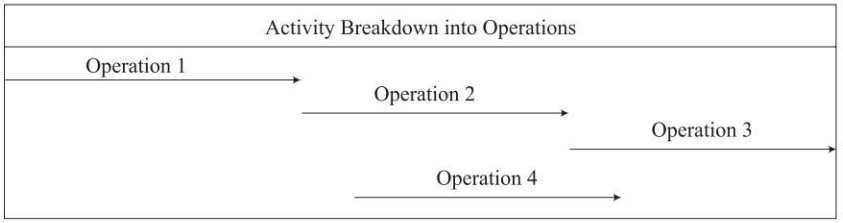

Housing Project
Residential Buildings
334 nos. modules
Residential Building Foundation
Residential Building Super-structure
Residential Building finishes
Educational Buildings
High School 4 nos.
Primary School 6 nos.
K.G. 4 nos
Nursery 2 nos.
Public Buildings
Police station
Party office
Health Centre
Social Centre
Youth Centre
Shopping complex
Sub-shopping
Post office
Hammam
Swimming pool
Mosque
External Services
Filtered water supply system
Unfiltered water supply system
Sewerage system
Electrical system
Road pavements etc.
Gas supply system
Service buildings
Sub-project level
Task level

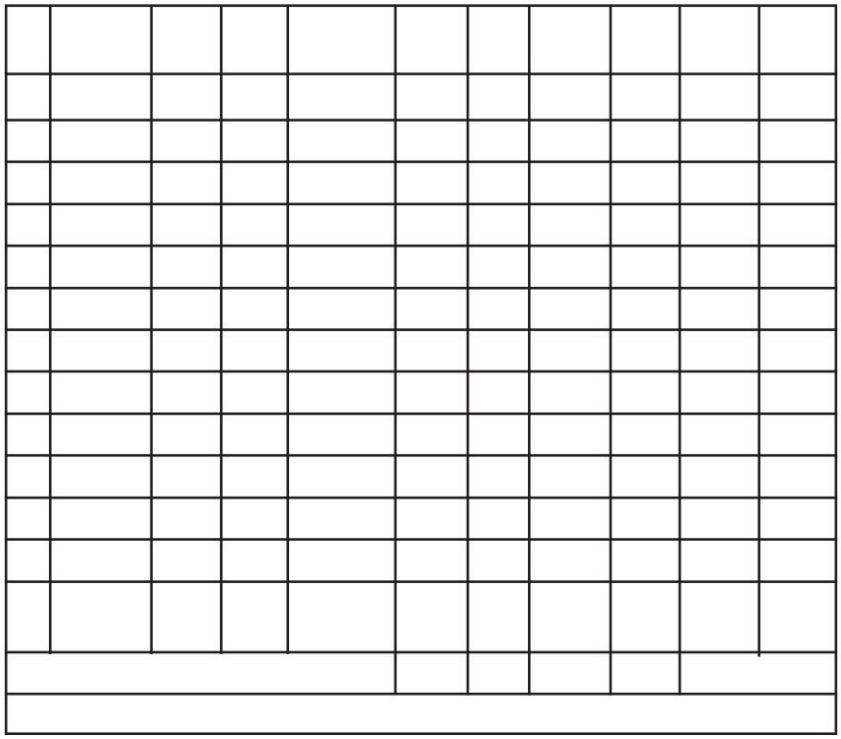
Construction of Residential Building: Work-breakdown Structure

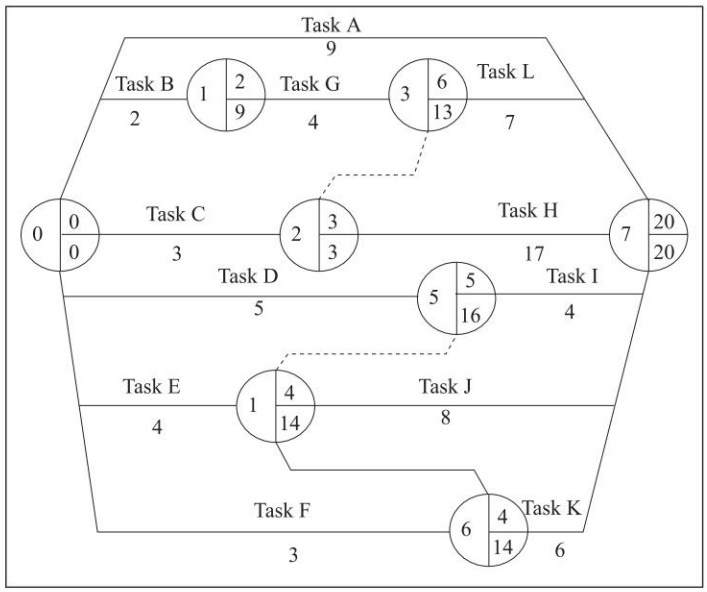


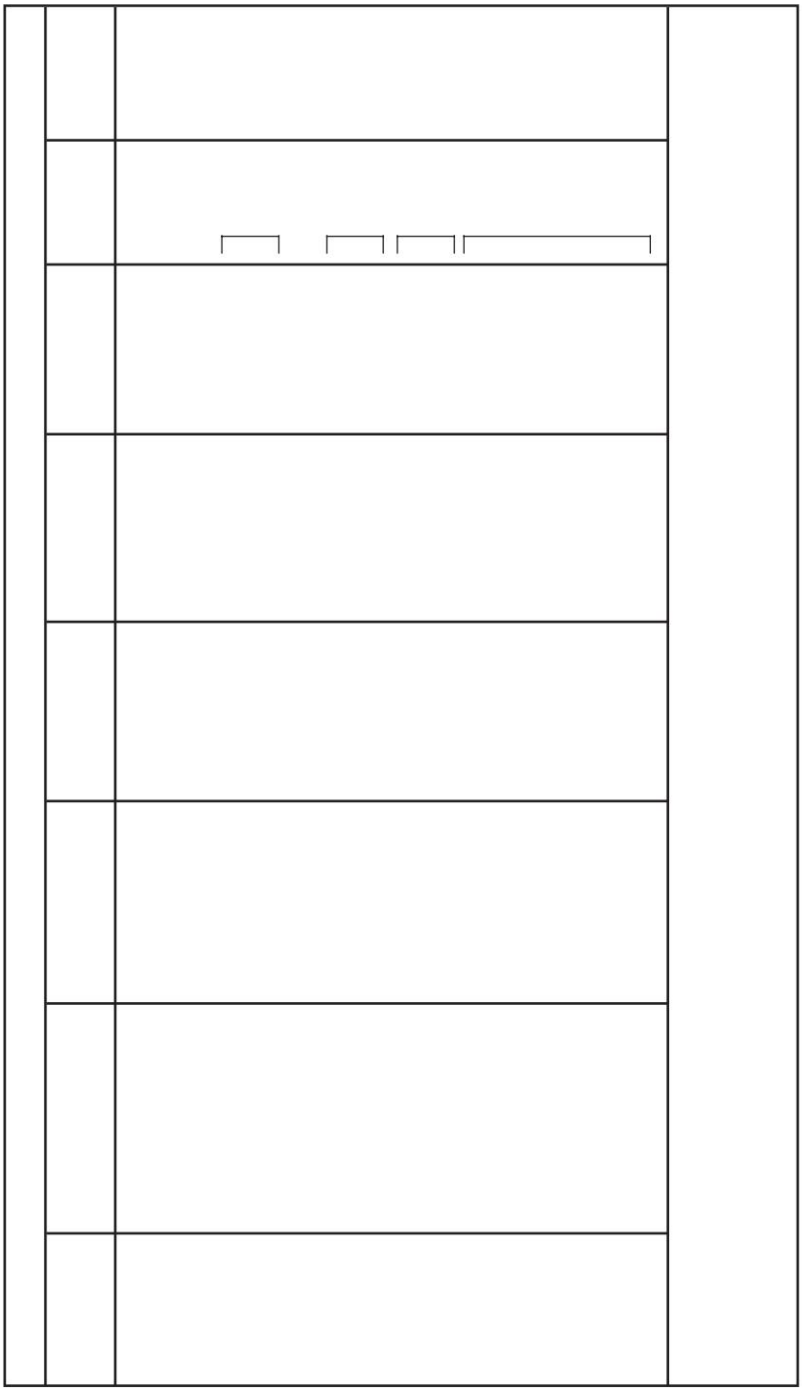
Construction of Residential Buildings: Work breakdown Structure

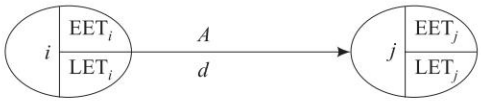




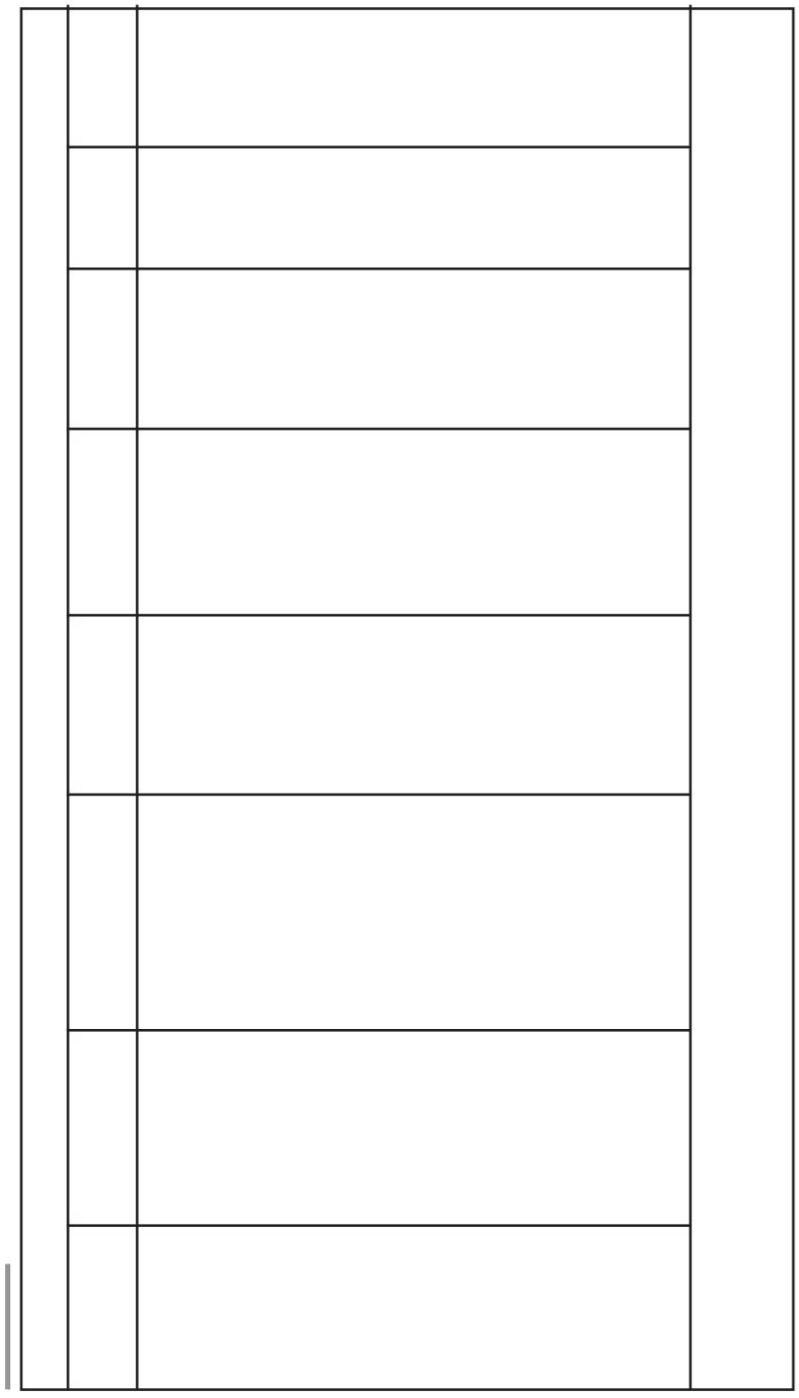


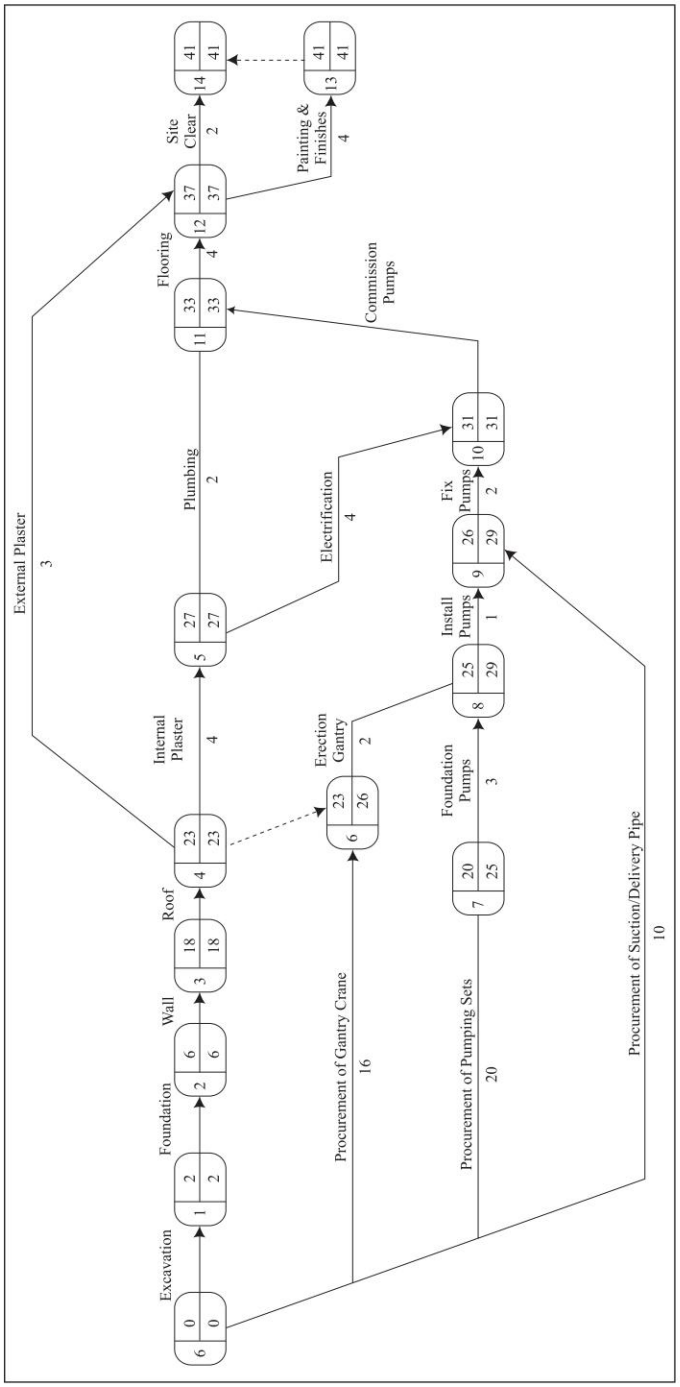

Task A
9
Task B
2
1
2
9
Task G
4
3
6
13
Task L
7
0
0
0
Task C
3
2
3
3
Task H
17
7
20
20
Task D
5
5
5
16
Task I
4
Task E
4
1
4
14
Task J
8
Task F
3
6
4
14
Task K
6

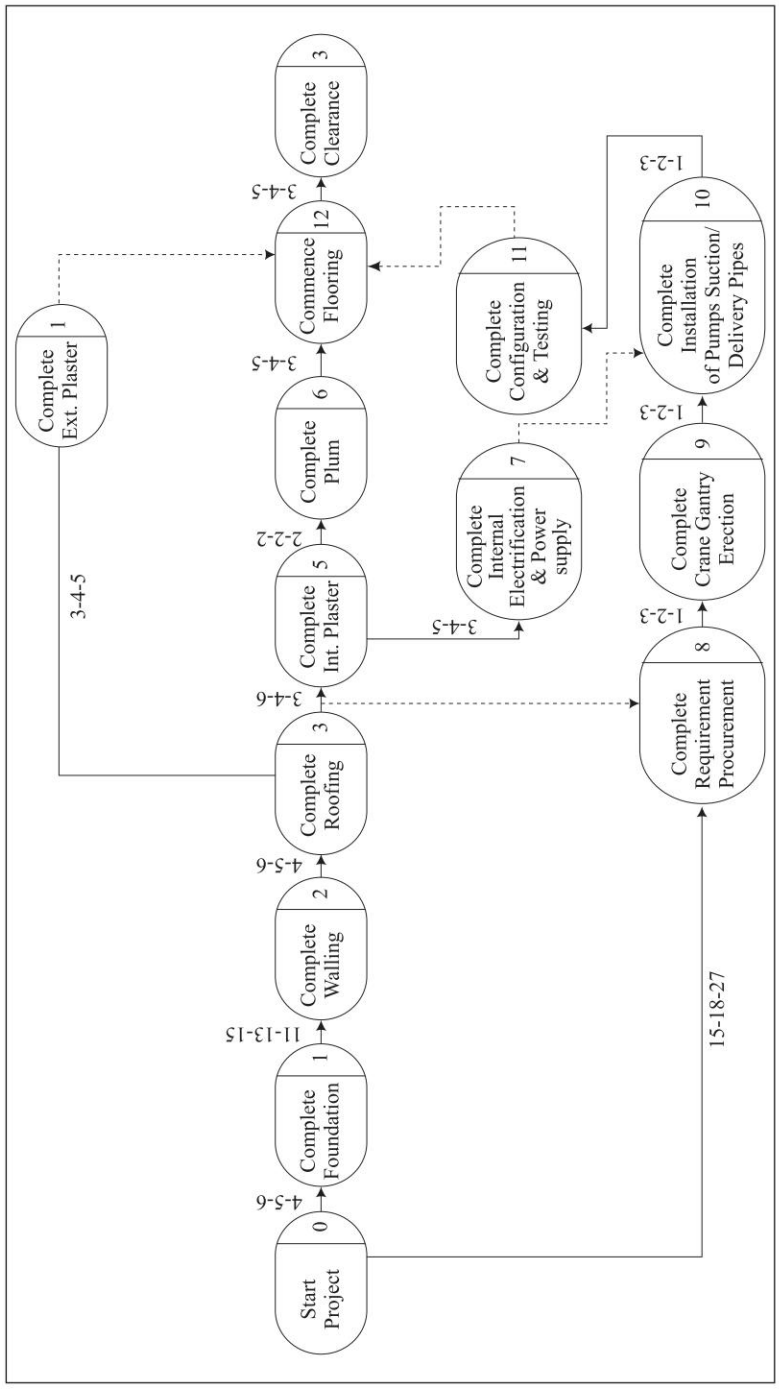


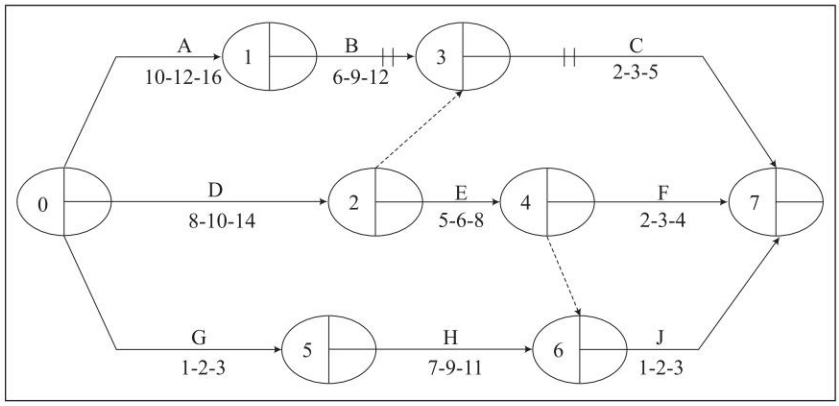


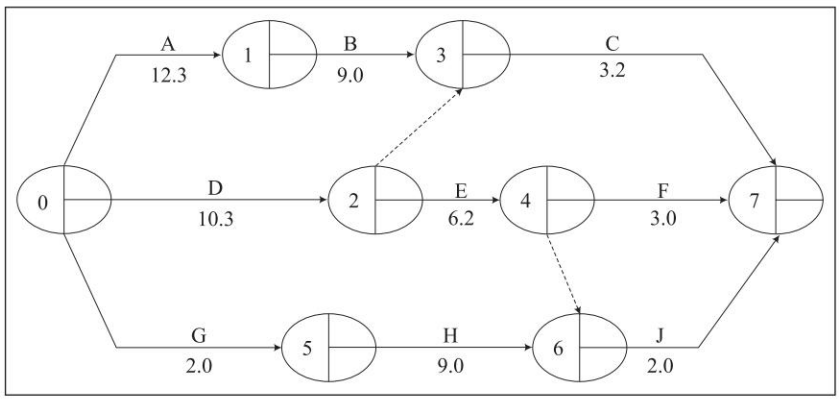
$$\text{Float} = \text{LST} - \text{EST} = \text{LET}_j - d - \text{EET}_i$$

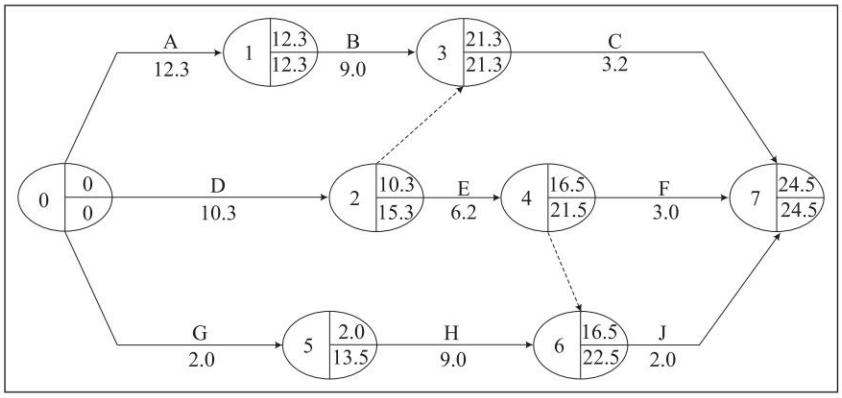


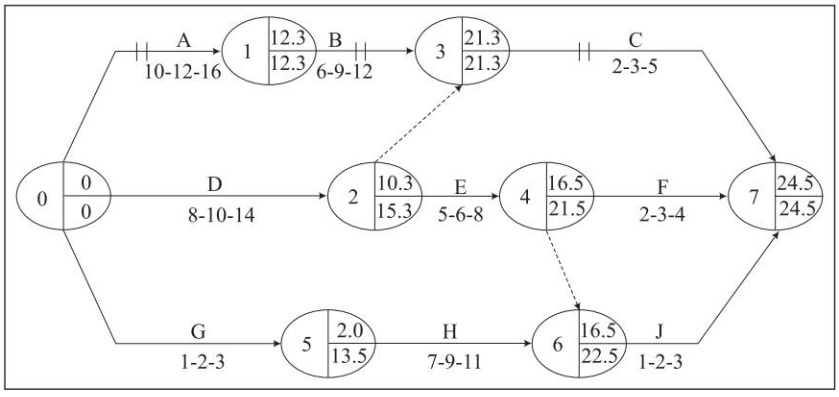

Excavation
Foundation
Wall
Roof
External Plaster
Internal Plaster
Plumbing
Flooring
Site Clear
Painting & Finishes
Procurement of Gantry Crane
16
Erection Gantry
2
Procurement of Pumping Sets
20
Foundation Pumps
3
Install Pumps
1
Electrification
4
Fix Pumps
2
Commission Pumps
Procurement of Suction/Delivery Pipe
10

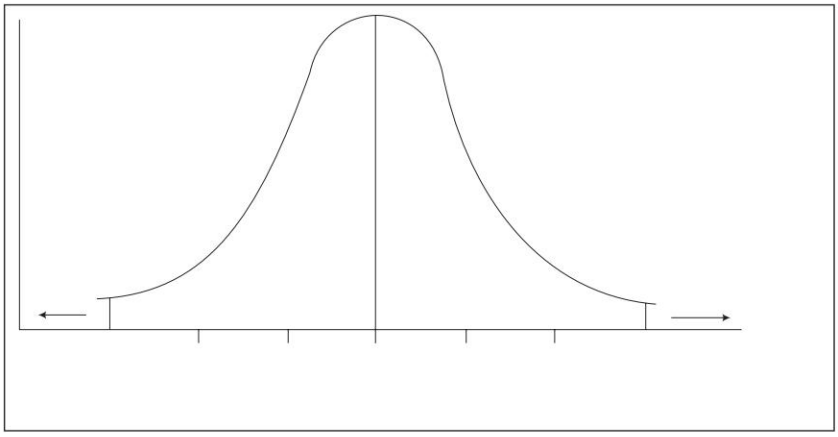

Start Project
0
Complete Foundation
1
Complete Walling
2
Complete Roofing
3
Complete Ext. Plaster
1
Complete Int. Plaster
5
Complete Plum
6
Commence Flooring
12
Complete Clearance
3
Complete Internal Electrification & Power supply
7
Complete Configuration & Testing
11
Complete Requirement Procurement
8
Complete Crane Gantry Erection
9
Complete Installation of Pumps Suction/ Delivery Pipes
10
4-5-6
11-13-15
4-5-6
3-4-6
3-4-5
2-2-2
3-4-5
3-4-5
3-4-5
1-2-3
1-2-3
1-2-3
15-18-27




A
12.3
1
B
9.0
3
C
3.2
0
D
10.3
2
E
6.2
4
F
3.0
7
G
2.0
5
H
9.0
6
J
2.0


A
12.3
1
12.3
12.3
B
9.0
3
21.3
21.3
C
3.2
0
0
0
D
10.3
2
10.3
15.3
E
6.2
4
16.5
21.5
F
3.0
7
24.5
24.5
G
2.0
5
2.0
13.5
H
9.0
6
16.5
22.5
J
2.0


A
10-12-16
1
12.3
12.3
B
6-9-12
3
21.3
21.3
C
2-3-5
0
0
0
D
8-10-14
2
10.3
15.3
E
5-6-8
4
16.5
21.5
F
2-3-4
7
24.5
24.5
G
1-2-3
5
2.0
13.5
H
7-9-11
6
16.5
22.5
J
1-2-3



EST	Dur	EFT
Activity description		
LST	No.	LFT

EST	Dur	EFT
Description & resource		
LST	No.	LFT

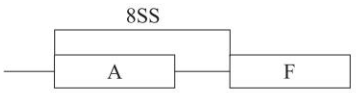
EST	Dur	EFT
Activity ID & description with contract value		
LST	No.	LFT

EST = Earliest start time
LFT = Latest finish time
Dur = Duration
No. = Activity number or identification label
TF = Total float
Resource = Gang size or man-days or production cost or value of worked one, etc. can be written below the description, if considered necessary.

Finish-to-start
i.e. delay from the finish of preceding activity to the start of the succeeding one.

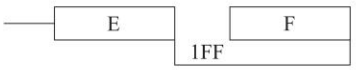
Completion of Activity A

Start-to-start
i.e. delay from the start of preceding activity to the start of the succeeding one.



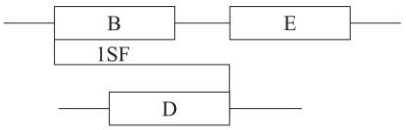
Activity F starts after 8 time unit delay constraints from commencement of activity A

Finish-to-finish
i.e. delay from the finish of preceding activity to the finish of the succeeding one.

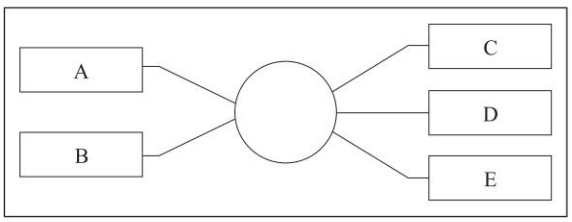


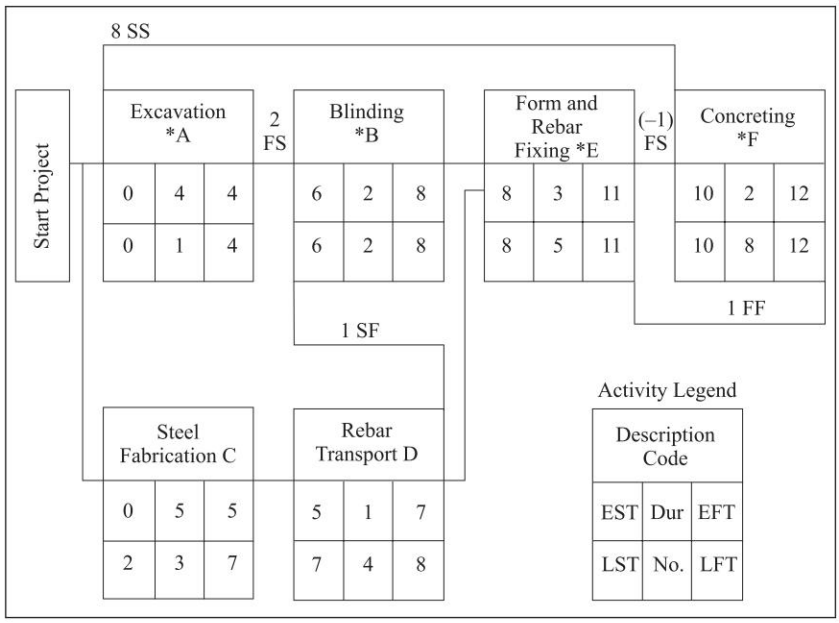
Completion of activity F will take at least one time unit after completion of activity E

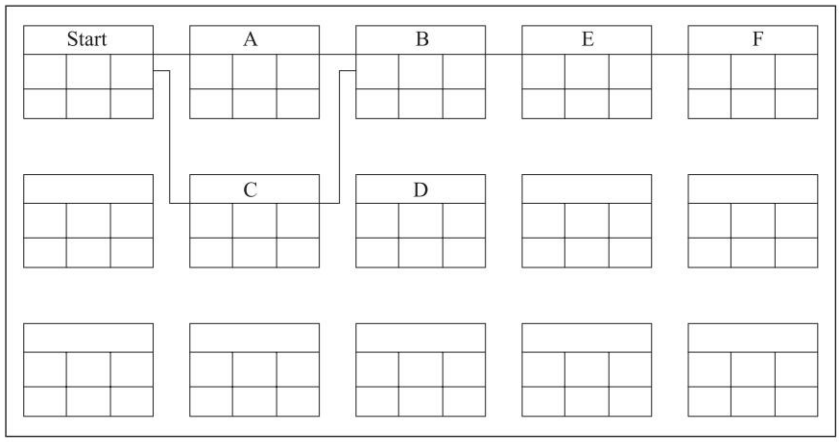
Start-to-finish
i.e. delay from the start of preceding activity to the finish of the succeeding one.

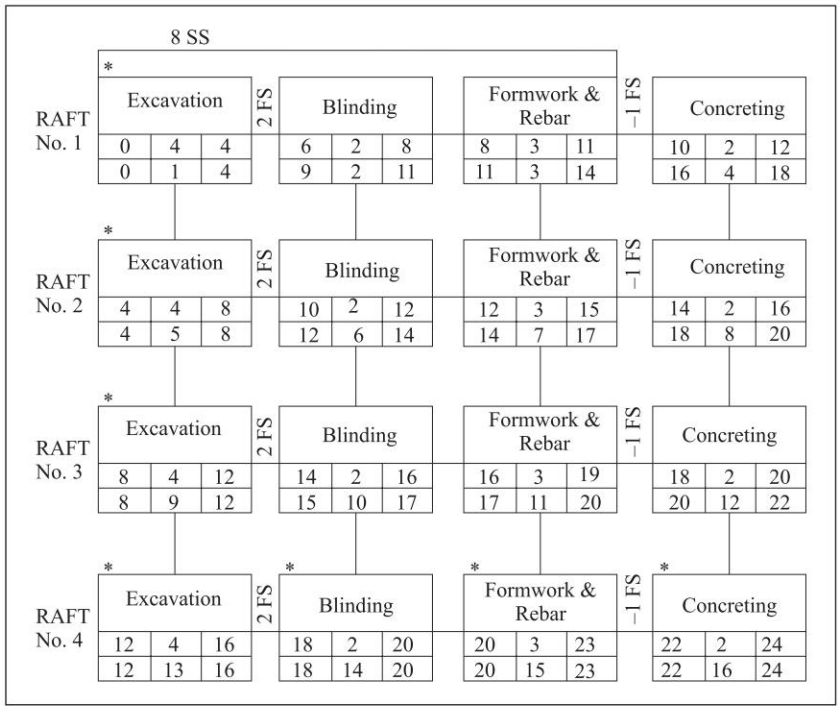


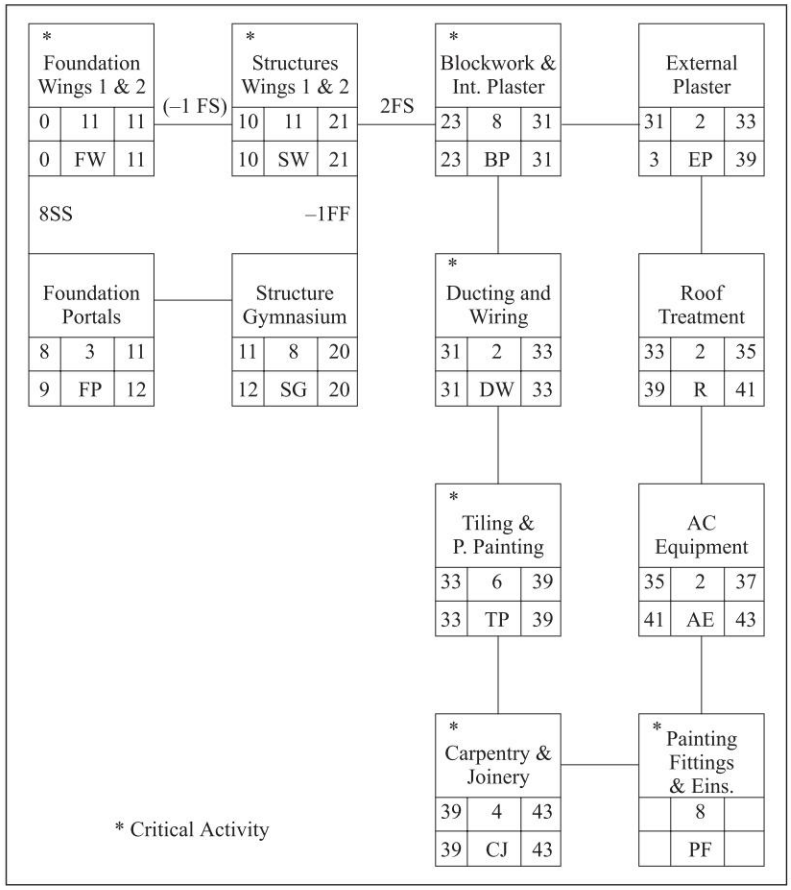
Activity D is finished after at least 1 time unit delay from start of activity B

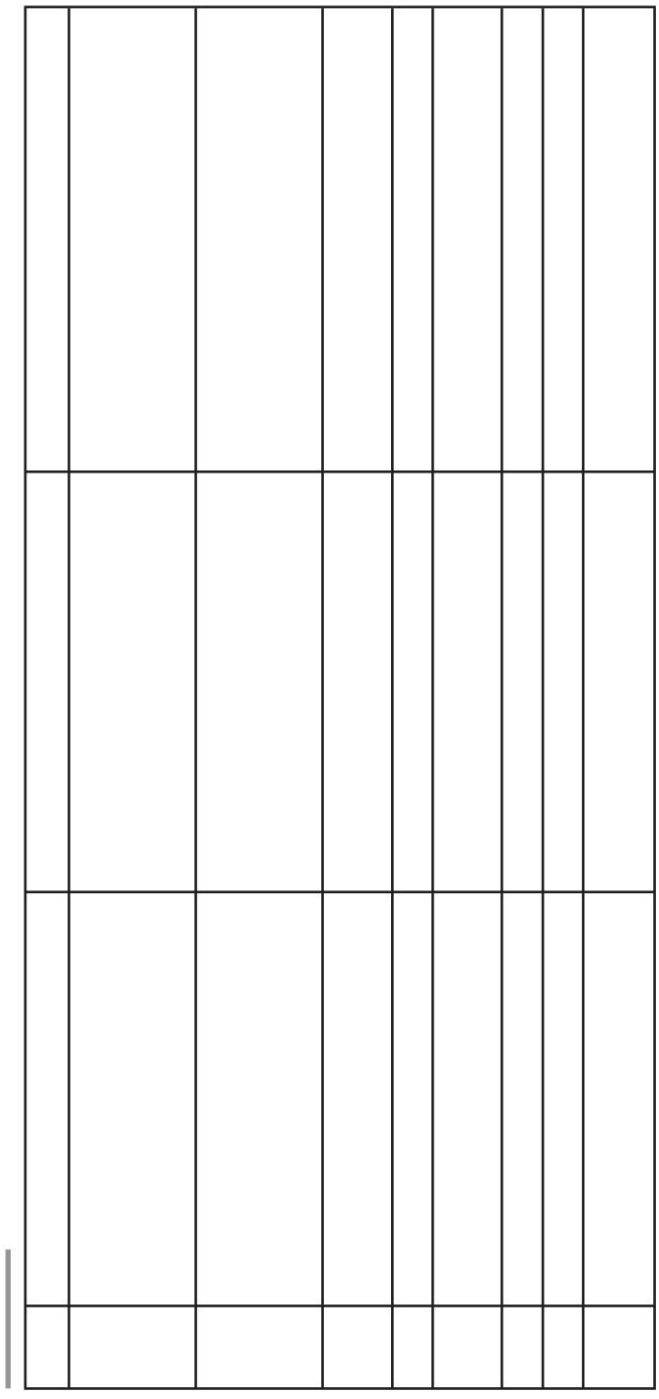


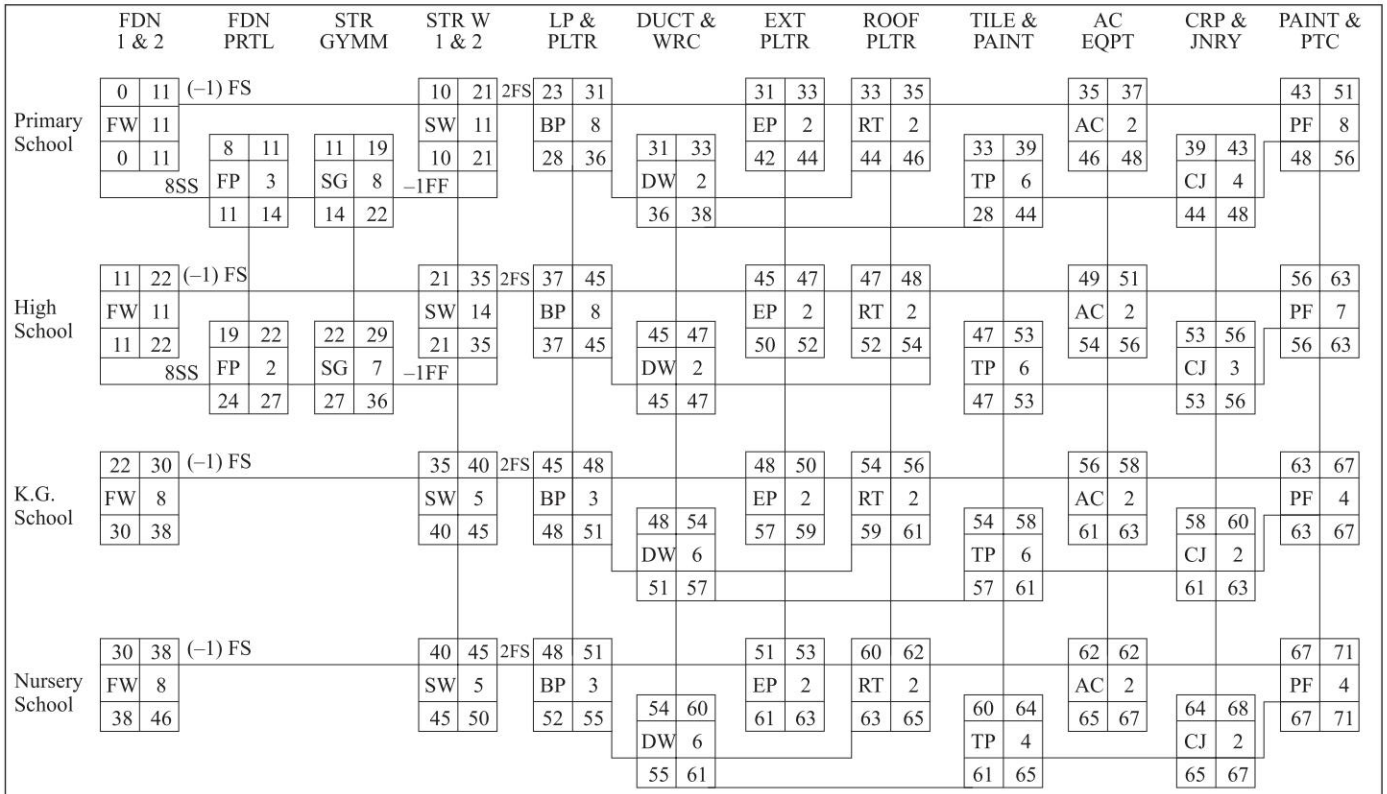

8 SS
Start Project
Excavation *A
2 FS
Blinding *B
Form and Rebar Fixing *E
(–1) FS
Concreting *F
0 4 4
0 1 4
6 2 8
6 2 8
8 3 11
8 5 11
10 2 12
10 8 12
1 FF
1 SF
Steel Fabrication C
Rebar Transport D
0 5 5
2 3 7
5 1 7
7 4 8
Activity Legend
Description Code
EST Dur EFT
LST No. LFT



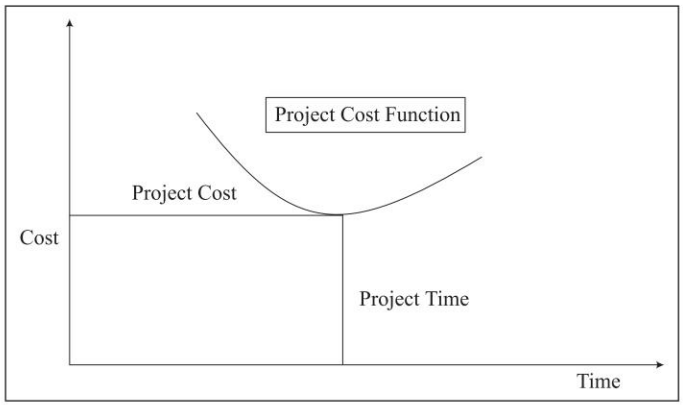

8 SS
RAFT No. 1
RAFT No. 2
RAFT No. 3
RAFT No. 4
Excavation
Blinding
Formwork & Rebar
Concreting
2 FS
–1 FS
0 4 4
0 1 4
6 2 8
9 2 11
8 3 11
11 3 14
10 2 12
16 4 18
4 4 8
4 5 8
10 2 12
12 6 14
12 3 15
14 7 17
14 2 16
18 8 20
8 4 12
8 9 12
14 2 16
15 10 17
16 3 19
17 11 20
18 2 20
20 12 22
12 4 16
12 13 16
18 2 20
18 14 20
20 3 23
20 15 23
22 2 24
22 16 24

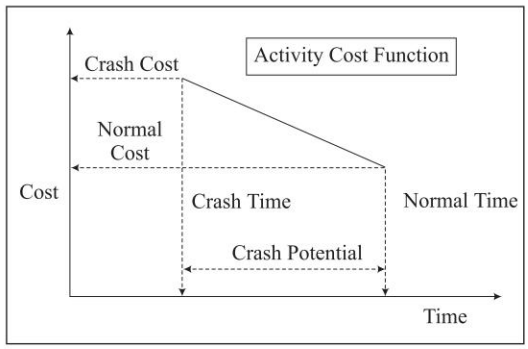


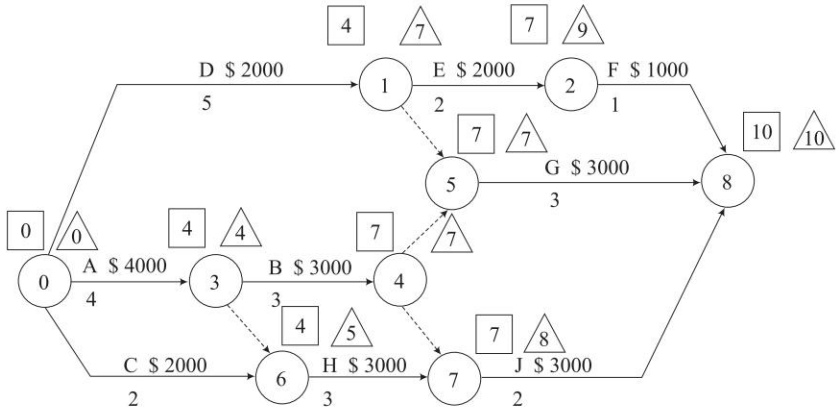




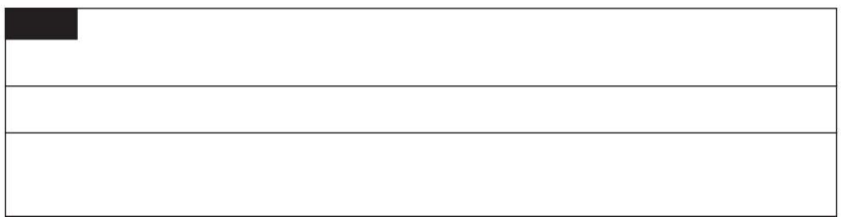
Note: Unit of time is in weeks. Sequence of buildings is as per client's requirement.

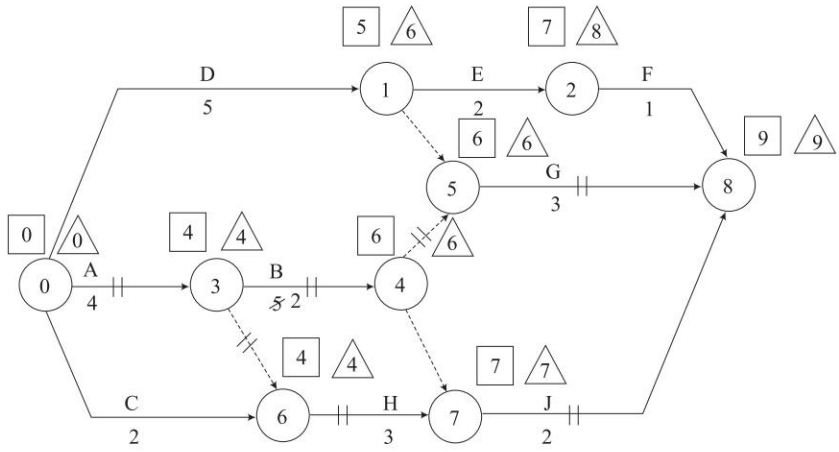

Project Cost Function
Project Cost
Cost
Project Time
Time

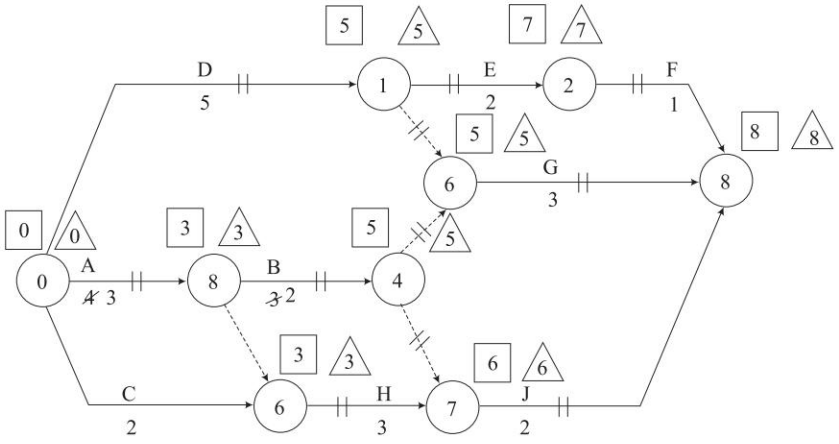


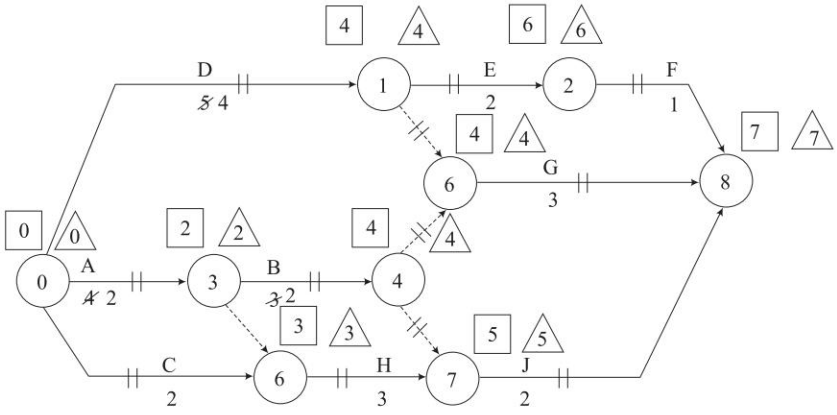


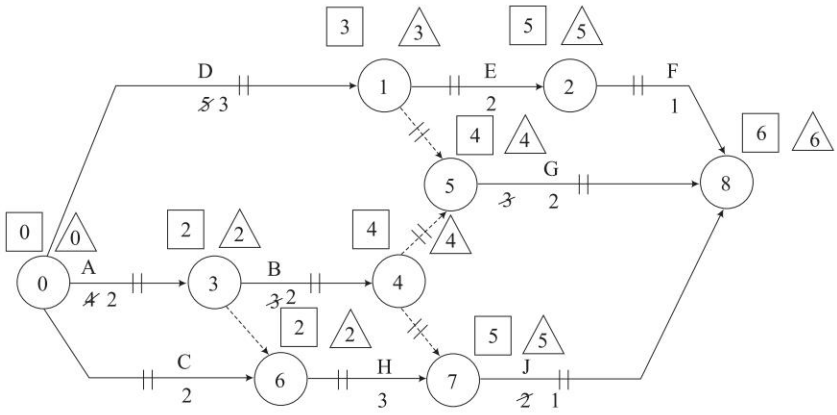
Original Network with Assessed Activity Cost

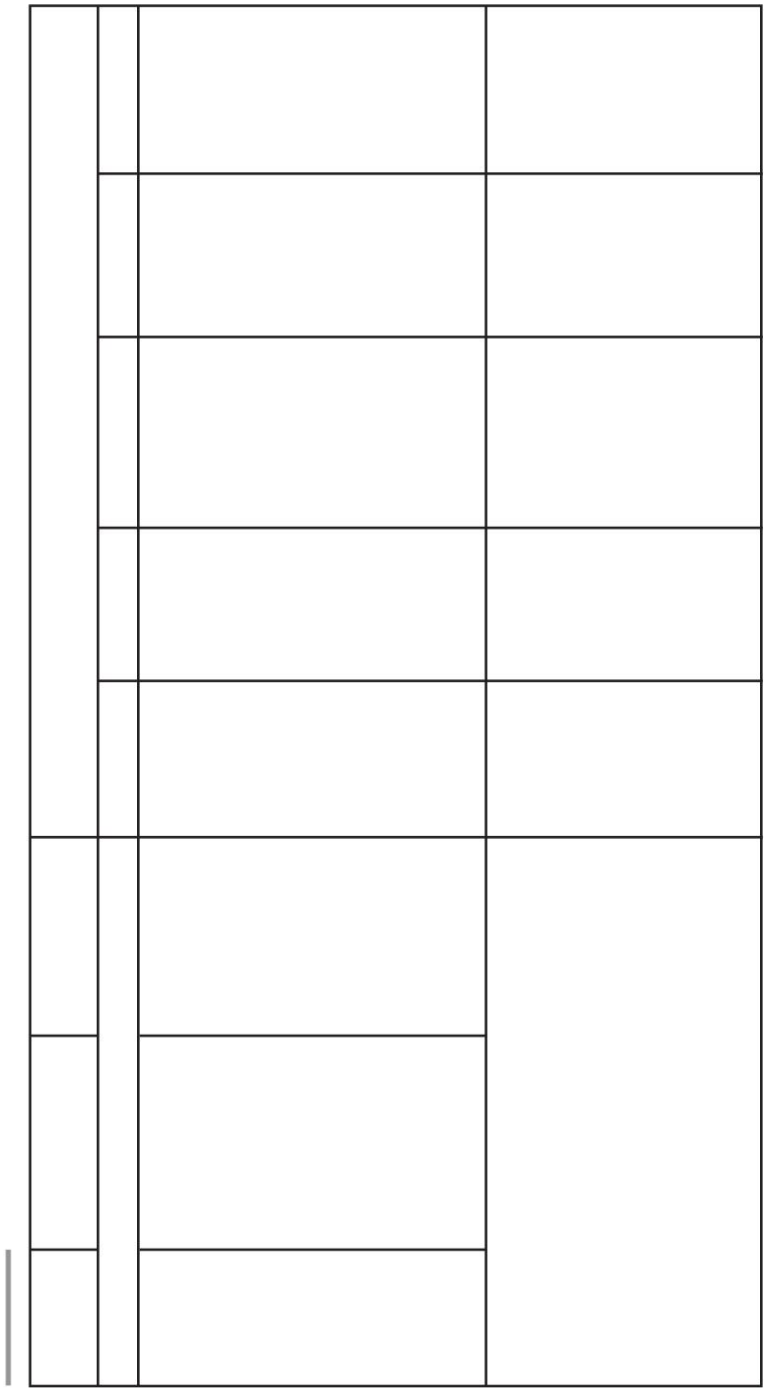


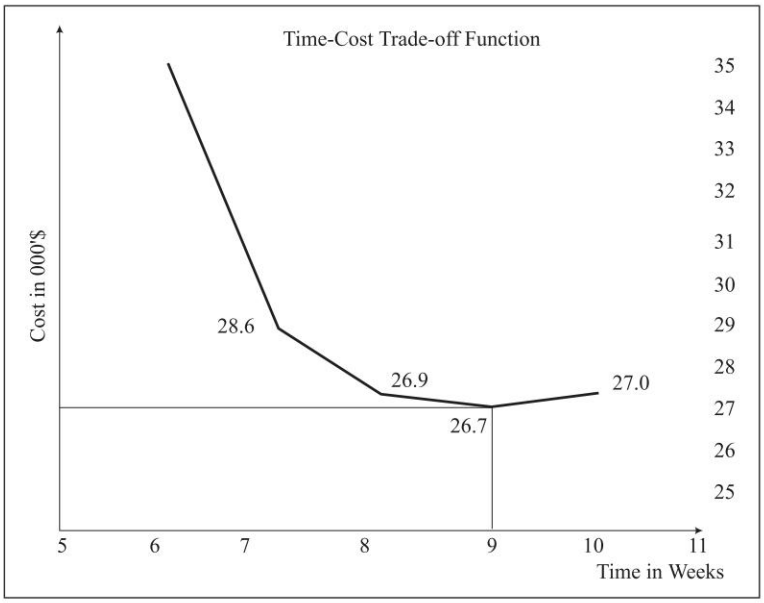

5 6
7 8
D
5
1
E
2
2
F
1
9 9
6 6
G
3
5
8
0 0
4 4
6 6
A
4
0
3
B
4
4 4
7 7
C
2
6
H
3
7
J
2


5 5
7 7
D
5
1
E
2
2
F
1
8 8
5 5
G
3
6
8
0 0
3 3
5 5
A
4 3
0
8
B
3 2
4
3 3
6 6
C
2
6
H
3
7
J
2

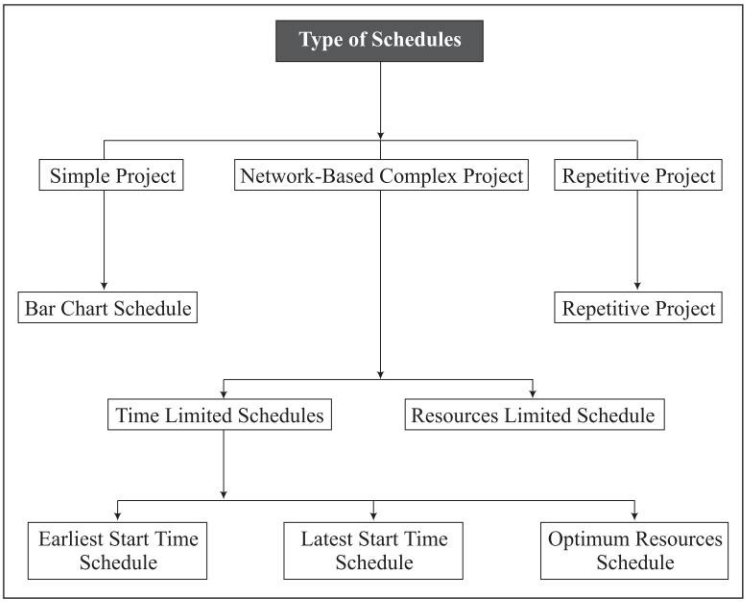

4
4
6
6
D
5 4
1
E
2
2
F
1
4
4
7
7
6
G
3
8
0
0
2
2
4
4
0
A
4 2
3
B
3 2
4
3
3
5
5
C
2
6
H
3
7
J
2

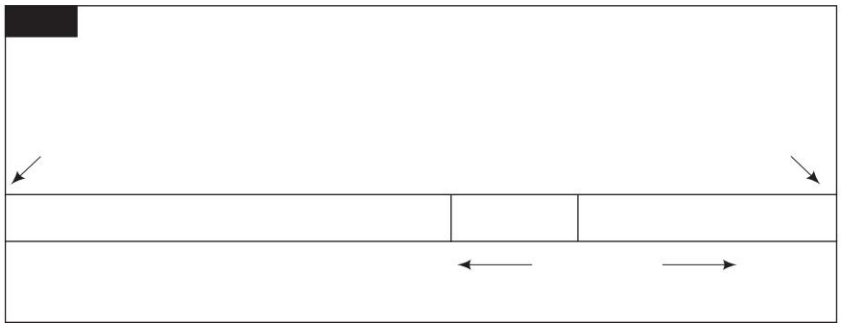

3
3
5
5
D
5 3
1
E
2
2
F
1
4
4
6
6
G
3 2
5
8
0
0
2
2
4
4
A
4 2
0
3
B
3 2
4
2
2
5
5
C
2
6
H
3
7
J
2 1

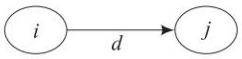


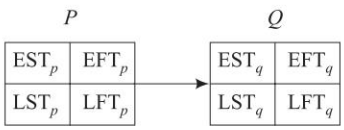

Time-Cost Trade-off Function
Cost in 000'$
35
34
33
32
31
30
29
28
27
26
25
28.6
26.9
27.0
26.7
5
6
7
8
9
10
11
Time in Weeks

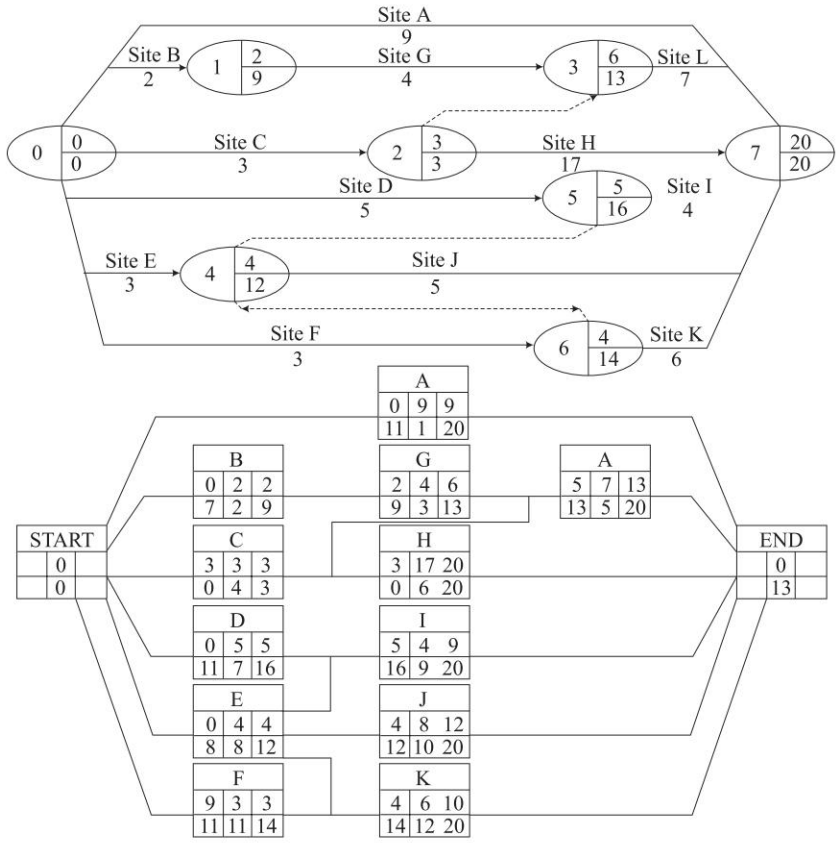
Activity	Dozer	Compressors	Duration	Working Period in Weeks																			
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Task C	1	-	3																				
Task H	1	-	17																				
Task B	1	-	2																				
Task G	1	-	4																				
Task L	1	-	7																				
Task E	1	-	4																				
Task J	1	-	8																				
Task F	1	-	3																				
Task K	1	-	6																				
Task D	1	1	5																				
Task I	1	1	4																				
Task A	1	-	9																				
Dozers Required				4	4	4	4	4	4	4	4	4	4	4	5	4	3	3	3	3	3	2	2

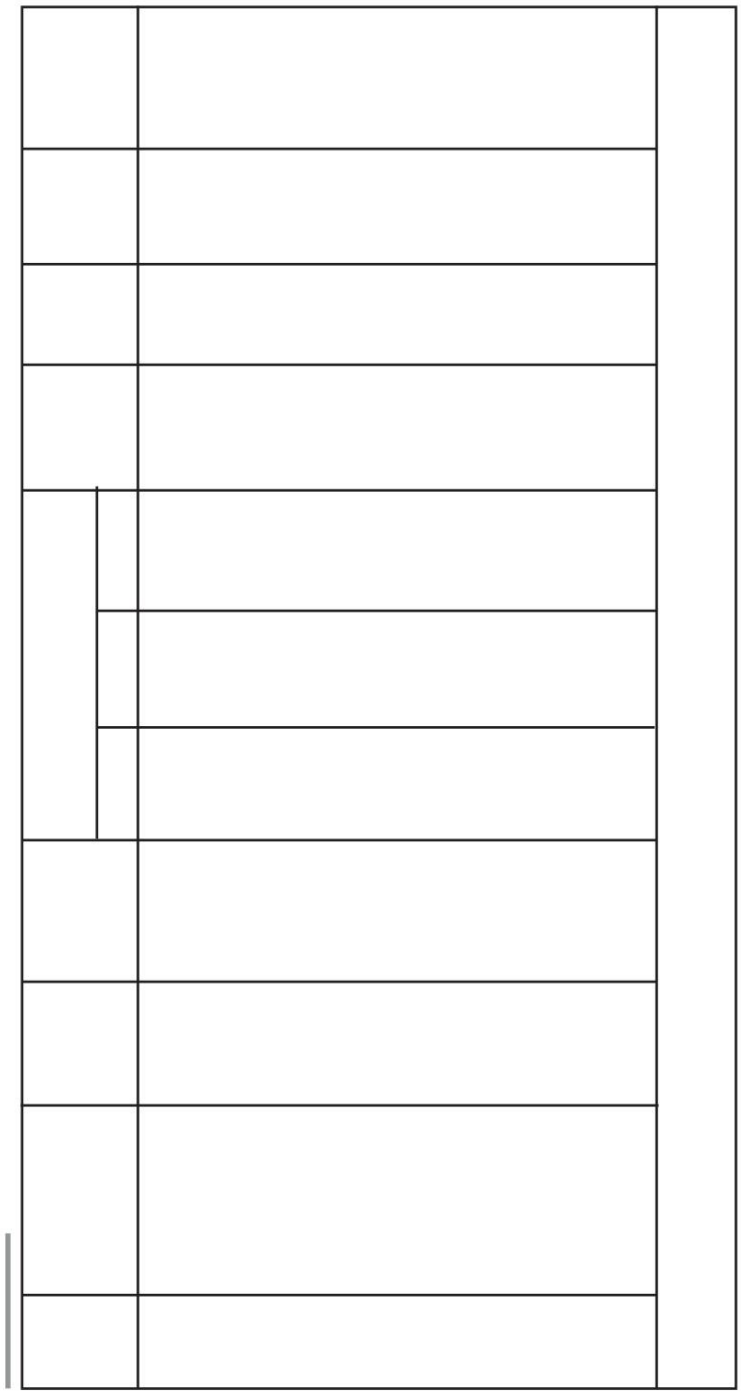




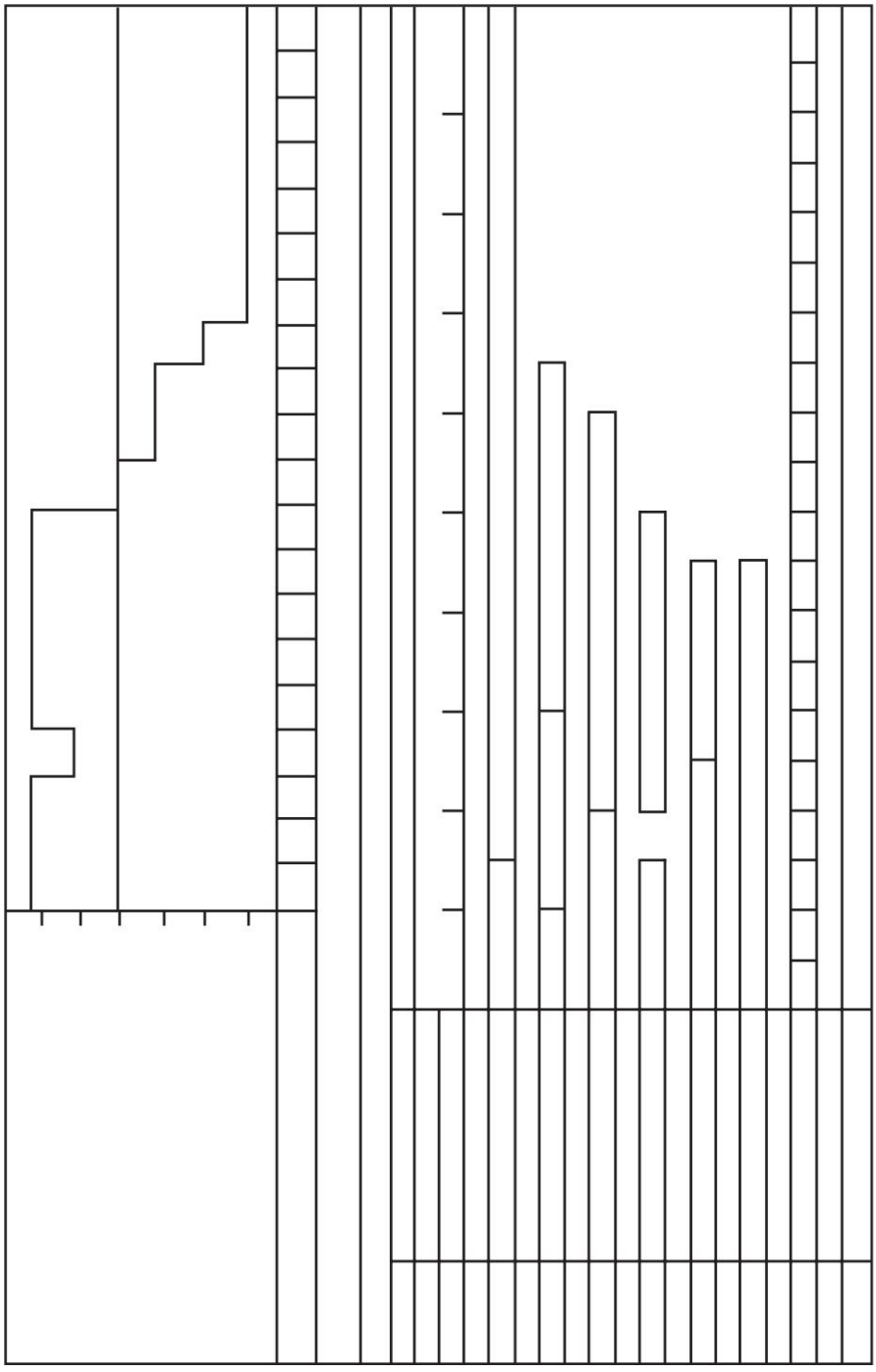


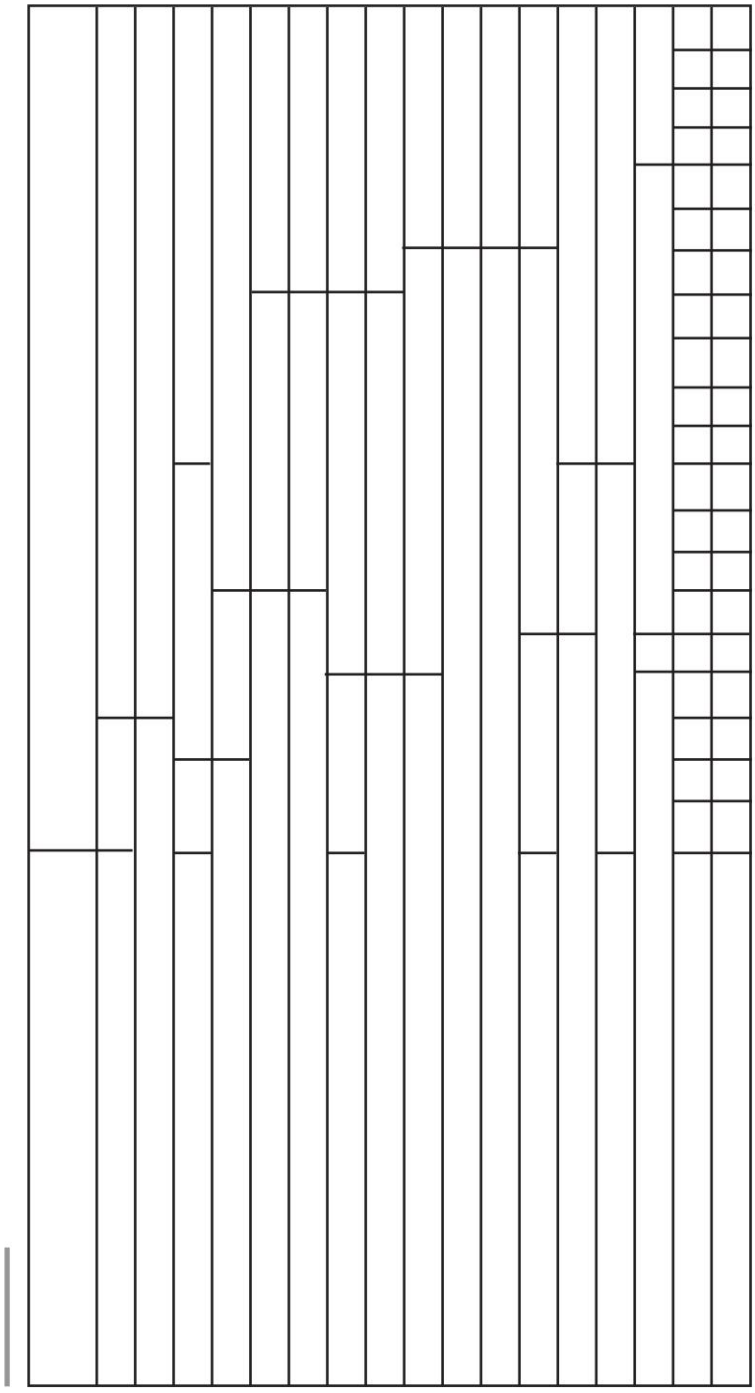


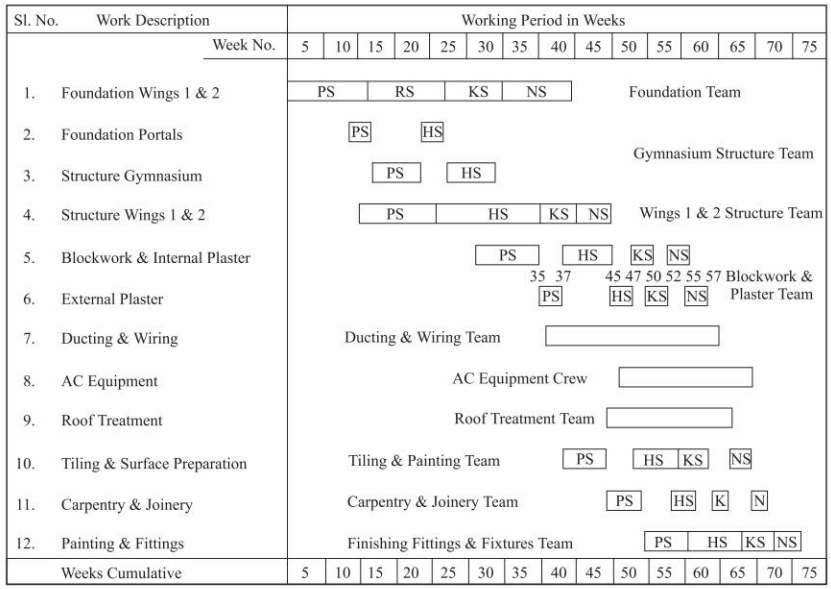


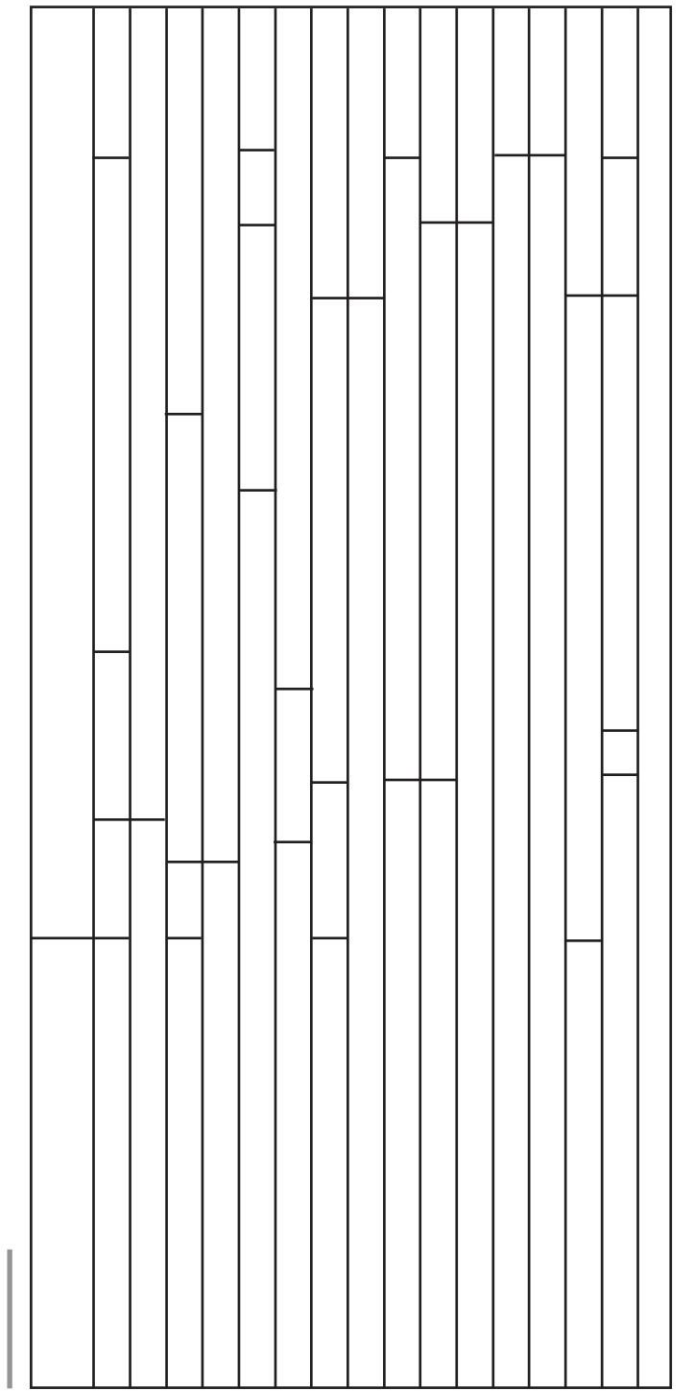


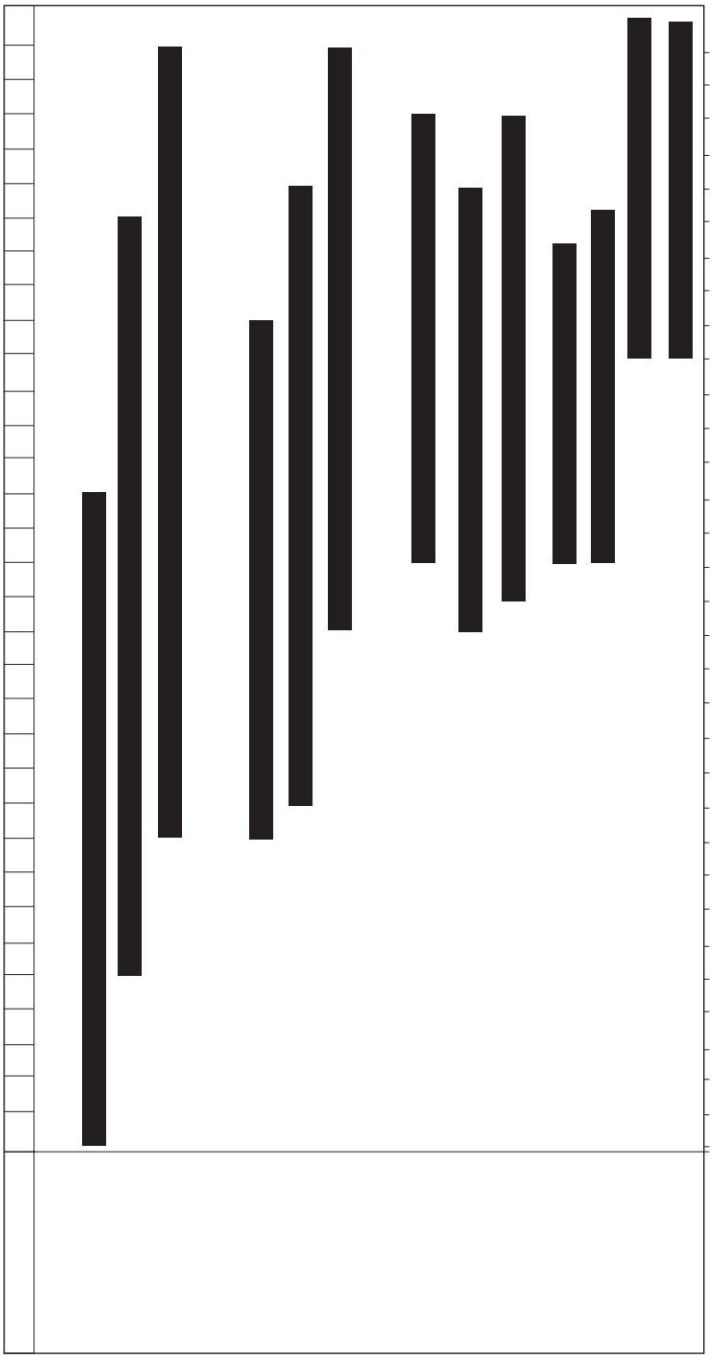
Activity		Out turn	EET_i	EET_j	LET_j	Warning Period Weeks																			
						01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
C	0-2	3	0	3	3	1	1	1																	
H	2-7	17	3	20	20				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
B	0-1	2	0	2	9	1	1					IF													
O	1-3	4	2	6	13			1	1	1	1				IF										
L	3-7	7	6	20	20							1	1	1	1	1	1	1				FF			
-	2-3	0	2	6	13				-	FF	-		-	-	-	IF	-	-	-						
E	0-4	4	0	4	12	1	1	1	1					IF											
J	4-7	0	4	20	20					1	1	1	1	1	1	1	1					FF			
-	4-0	0	4	4	14					-	-	-	-	-	IF	-	-	-							
F	0-6	3	0	4	14	1	1	1	FF																
K	0-7	6	4	20	20					1	1	1	1	1	1						FF				
D	0-6	6	0	5	16	1	1	1	1	1					IF										
I	6-7	4	5	20	20						1	1	1	1						FF					
A	0-7	0	0	20	20	1	1	1	1	1	1	1	1	1											
-	4-5	0	4	5	20					FF	-	-	-	-	IF	-	-	-	-	-					
Total Dozers Required Per Week						6	6	5	6	6	6	6	6	6	4	3	2	2	1	1	1	1	1	1	1

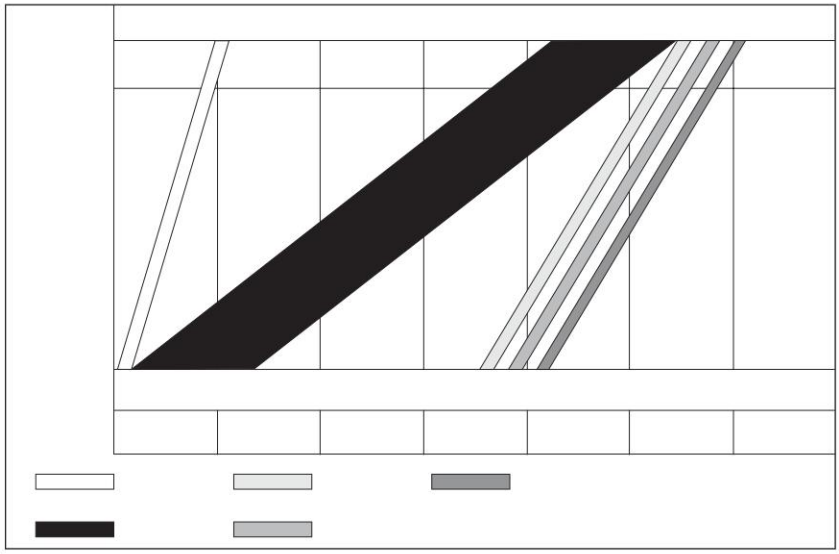


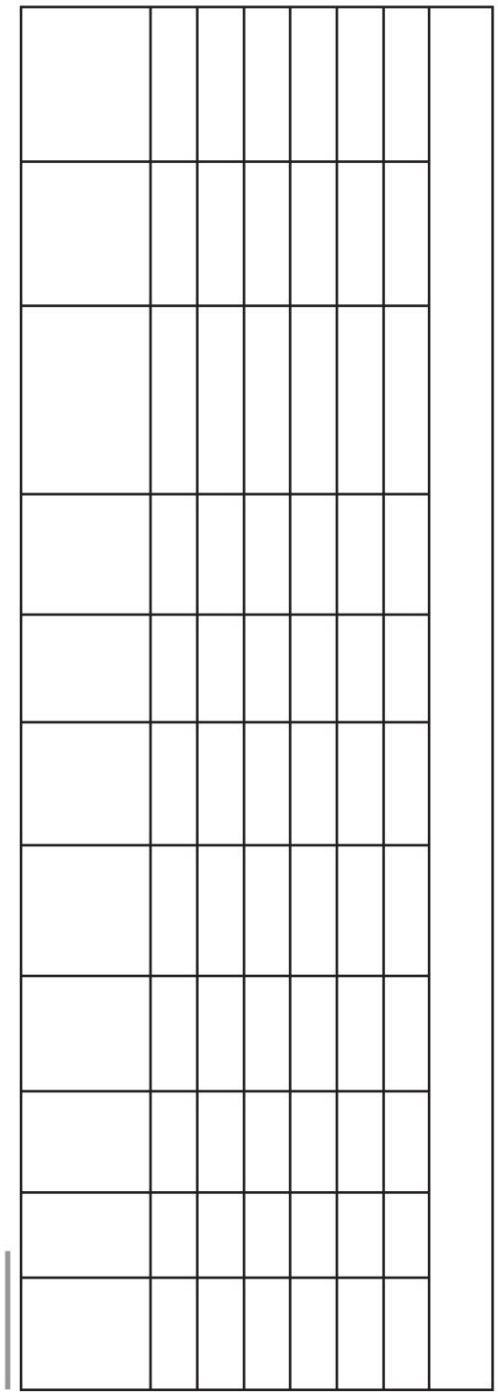


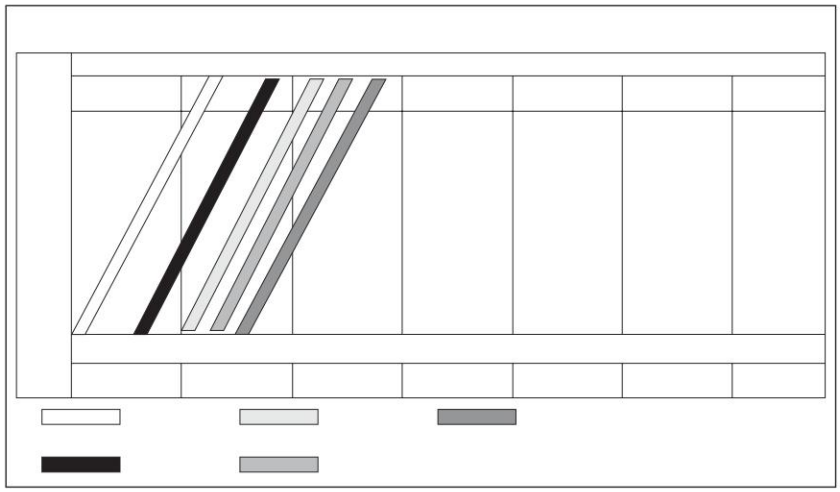

Sl. No.
Work Description
Working Period in Weeks
Week No.
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75
1. Foundation Wings 1 & 2
PS RS KS NS
Foundation Team
2. Foundation Portals
PS HS
Gymnasium Structure Team
3. Structure Gymnasium
PS HS
4. Structure Wings 1 & 2
PS HS KS NS
Wings 1 & 2 Structure Team
5. Blockwork & Internal Plaster
PS HS KS NS
35 37 45 47 50 52 55 57 Blockwork &
6. External Plaster
PS HS KS NS
Plaster Team
7. Ducting & Wiring
Ducting & Wiring Team
8. AC Equipment
AC Equipment Crew
9. Roof Treatment
Roof Treatment Team
10. Tiling & Surface Preparation
Tiling & Painting Team
PS HS KS NS
11. Carpentry & Joinery
Carpentry & Joinery Team
PS HS K N
12. Painting & Fittings
Finishing Fittings & Fixtures Team
PS HS KS NS
Weeks Cumulative
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

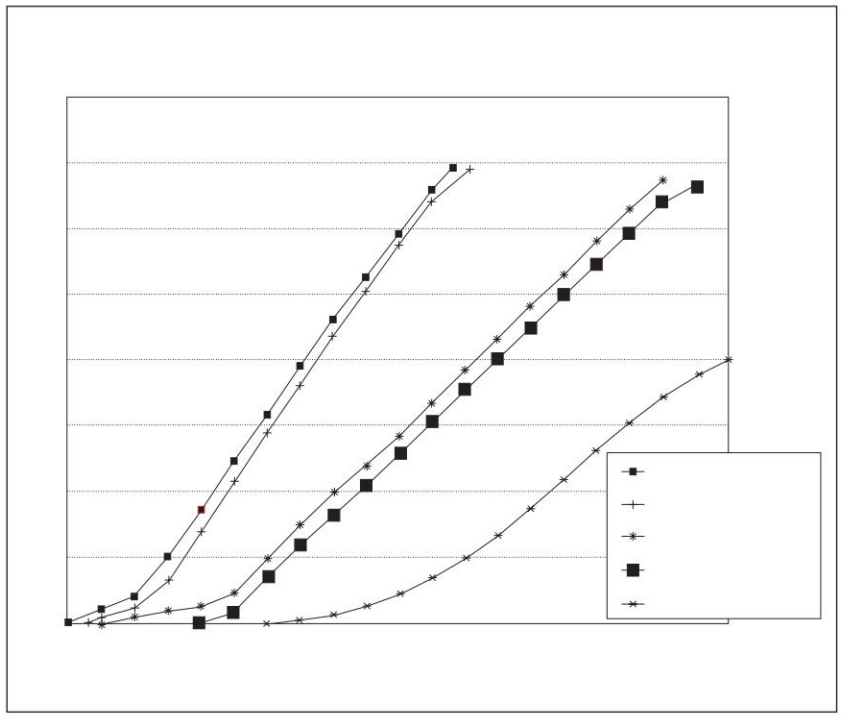


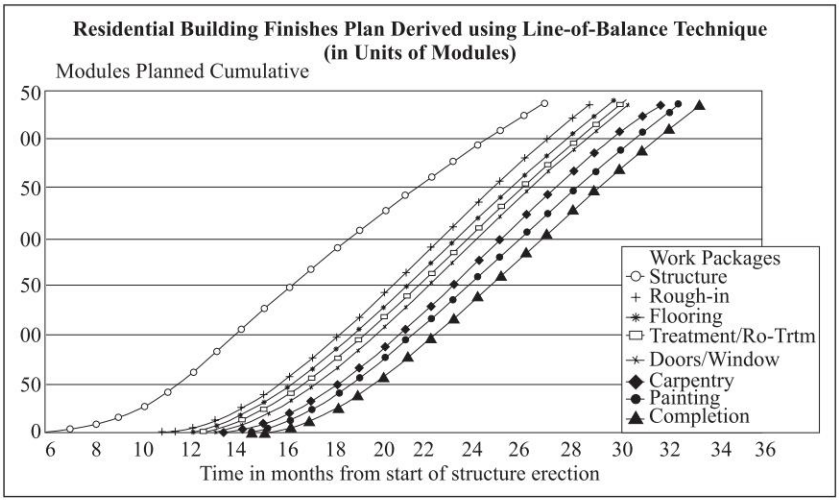




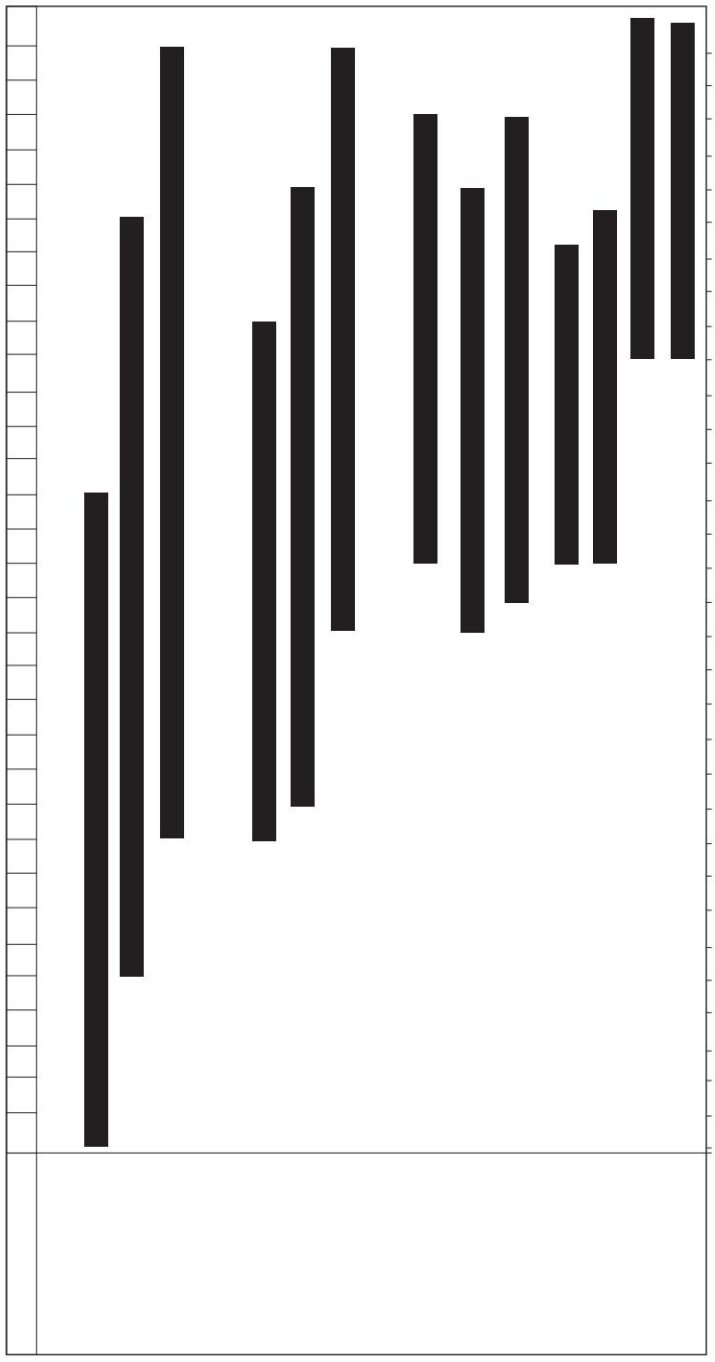


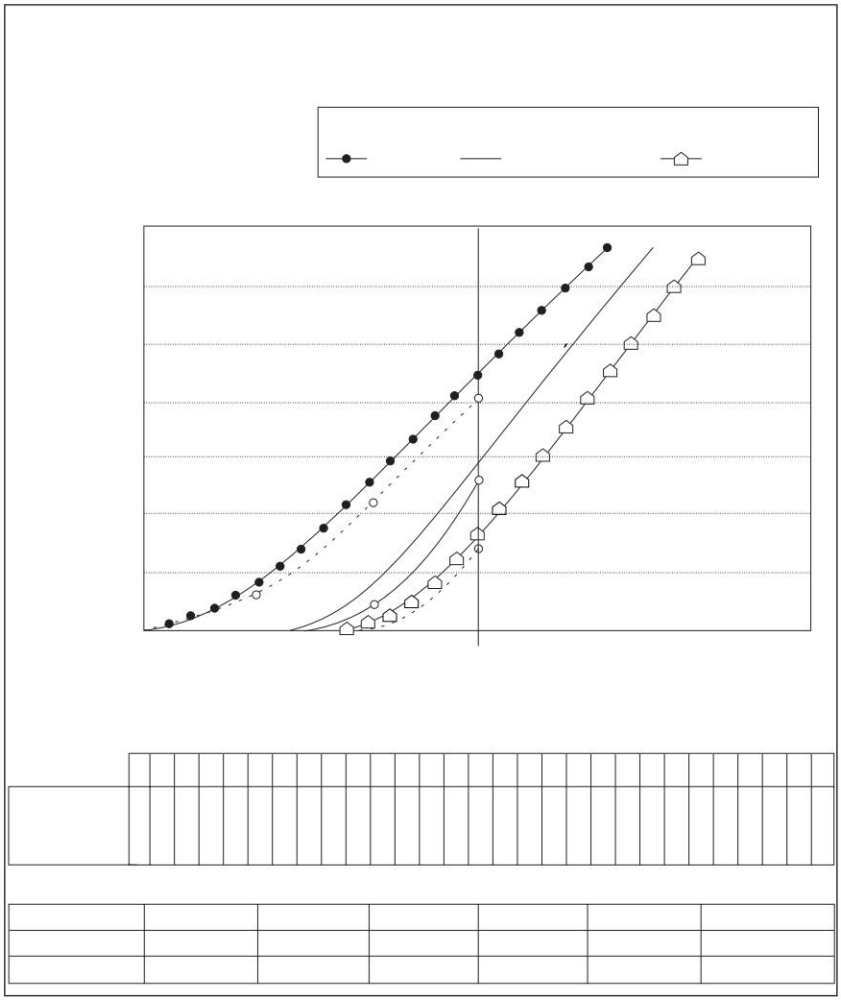


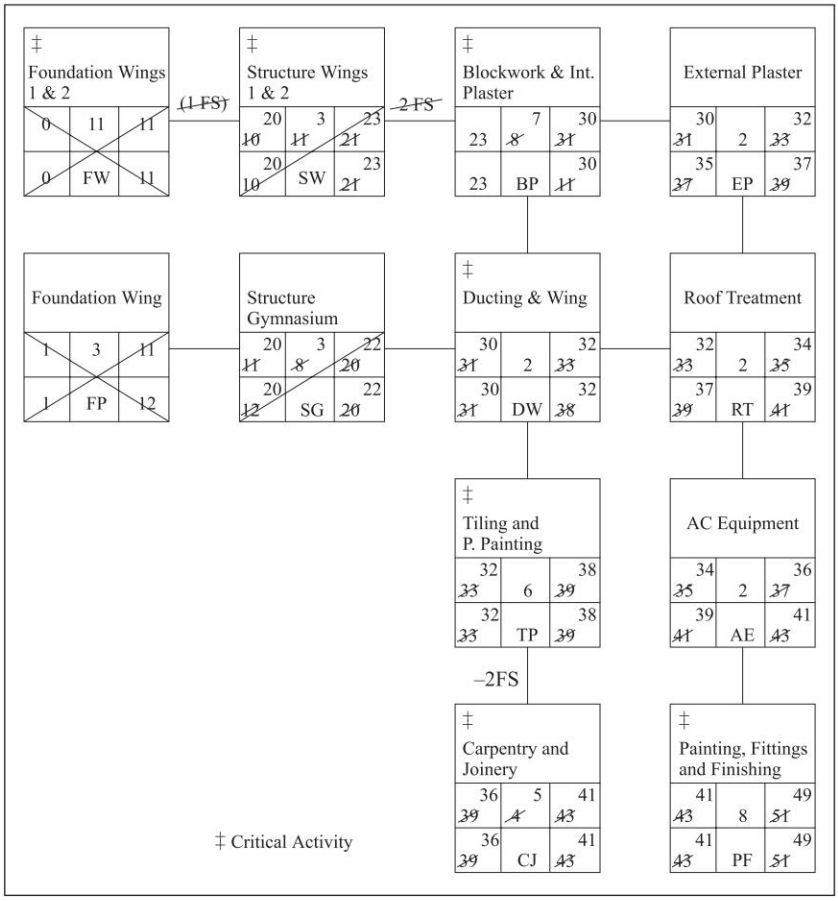


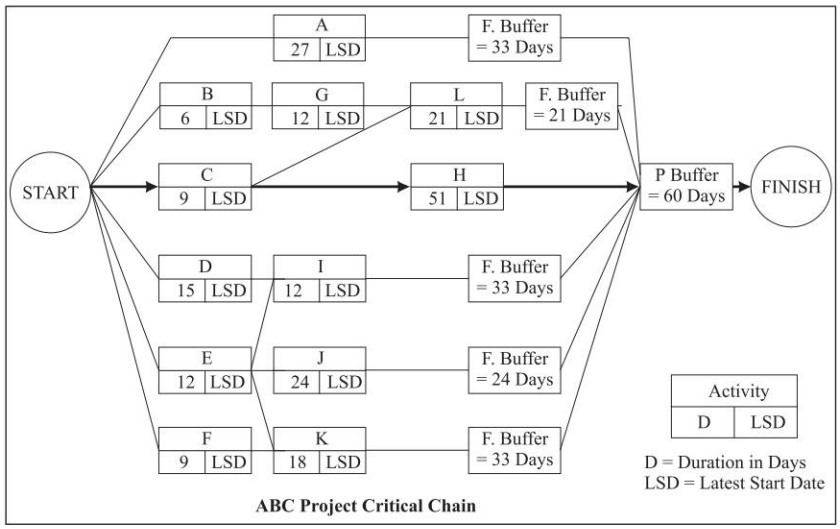

Residential Building Finishes Plan Derived using Line-of-Balance Technique
(in Units of Modules)
Modules Planned Cumulative
50
00
50
00
50
00
50
0
6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36
Time in months from start of structure erection
Work Packages
Structure
Rough-in
Flooring
Treatment/Ro-Trtm
Doors/Window
Carpentry
Painting
Completion

Residential Building Monthly Target Tracking Chart																					
No.	**Work Description**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1	Base Construction	12	16	25	37	36	37	36	36	33	30	34	2								
2	Foundation Rafts	6	12	25	37	36	37	36	36	33	30	34	12								
3	Plinth Walls	5	5	5	12	25	24	24	22	20	23	24	25	24	25	25	24	22			
4	Ground Slabs					12	25	24	24	22	20	23	24	25	24	25	25	24	25	12	
5	Super Structure								4	6	8	10	12	14	16	18	20	20	19	20	19
6	Wiring												4	8	12	16	20	24	25	24	20
7	Plumbing												4	8	12	16	20	24	25	24	20
8	Air Cooling Ducts									4	8	12	16	20	24	25	24	24	23	20	20
9	Door Frames											4	8	12	16	20	24	25	24	24	20
10	Screeding											2	6	10	14	18	24	25	24	24	20
11	Roof Treatment														4	8	12	16	20	25	20
12	Terrazzo-Ceramic Tiles													4	8	12	16	20	25	24	20
13	Doors/Windows Shutters													2	6	10	14	18	25	24	20
14	Preliminary Paint													4	8	12	16	20	24	24	20
15	Carpentry/Joinery, Glazing													2	6	10	14	18	24	24	20
16	P.V.C. Tiles													4	8	12	16	20	24	24	20
17	Fittings/Fixtures													2	6	10	14	18	24	24	20
18	Final Completion																4	8	12	16	20
	Months	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Working Days in a Month	25	24	25	25	24	25	24	24	22	20	23	24	25	24	25	25	24	25	24	20
	Working Days Cumulative	25	43	74	99	123	148	172	196	218	238	261	285	310	334	359	384	408	433	457	48

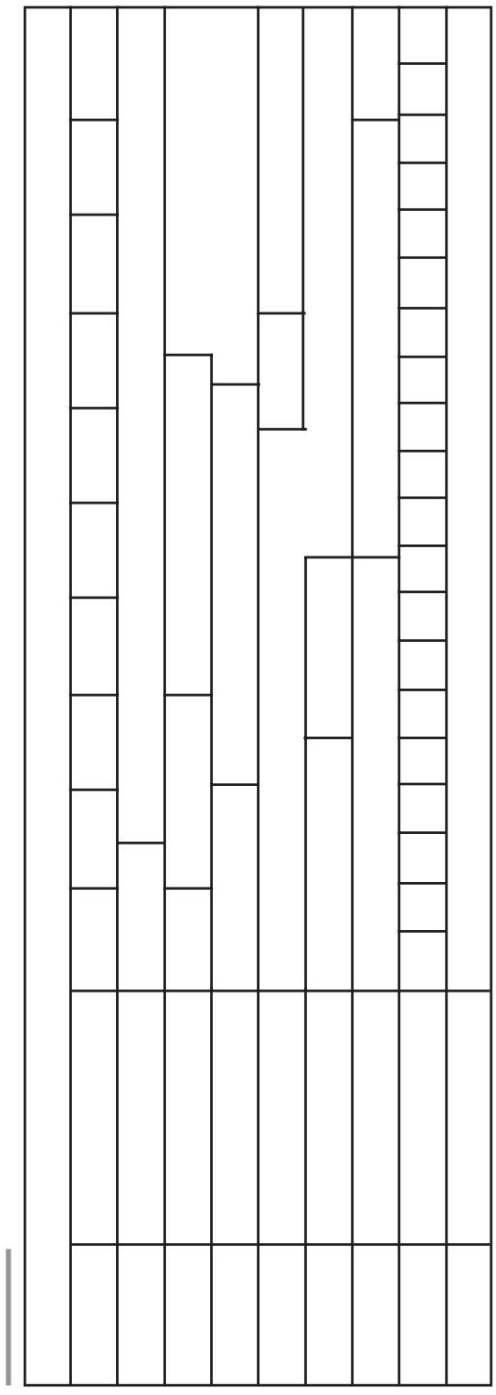





‡ Foundation Wings 1 & 2
0 11 11
0 FW 11
(1 FS)
‡ Structure Wings 1 & 2
20 3 23
10 11 21
20 SW 23
10 21
2 FS
‡ Blockwork & Int. Plaster
23 7 30
23 8 31
23 BP 30
31 11
External Plaster
30 2 32
31 33
35 EP 37
37 39
Foundation Wing
1 3 11
1 FP 12
Structure Gymnasium
20 3 22
11 8 20
20 SG 22
12 20
‡ Ducting & Wing
30 2 32
31 33
30 DW 32
31 38
Roof Treatment
32 2 34
33 35
37 RT 39
39 41
‡ Tiling and P. Painting
32 6 38
33 39
32 TP 38
33 39
AC Equipment
34 2 36
35 37
39 AE 41
41 43
–2FS
‡ Carpentry and Joinery
36 5 41
39 4 43
36 CJ 41
39 43
‡ Painting, Fittings and Finishing
41 8 49
43 51
41 PF 49
43 51
‡ Critical Activity



ABC Project Critical Chain



6

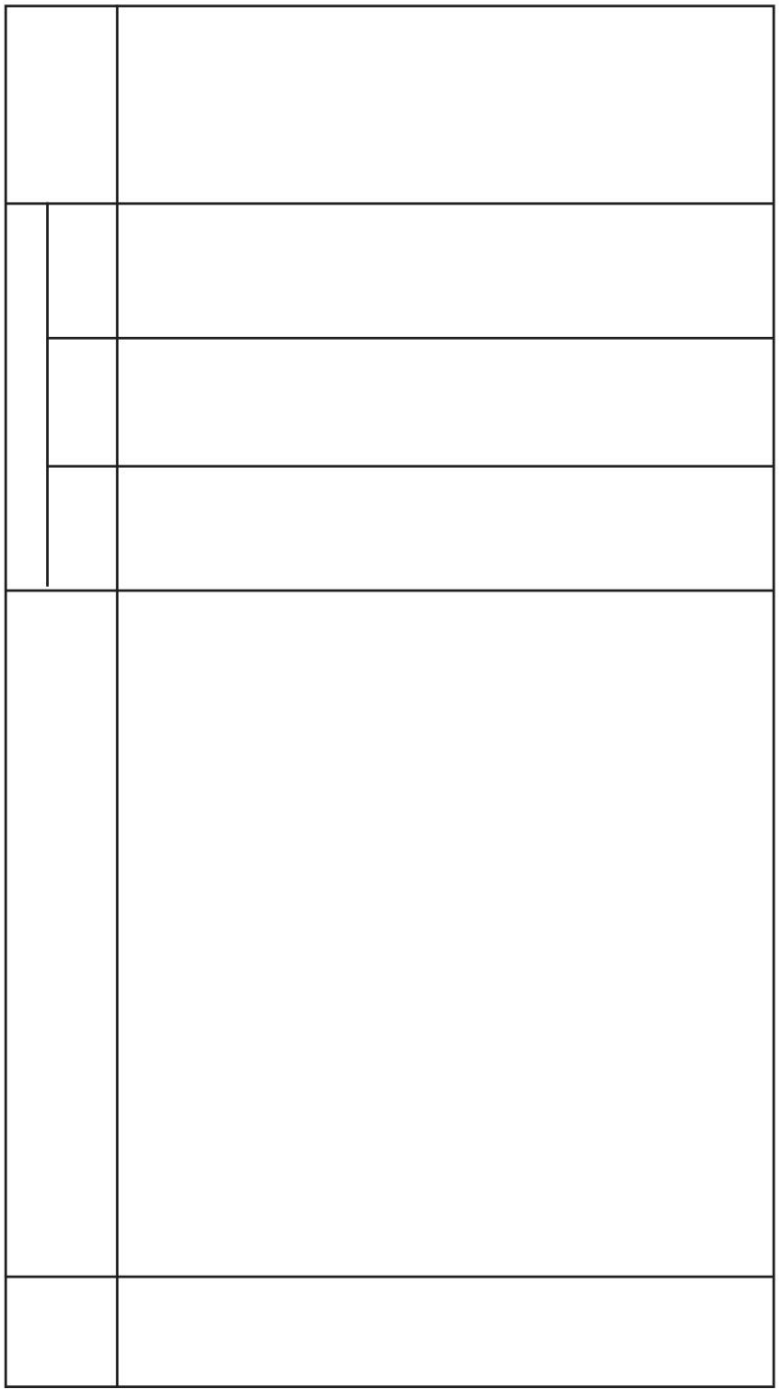
Introduction and Scope
Planning Workers
Planning Materials
Planning Equipment
Resources Productivity Control

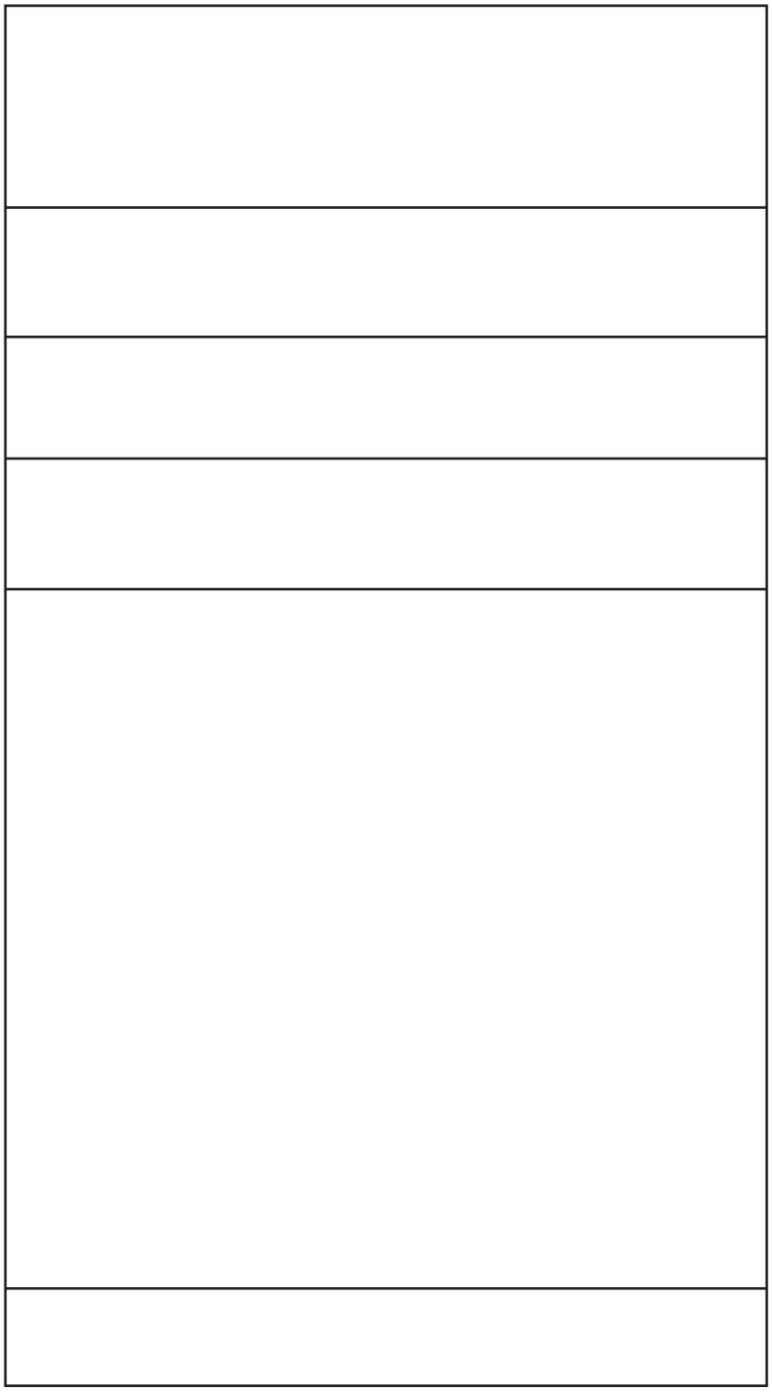
1. INTRODUCTION AND SCOPE

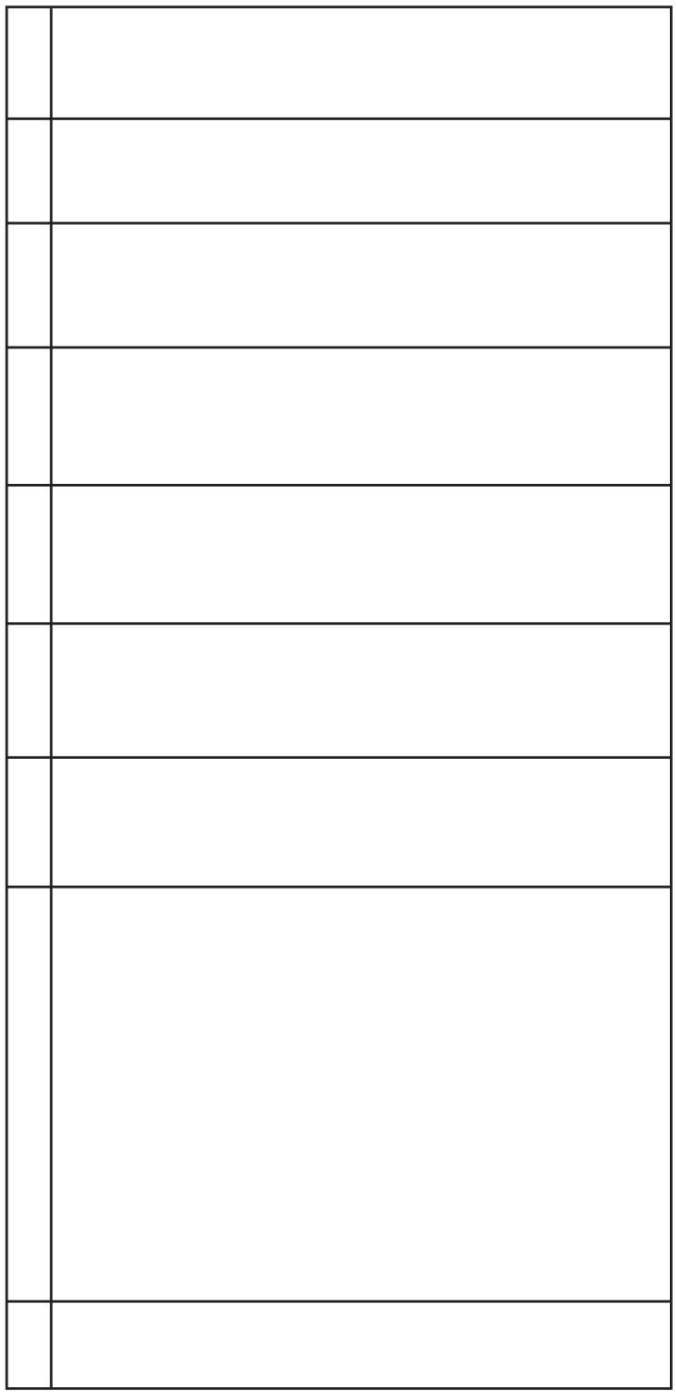
Physical resources in a project include men, materials, and machinery. Resource planning focuses on determining the resources required (workers, materials, equipment), the quantities in which they are needed and the quality, and when and where each is required in order to perform project activities. Management Personnel requirement will depend on the organisation structure and will vary from project to project and as such these are not covered in this chapter.

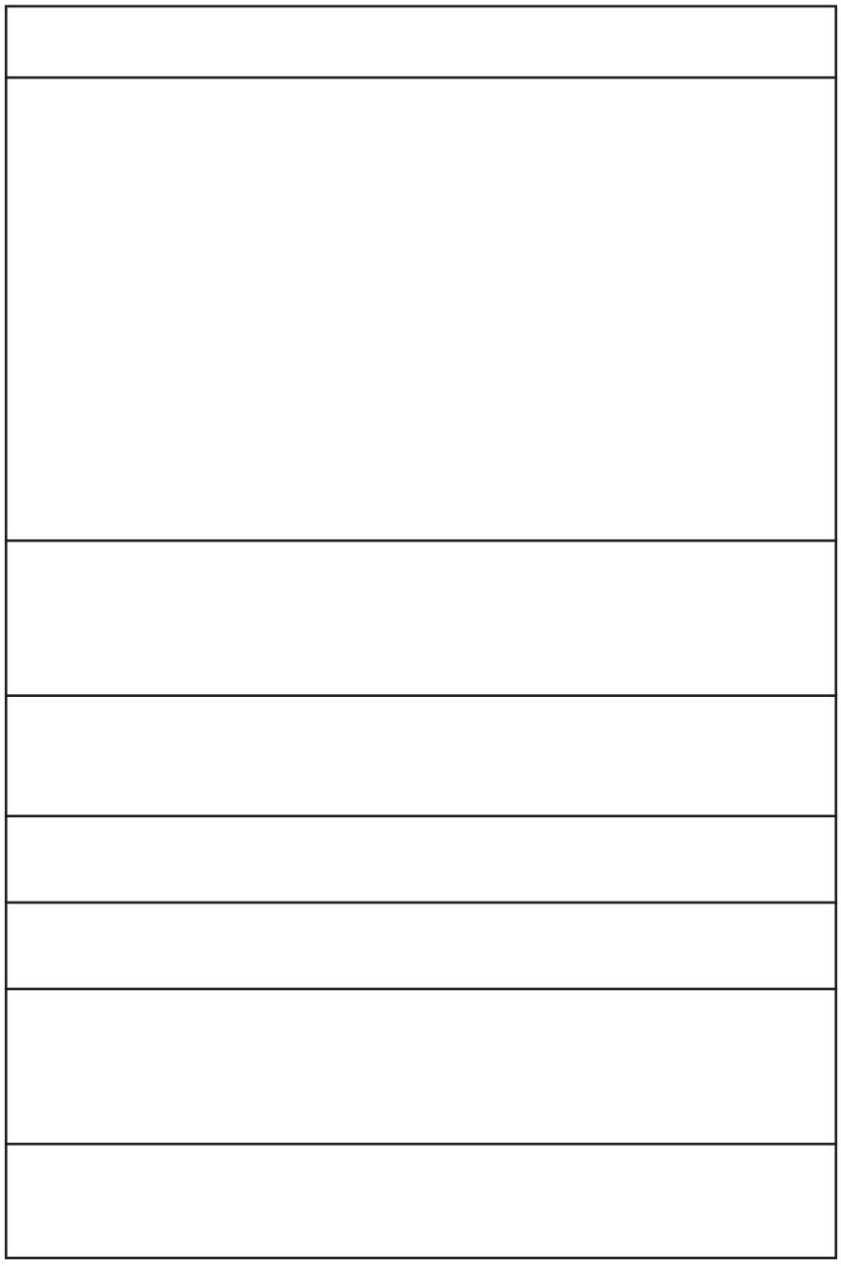
The resource inputs produce outputs in the form of work. The success of a project depends upon the performance of these input resources. Productivity provides the scale to measure the performance of these input resources. The various productivity parameters that need to be controlled in projects are labour productivity, equipment productivity and material productivity.

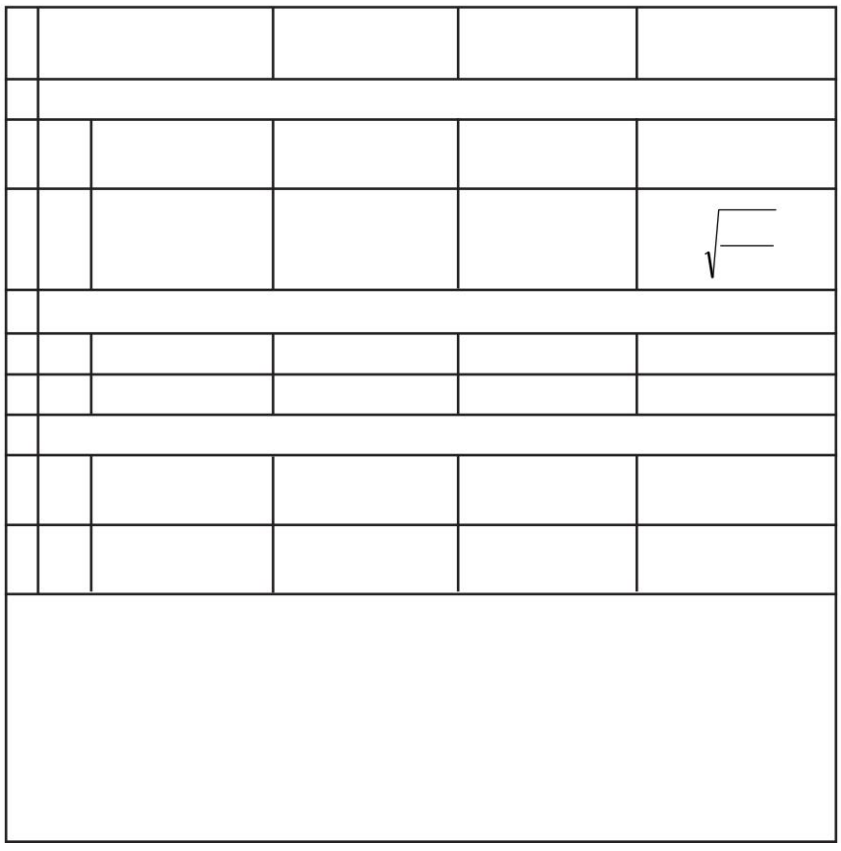
Project resources management aims at planning, scheduling, procurement and control of workers, materials and equipment required for the completion of the project, economically and efficiently.

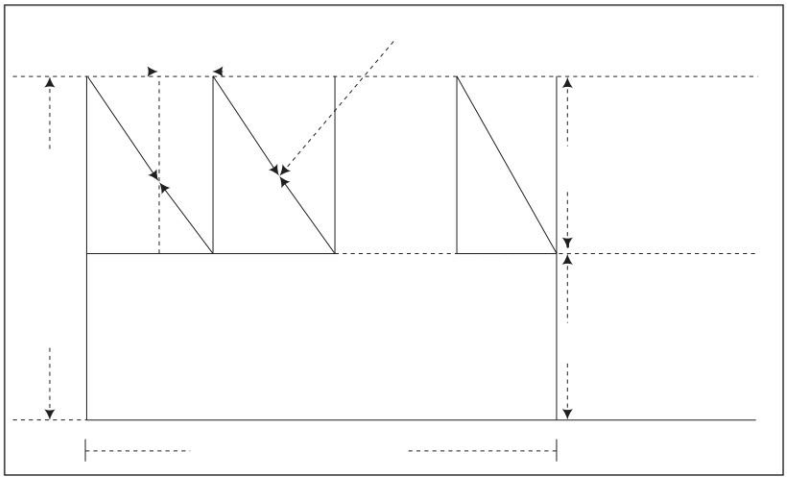


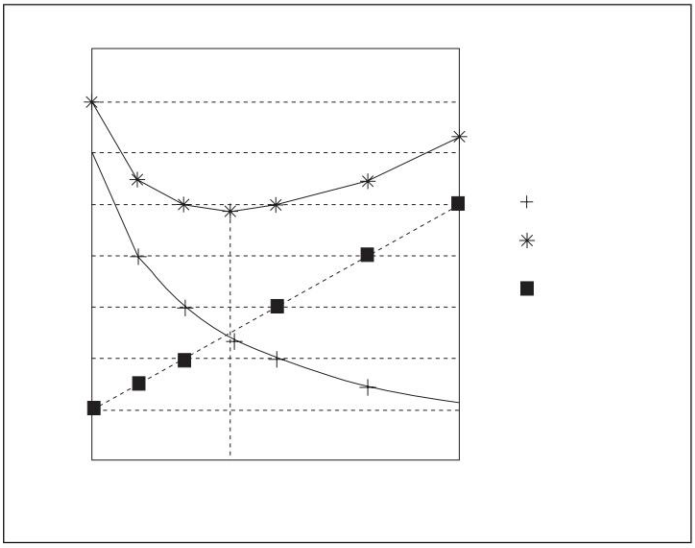


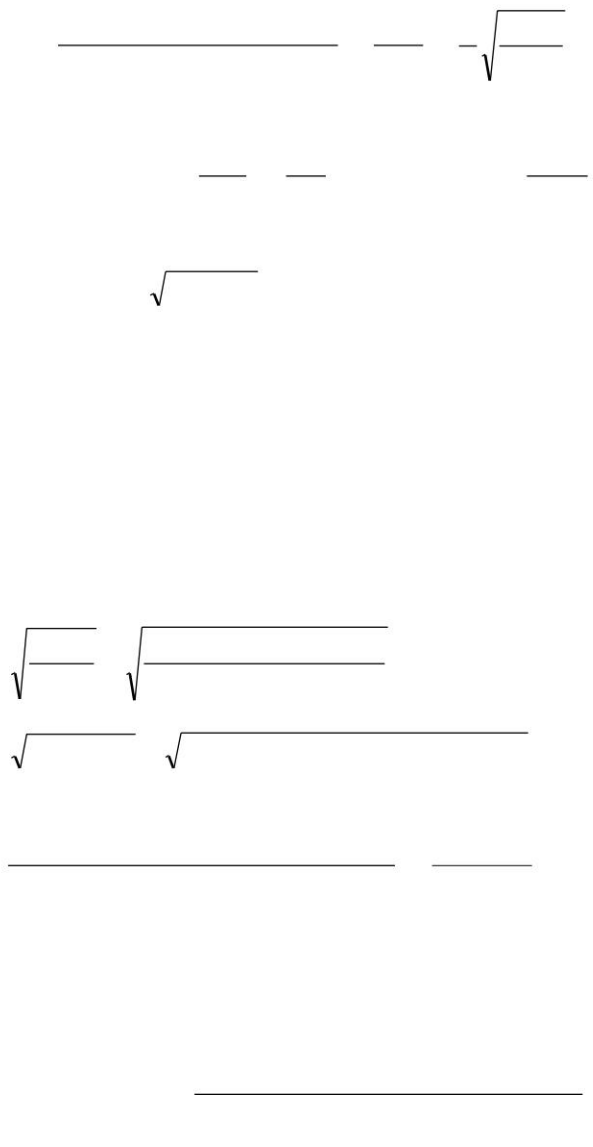


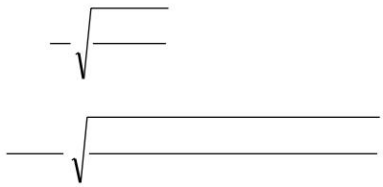


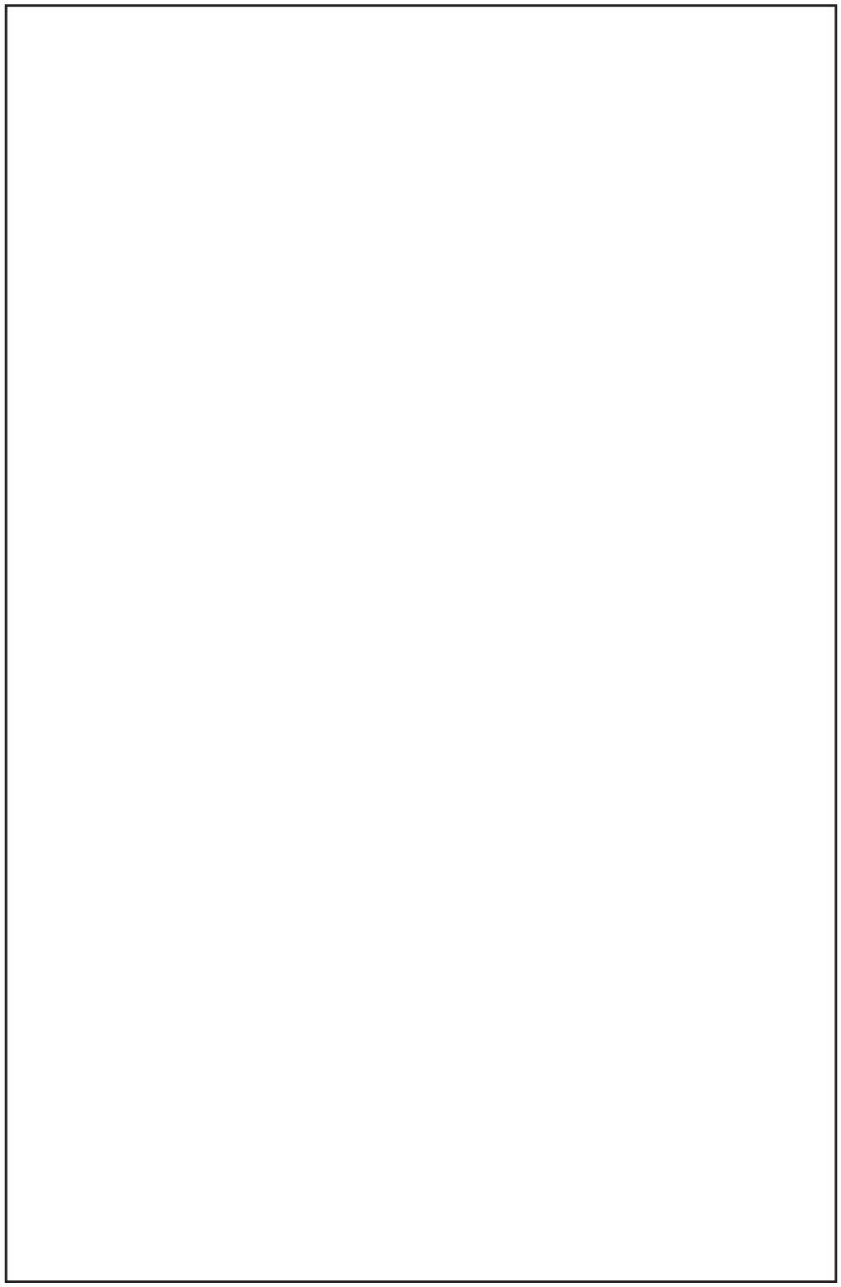


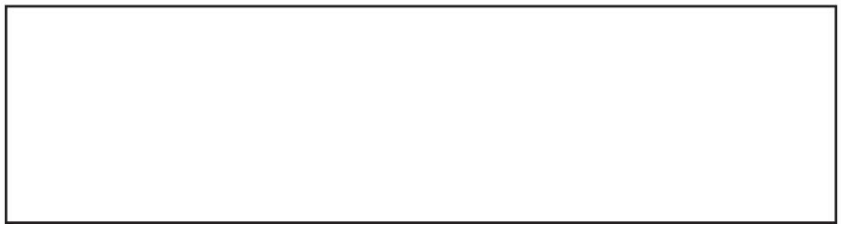


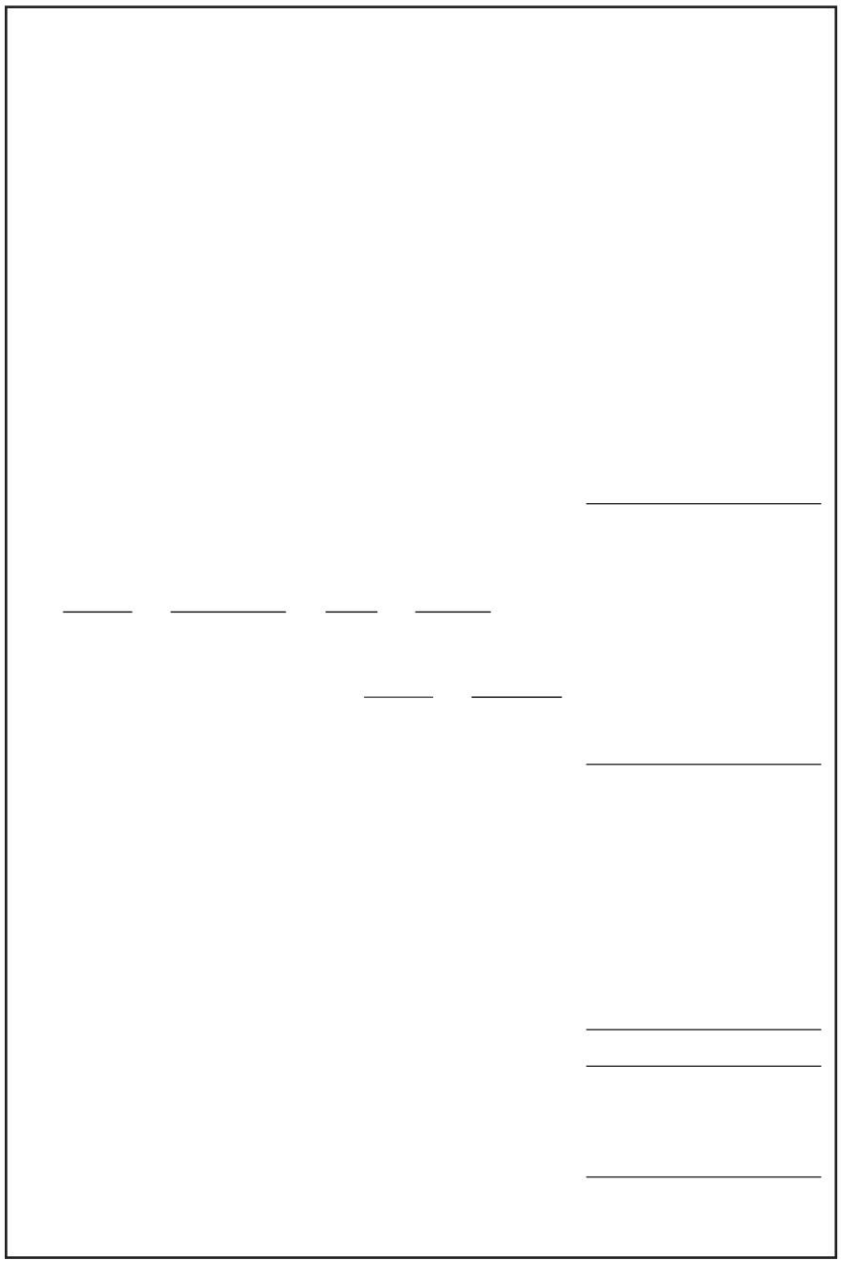












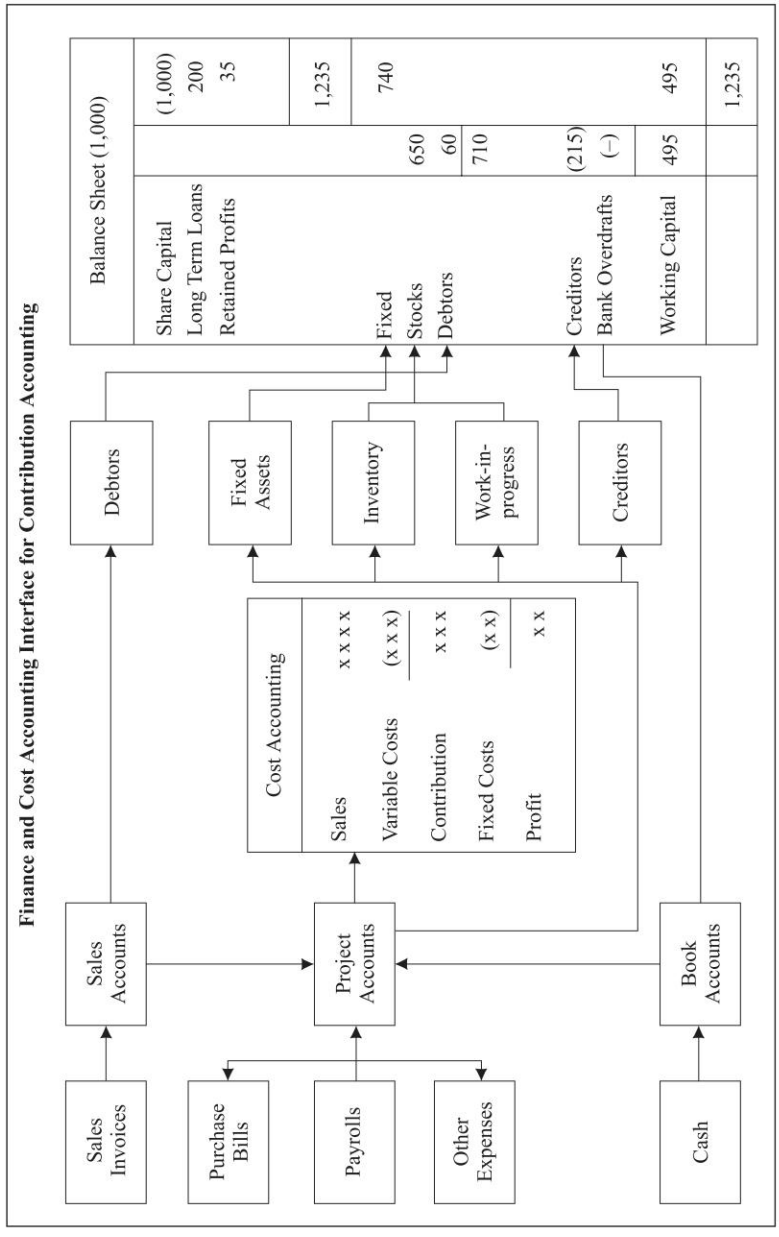
7

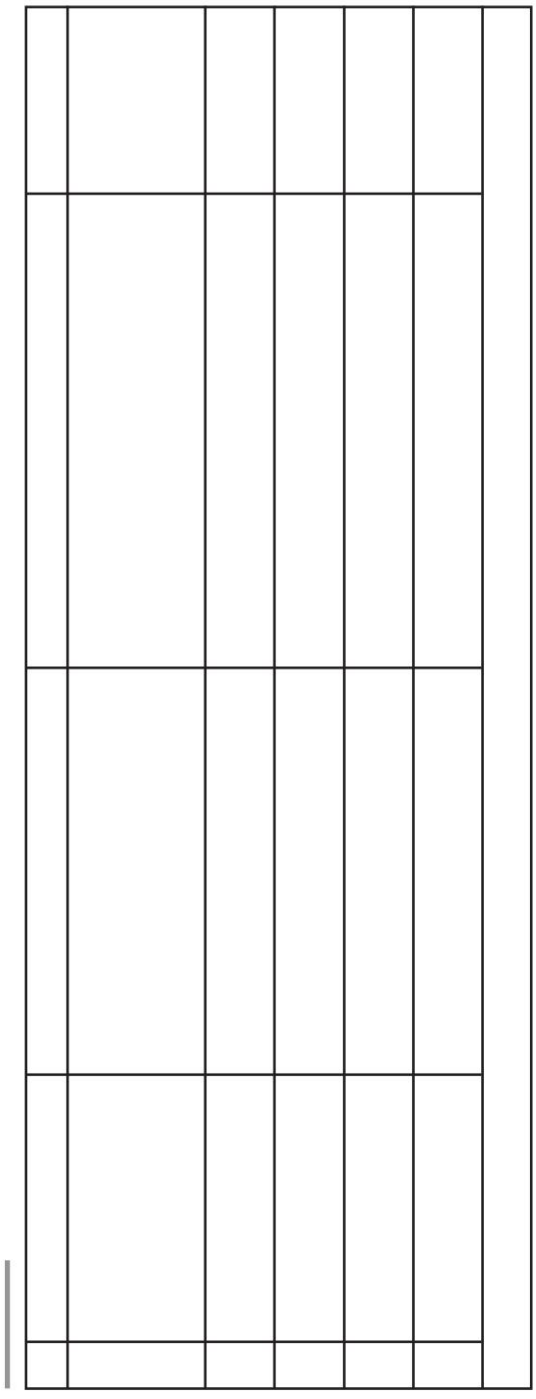
Introduction and Scope
Project Costs Estimation—An Overview
Costs Planning Process
Cost Budgeting Process
Costs Controlling Process
Earned Value Management System

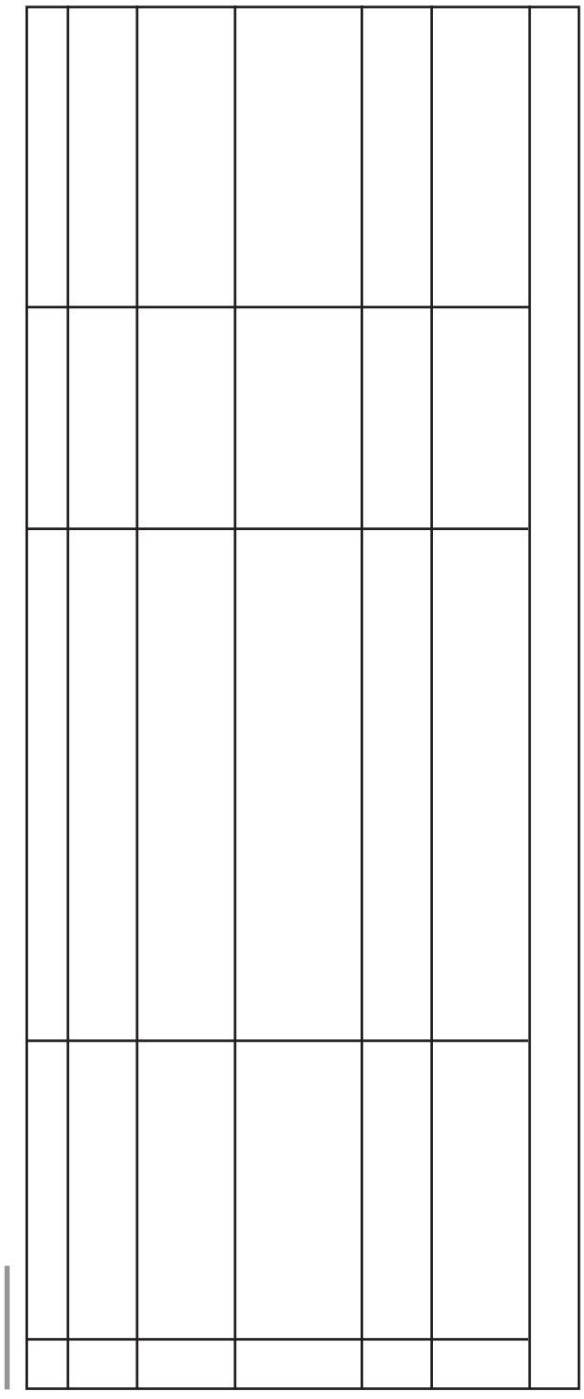
1. INTRODUCTION AND SCOPE

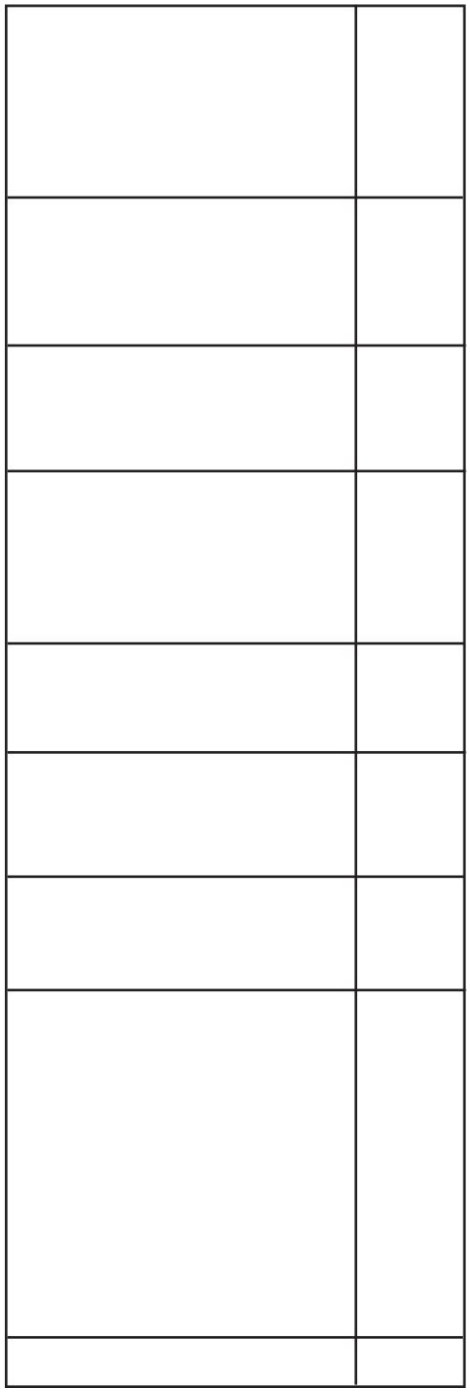
Cost accounting and financial accounting systems make use of the same sale value and expenditure data (Fig. 7.1), but there is a basic difference between them. Financial accounting involves recording, classifying and summarising the financial transactions with the primary aim of preparing the financial statements relating to profit and loss, balance sheet and cash flow, with a view to bring out the financial position of the organisation. It presents the financial status of the organisation to the shareholders, legal authorities or financial institutions who are not directly involved in the day-to-day running of the organisation. On the other hand, cost accounting reflects the classification and analysis of the costs on the basis of functions, processes, products, value , responsibility, etc. It is an internal accounting system designed for managing production costs in an organisation.

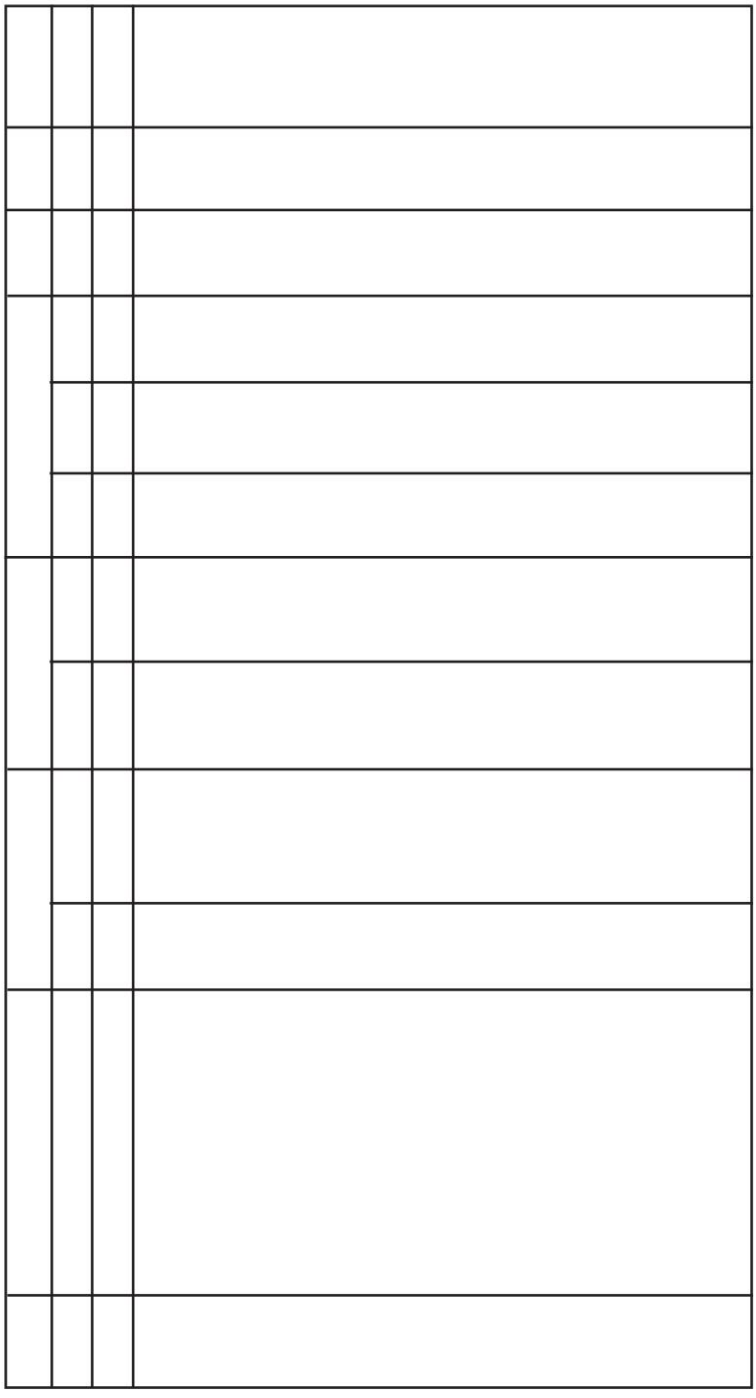
In a project, the sponsor/owner and developer (hereafter called the contractor) have the same objective of completing the project within the specified time and agreed cost, but their goals and approaches differ. The sponsors/clients costs associated with a project include initial capital investment for creating the facility and subsequent operation cost for utilising the facility. A sponsor's goal is to acquire a product/facility economi-

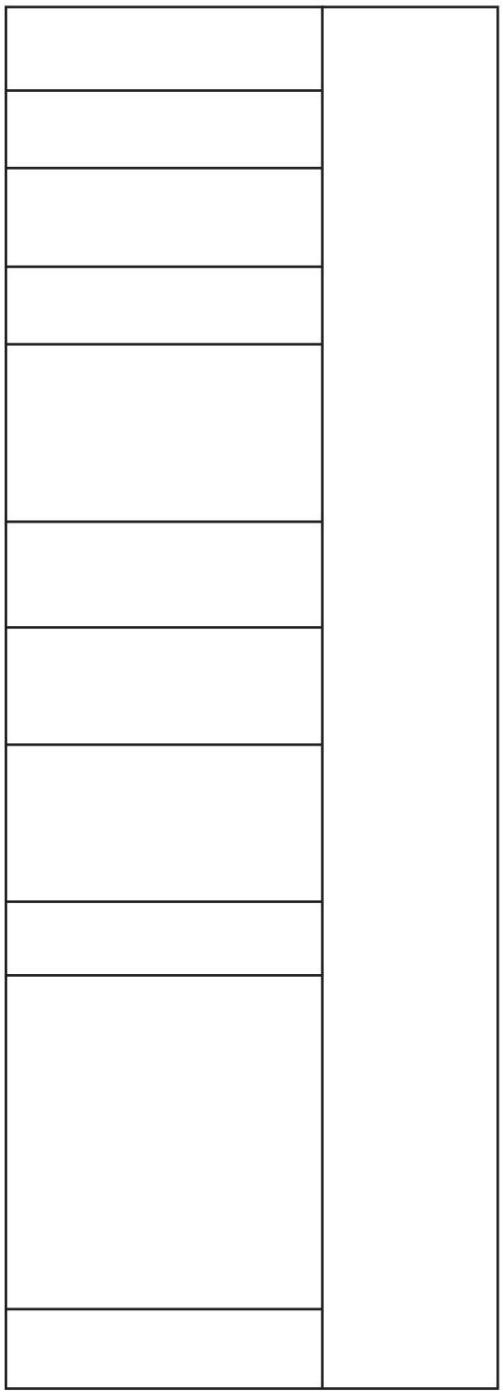

Finance and Cost Accounting Interface for Contribution Accounting
Balance Sheet (1,000)
Share Capital
Long Term Loans
Retained Profits
(1,000)
200
35
1,235
Fixed
Stocks
Debtors
650
60
710
740
Creditors
Bank Overdrafts
(–)
(215)
Working Capital
495
495
1,235
Debtors
Fixed Assets
Inventory
Work-in-progress
Creditors
Cost Accounting
Sales
x x x
Variable Costs
(x x x)
Contribution
x x x
Fixed Costs
(x x)
Profit
x x
Sales Accounts
Project Accounts
Book Accounts
Sales Invoices
Purchase Bills
Payrolls
Other Expenses
Cash

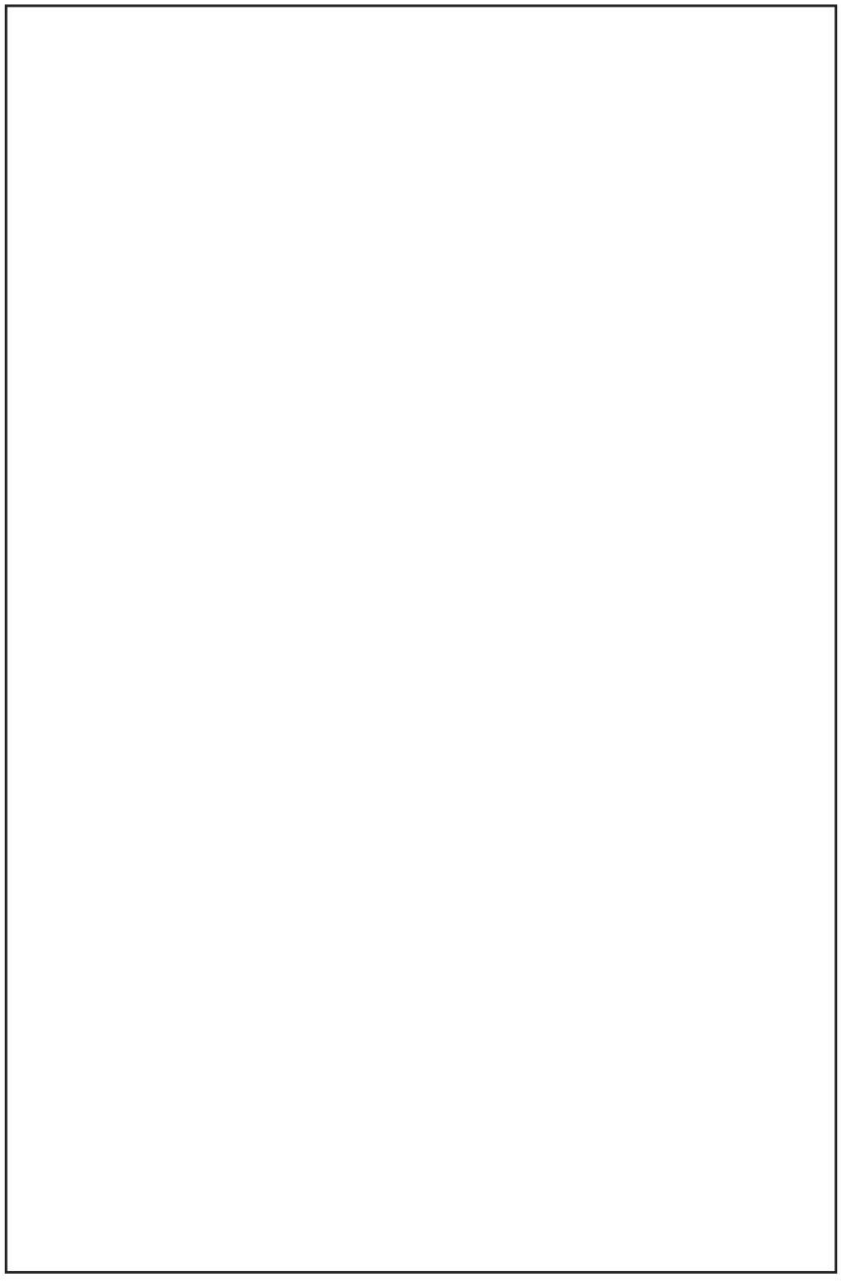


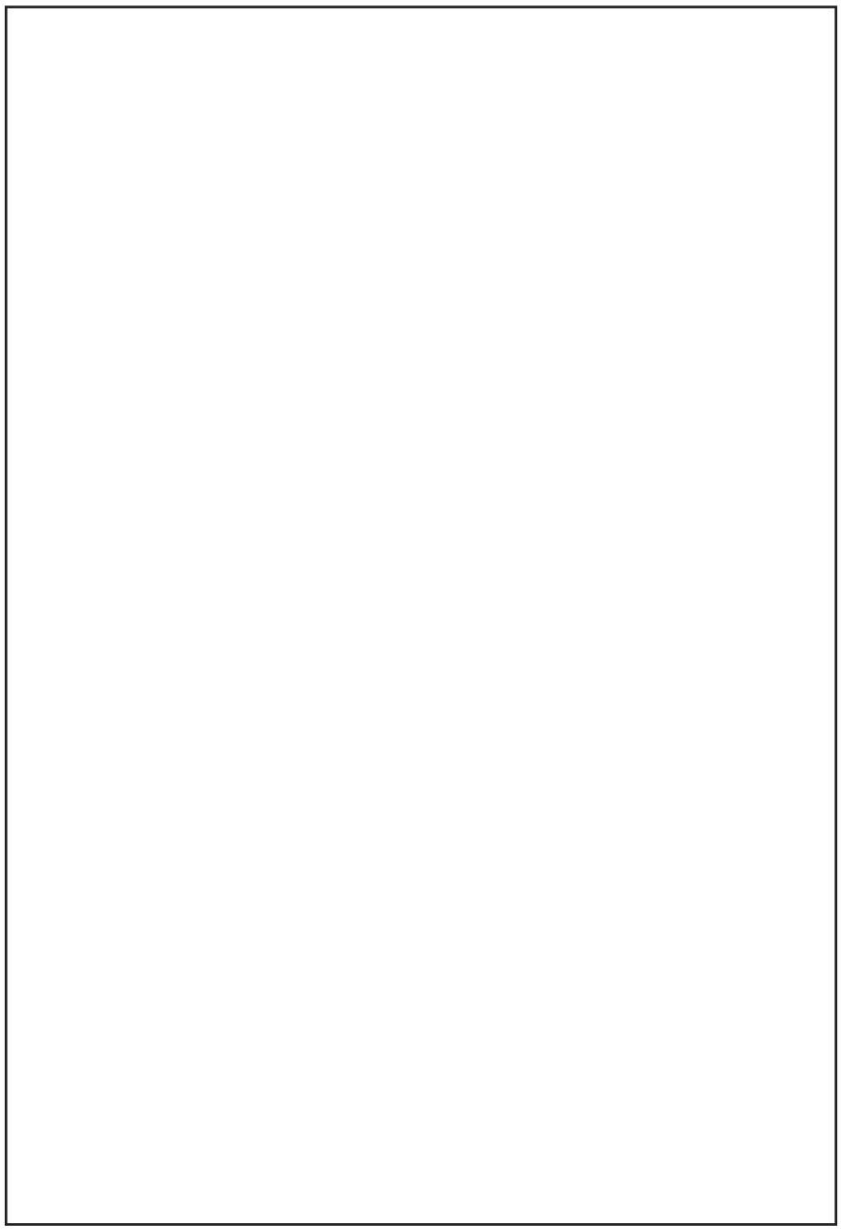


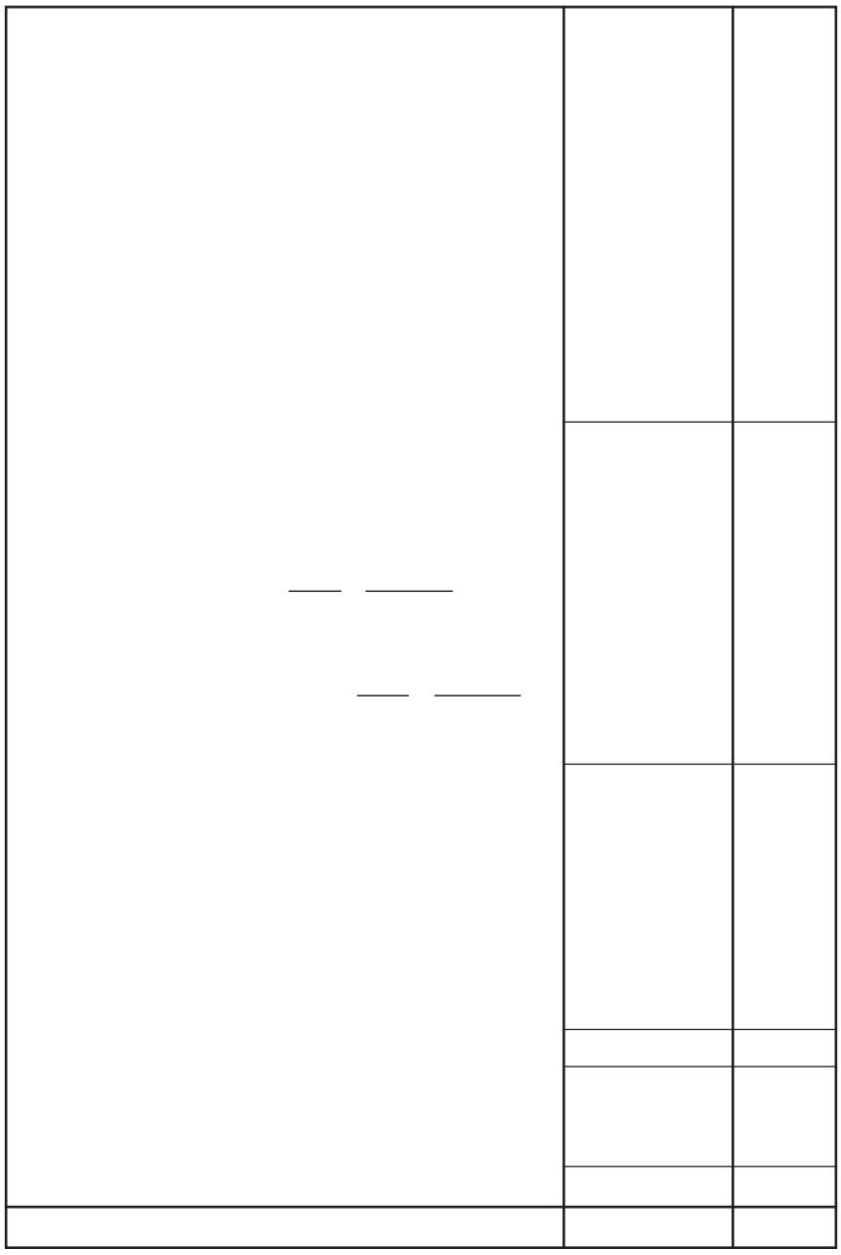


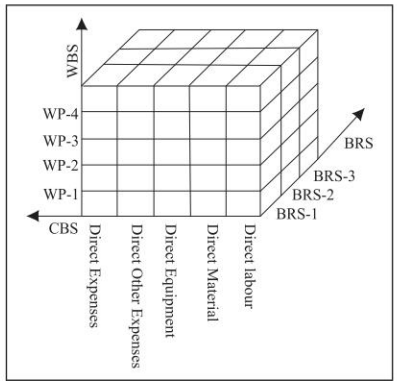


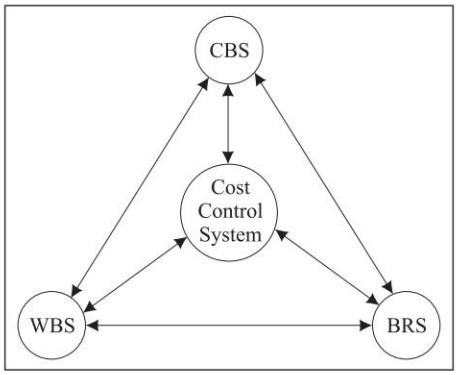


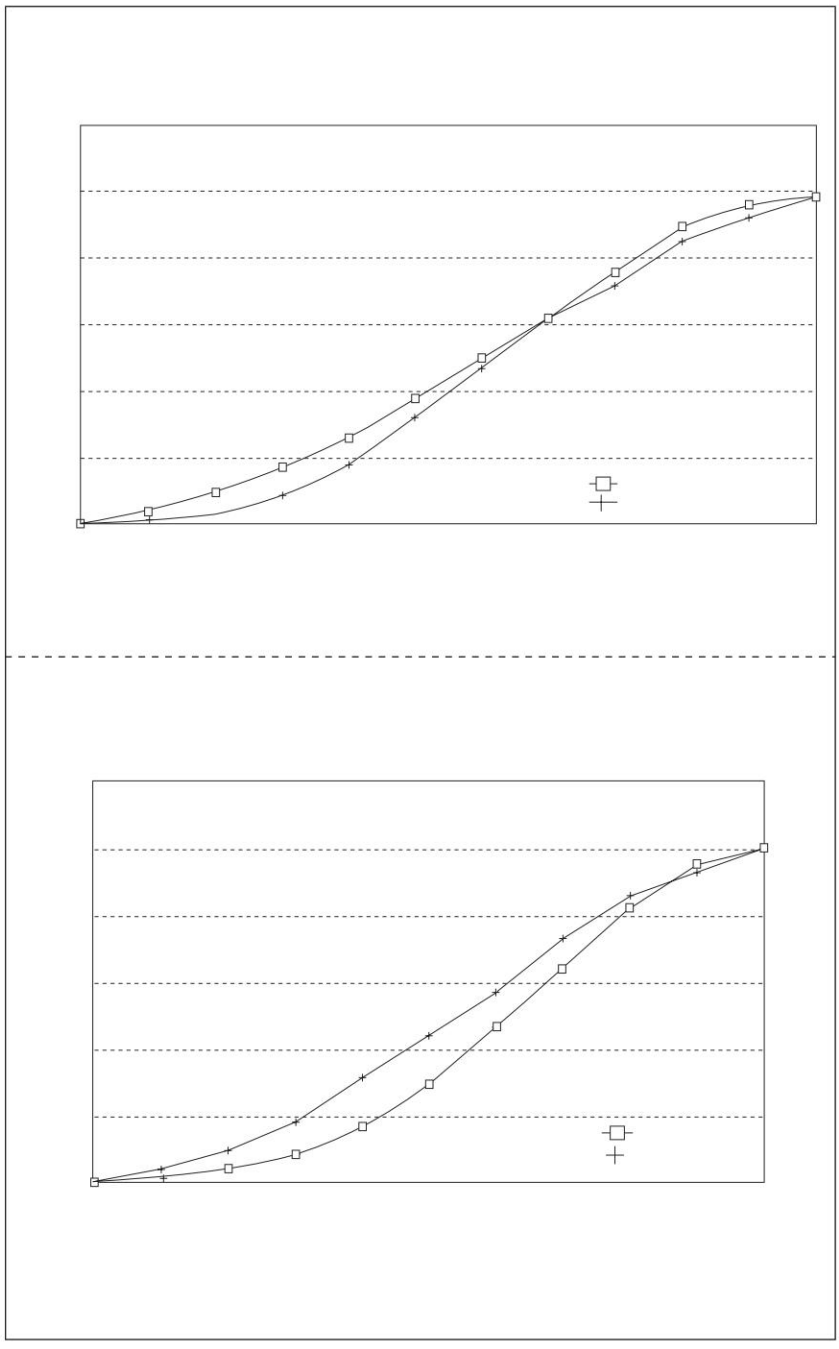


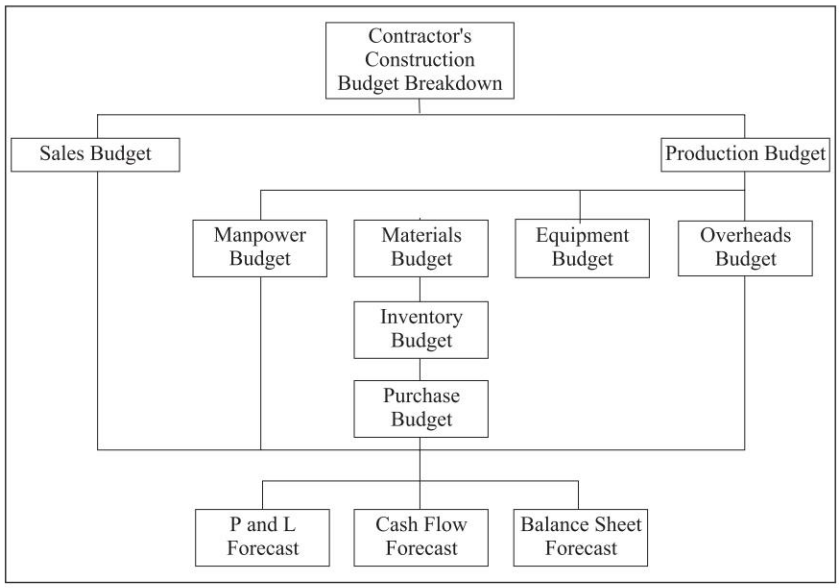


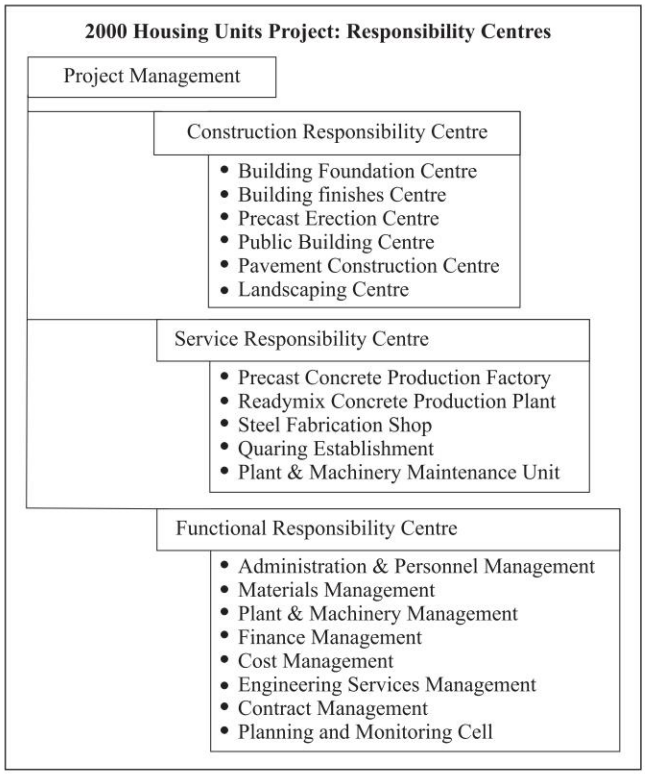


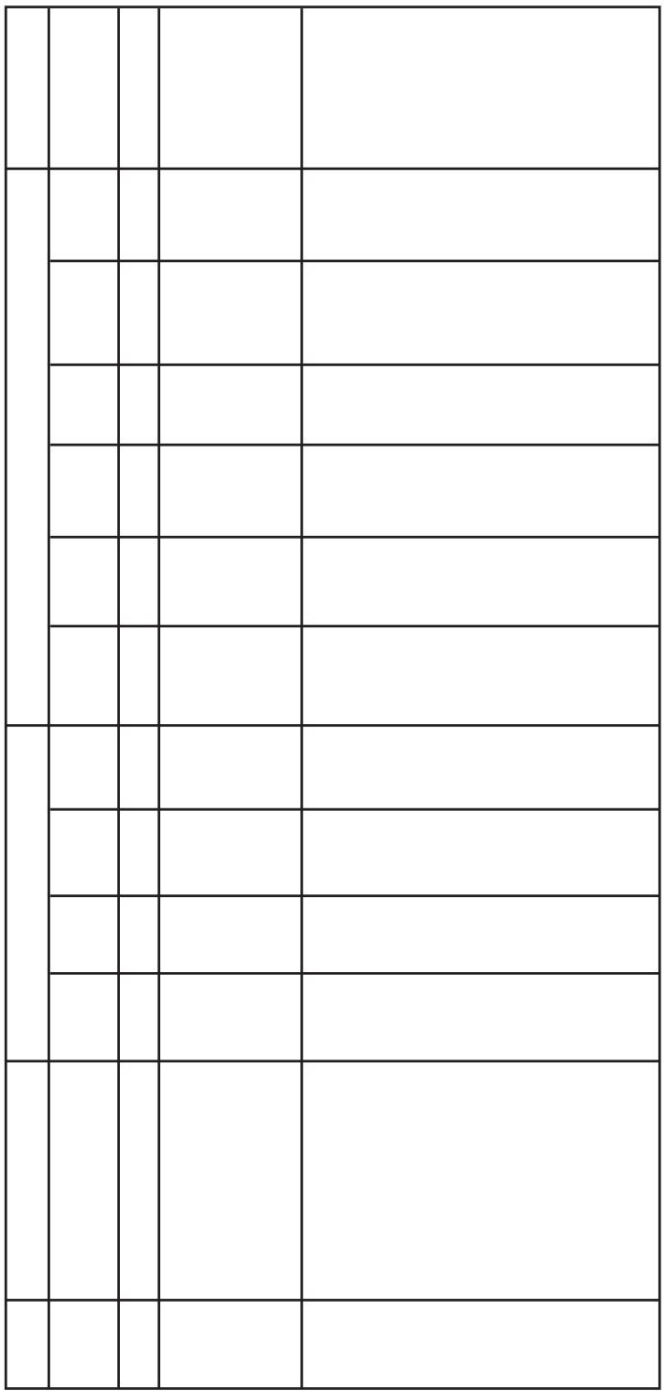

WBS
WP-4
WP-3
WP-2
WP-1
CBS
BRS
BRS-3
BRS-2
BRS-1
Direct Expenses
Direct Other Expenses
Direct Equipment
Direct Material
Direct labour

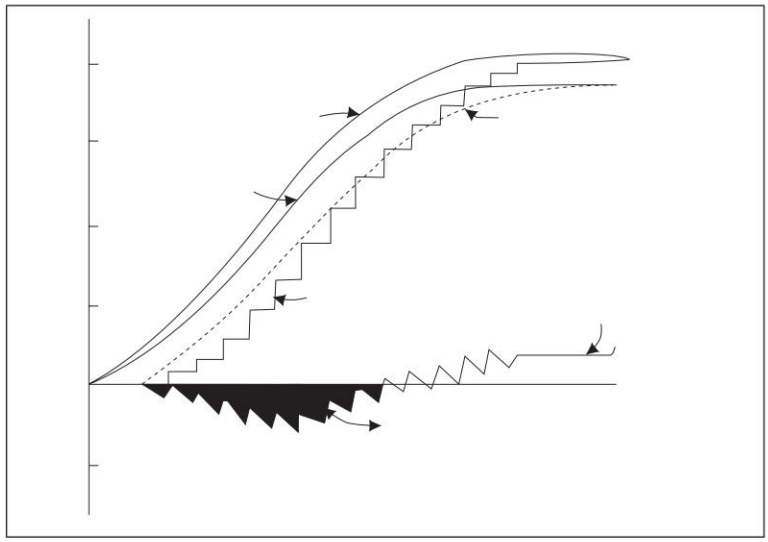

CBS
Cost
Control
System
WBS
BRS

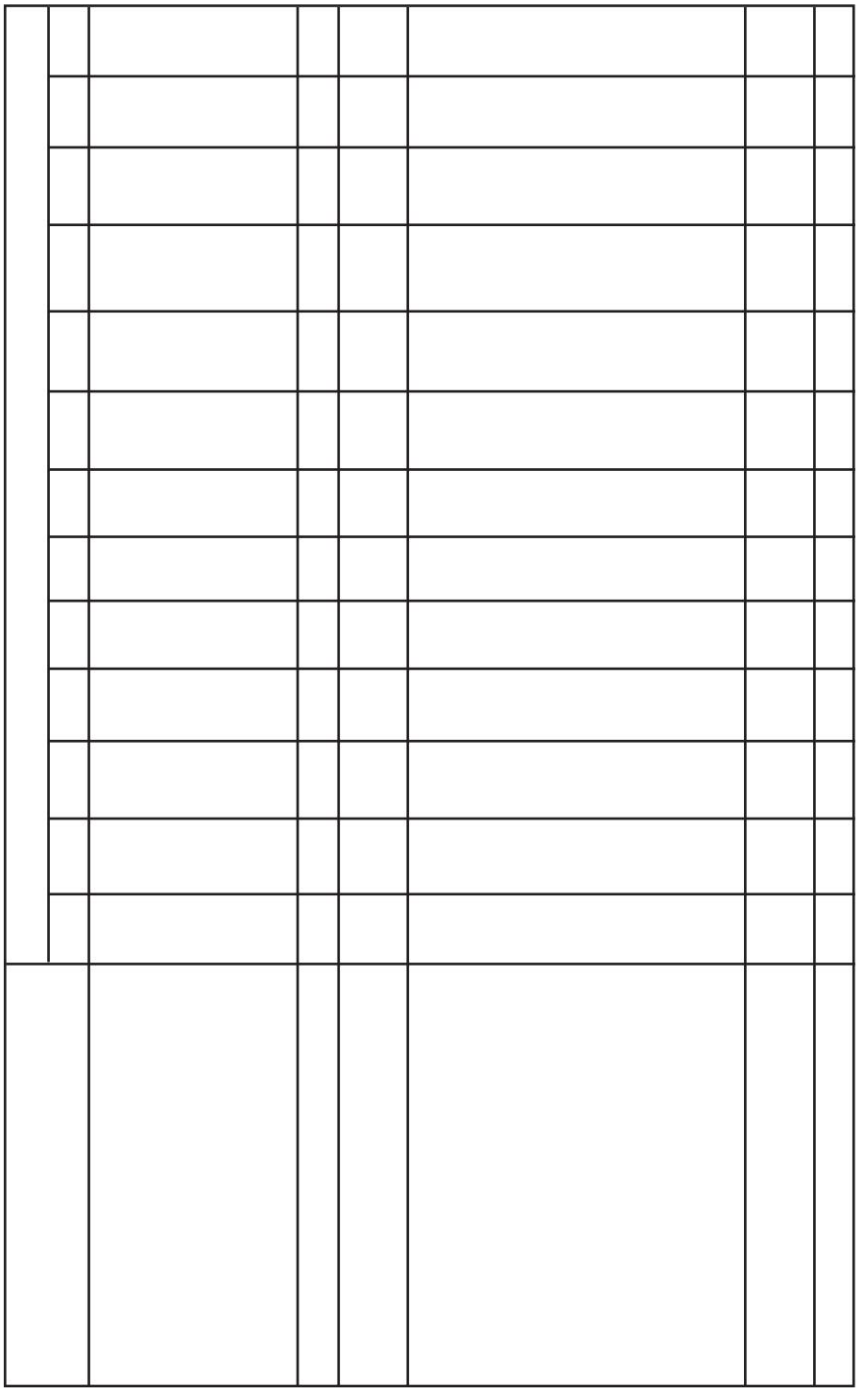


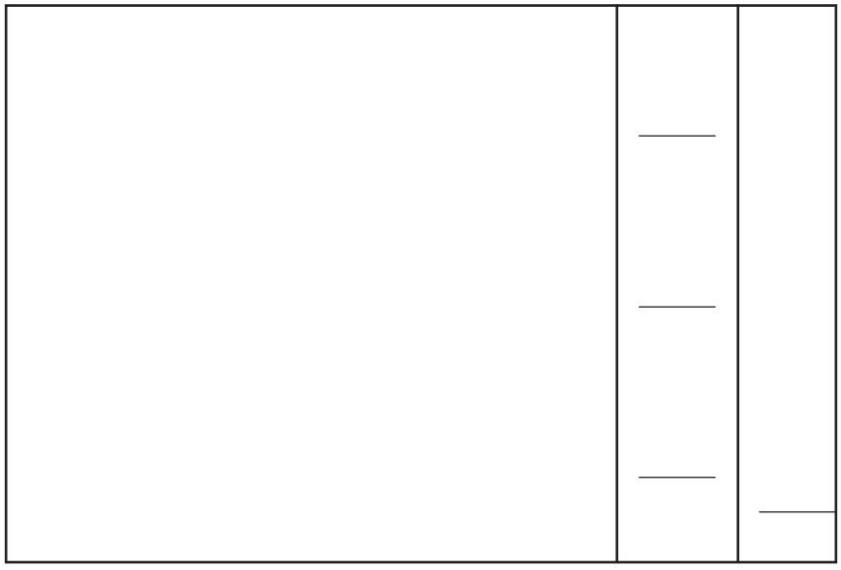


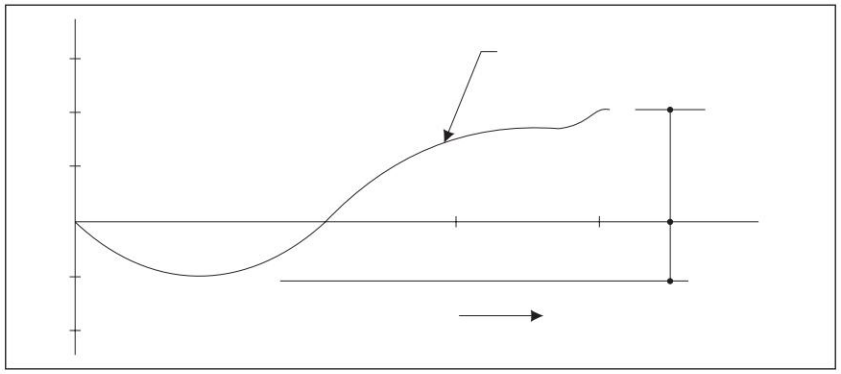

2000 Housing Units Project: Responsibility Centres
Project Management
Construction Responsibility Centre
• Building Foundation Centre
• Building finishes Centre
• Precast Erection Centre
• Public Building Centre
• Pavement Construction Centre
• Landscaping Centre
Service Responsibility Centre
• Precast Concrete Production Factory
• Readymix Concrete Production Plant
• Steel Fabrication Shop
• Quaring Establishment
• Plant & Machinery Maintenance Unit
Functional Responsibility Centre
• Administration & Personnel Management
• Materials Management
• Plant & Machinery Management
• Finance Management
• Cost Management
• Engineering Services Management
• Contract Management
• Planning and Monitoring Cell

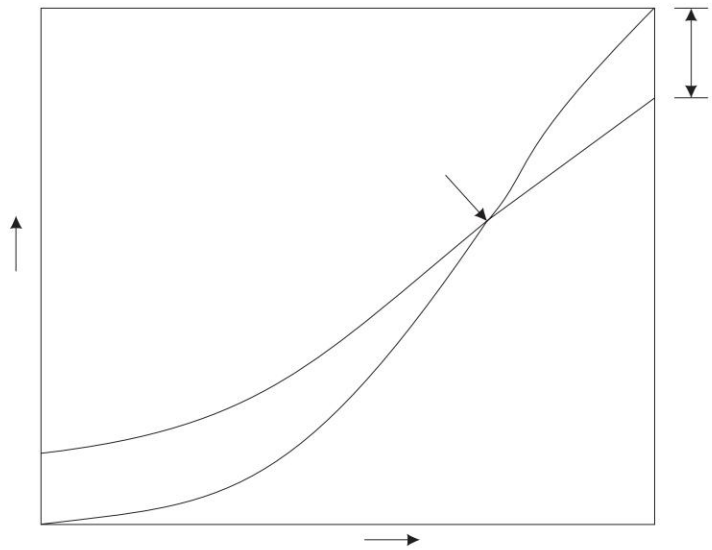


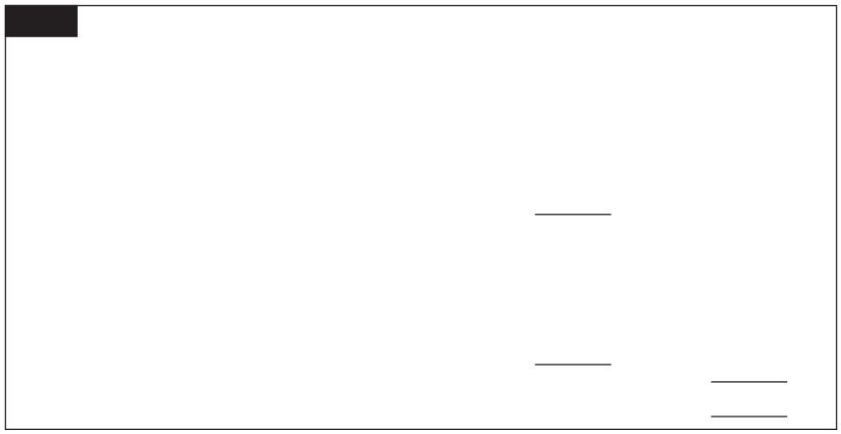




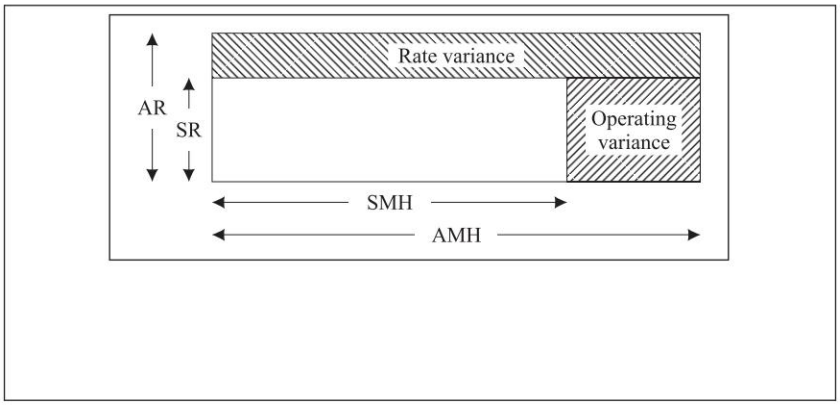


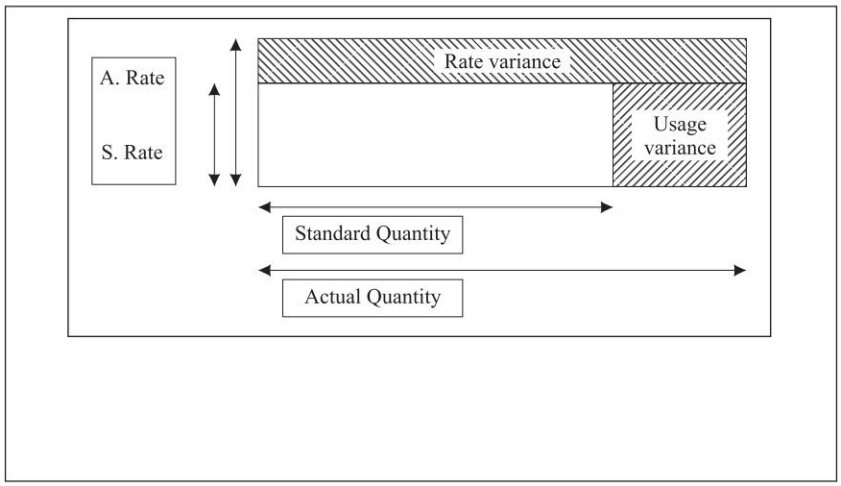


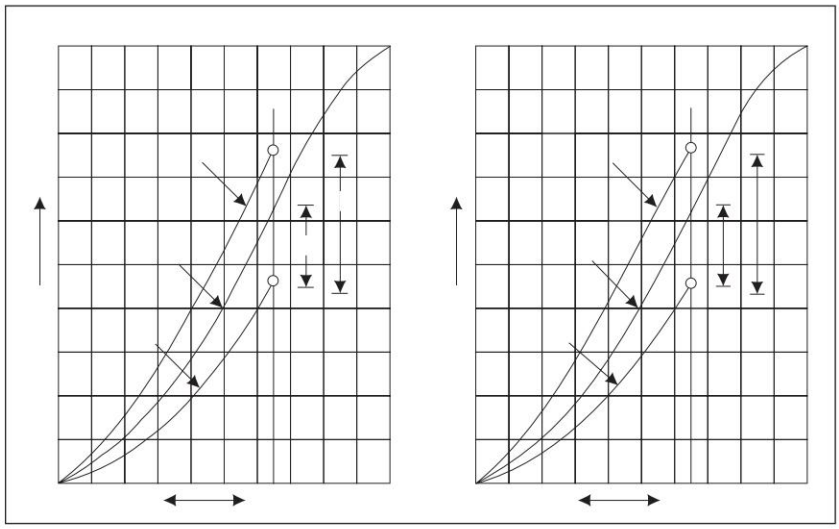


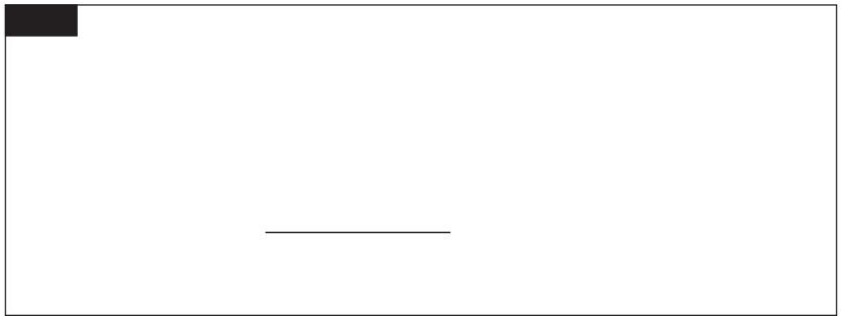


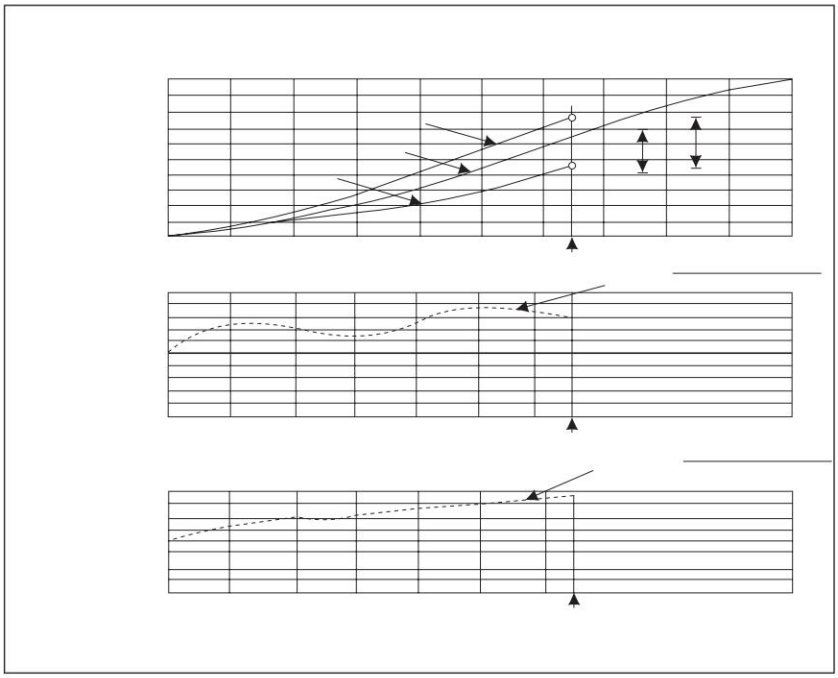
—

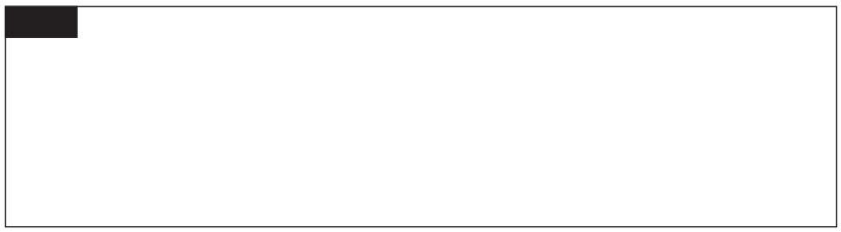



A. Rate
S. Rate
Rate variance
Usage variance
Standard Quantity
Actual Quantity





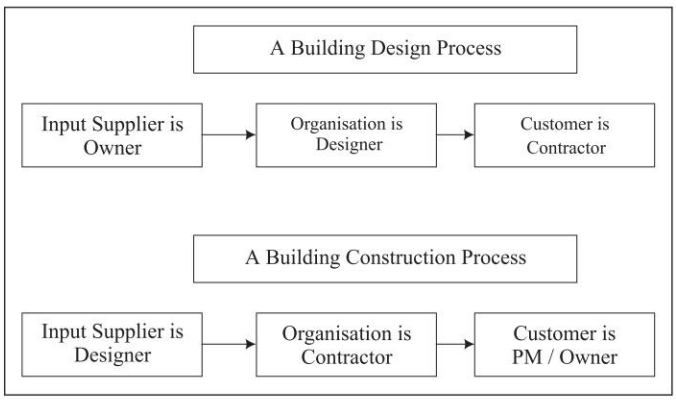


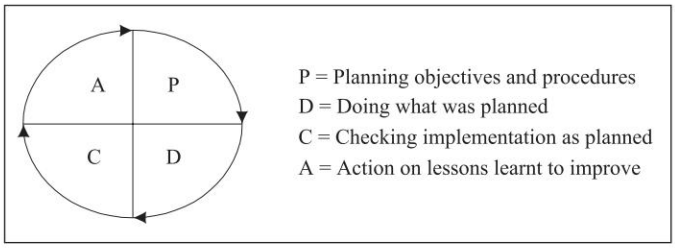


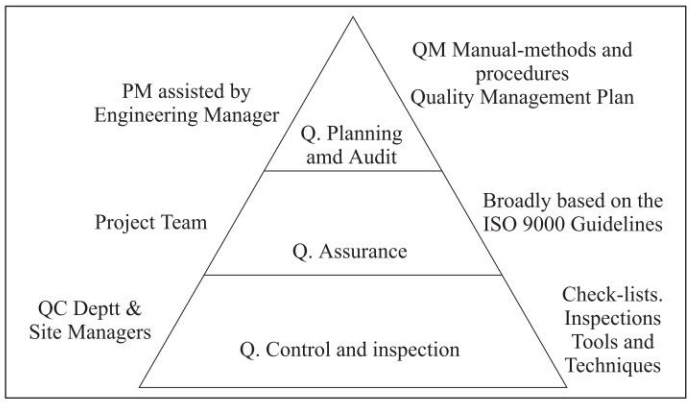
8

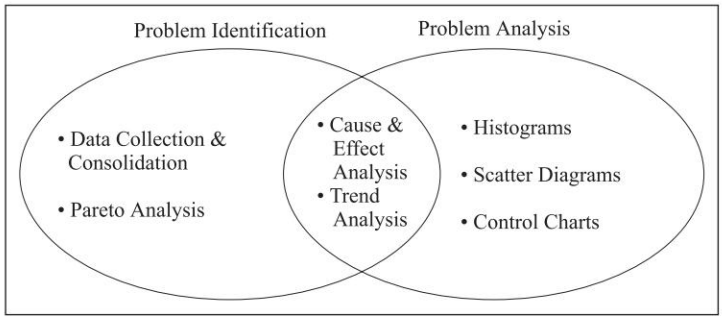
1. INTRODUCTION AND SCOPE

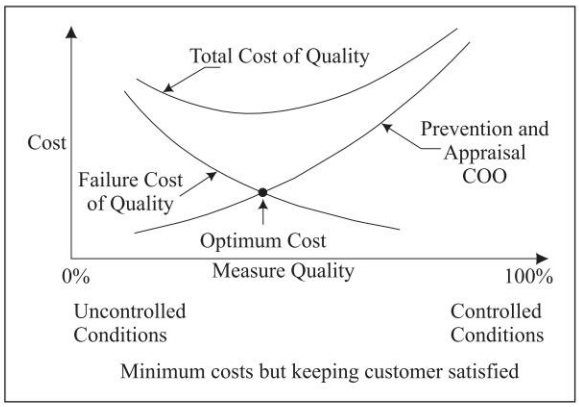
In this fast-changing environment, the single most important factor for good performance of an organisation is the quality of its product or service. Quality yields many benefits. It reduces complaints, production costs and production time. It improves customer satisfaction, morale of the people and the efficiency of the system. Product quality management is that aspect of the overall management function which determines the quality policy, objectives and responsibilities and implements them by means such as quality planning, quality assurance, quality control and quality improvement. Product quality management aims to ensure that the product will satisfy the needs for which it is undertaken.

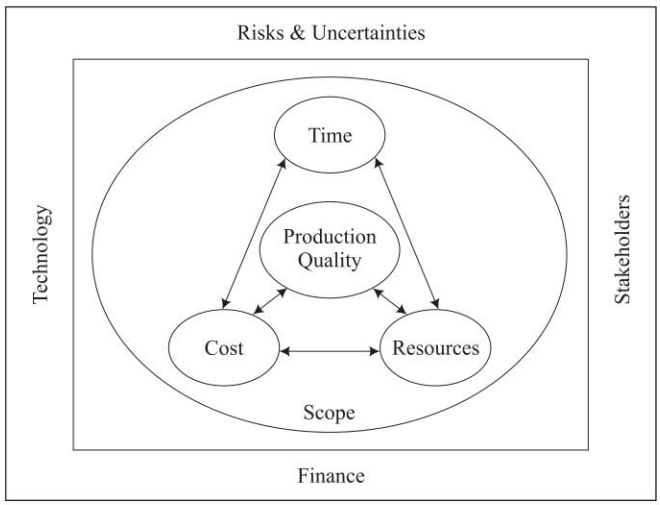



A
P
C
D
P = Planning objectives and procedures
D = Doing what was planned
C = Checking implementation as planned
A = Action on lessons learnt to improve





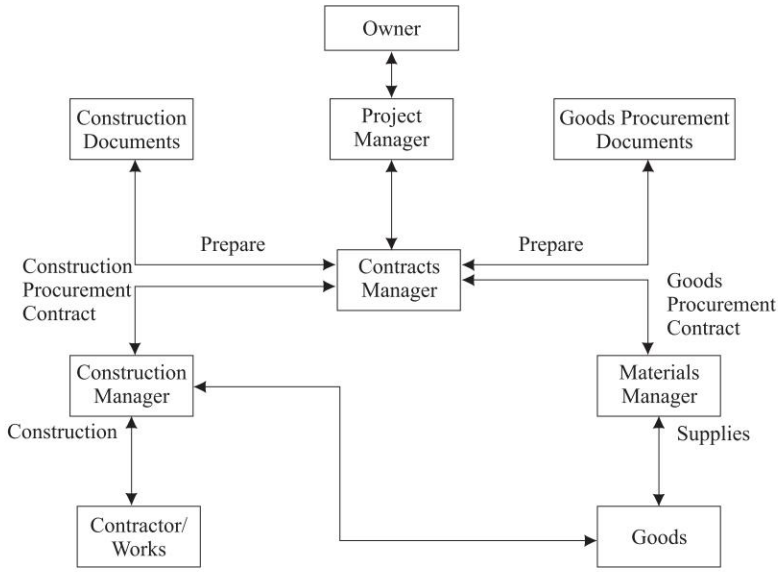


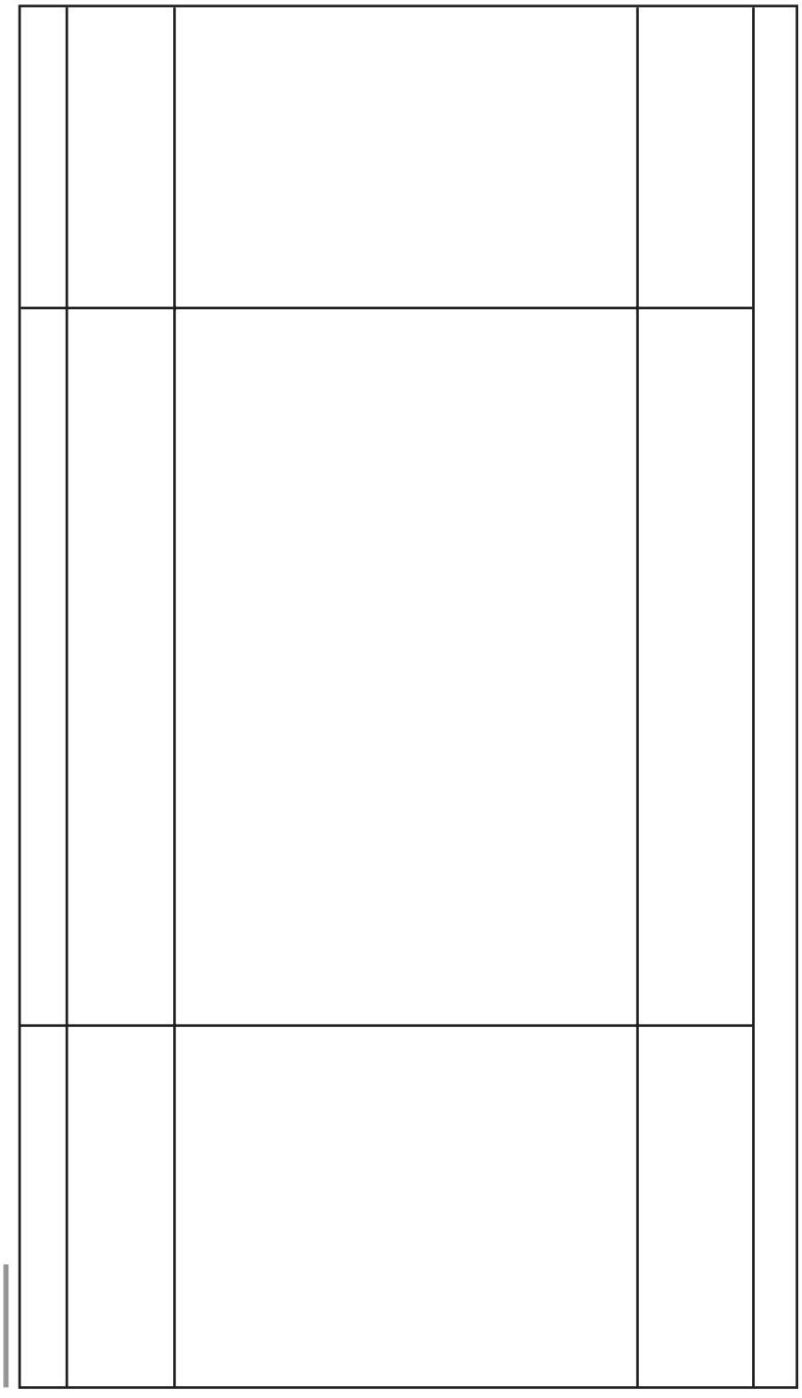


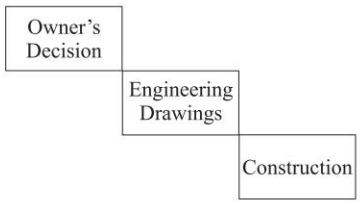
9

1. INTRODUCTION AND SCOPE

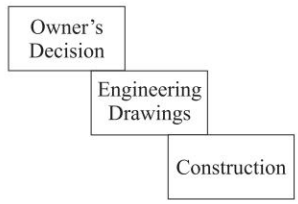
Procurement involves outsourcing of purchase or acquisition of goods, services, and construction-at-site needed to perform project work. The term goods include 'materials and equipment'; these goods are purchased from the manufacturers, traders, suppliers and vendors. Services are the works that are performed to support production of deliverables. Services may include preparation of designs and drawings, provisioning of utility services, installation of goods, field investigations, training of operating staff, post-completion maintenance and so on. Construction implies erection, installation, fabrication, and assembly of items involving civil, mechanical, and electrical works at the permanent site of the facility to be constructed. Main focus of procurement management is to procure and manage outsourced goods, products, services and construction at right time, in right quantity and quality and at right price with win-win results for all procurement stakeholders.


Owner
Construction Documents
Project Manager
Goods Procurement Documents
Prepare
Prepare
Construction Procurement Contract
Contracts Manager
Goods Procurement Contract
Construction Manager
Materials Manager
Construction
Supplies
Contractor/ Works
Goods

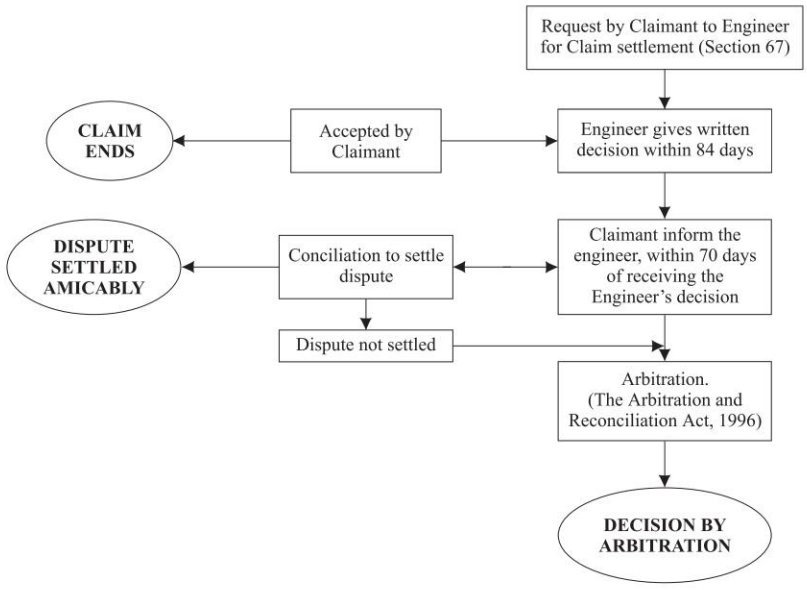




Sequential Traditional Approach



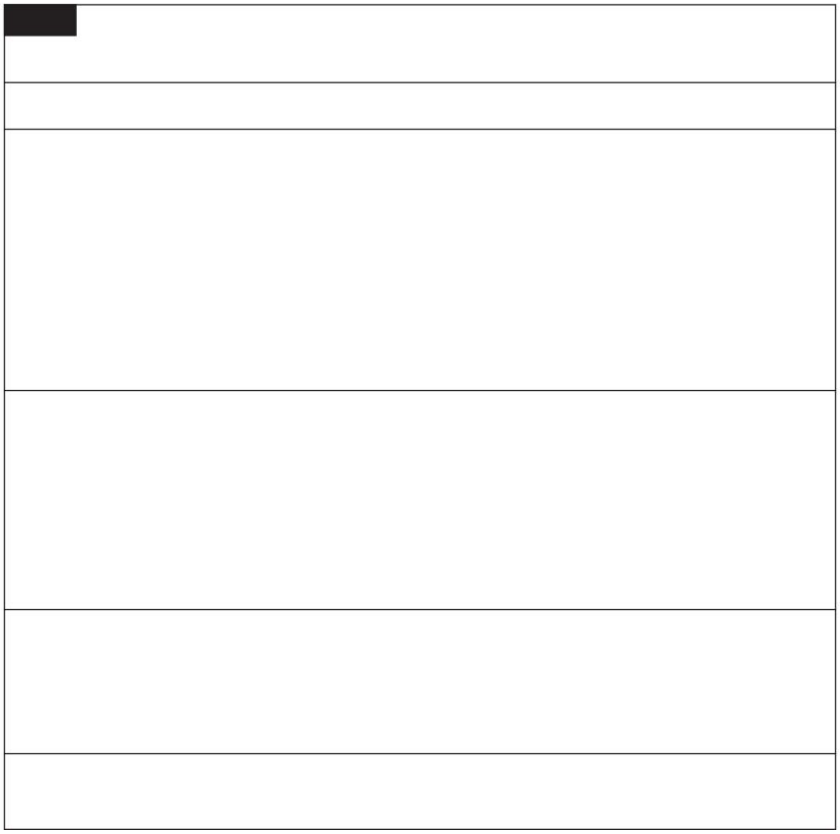
Fast Track Approach

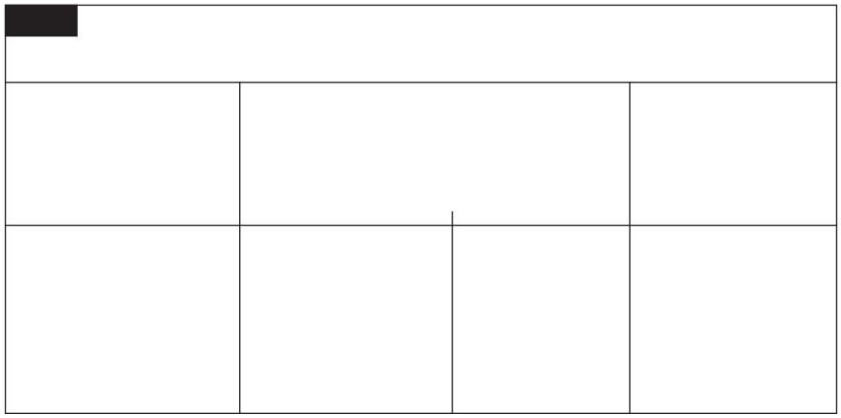

Request by Claimant to Engineer for Claim settlement (Section 67)
Engineer gives written decision within 84 days
Accepted by Claimant
CLAIM ENDS
Claimant inform the engineer, within 70 days of receiving the Engineer's decision
Conciliation to settle dispute
DISPUTE SETTLED AMICABLY
Dispute not settled
Arbitration. (The Arbitration and Reconciliation Act, 1996)
DECISION BY ARBITRATION

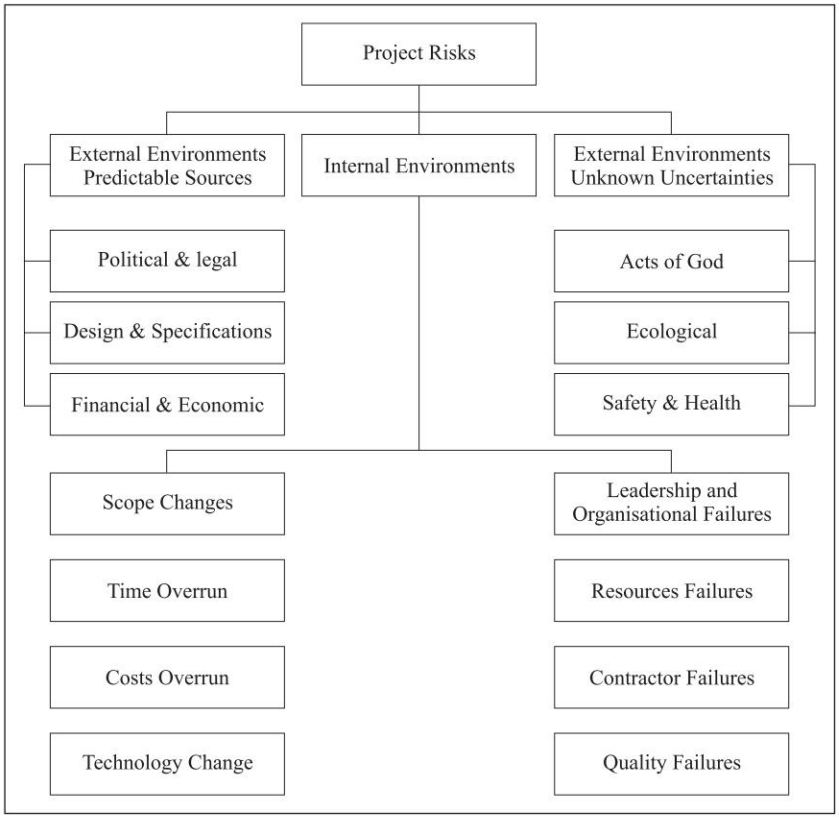
10

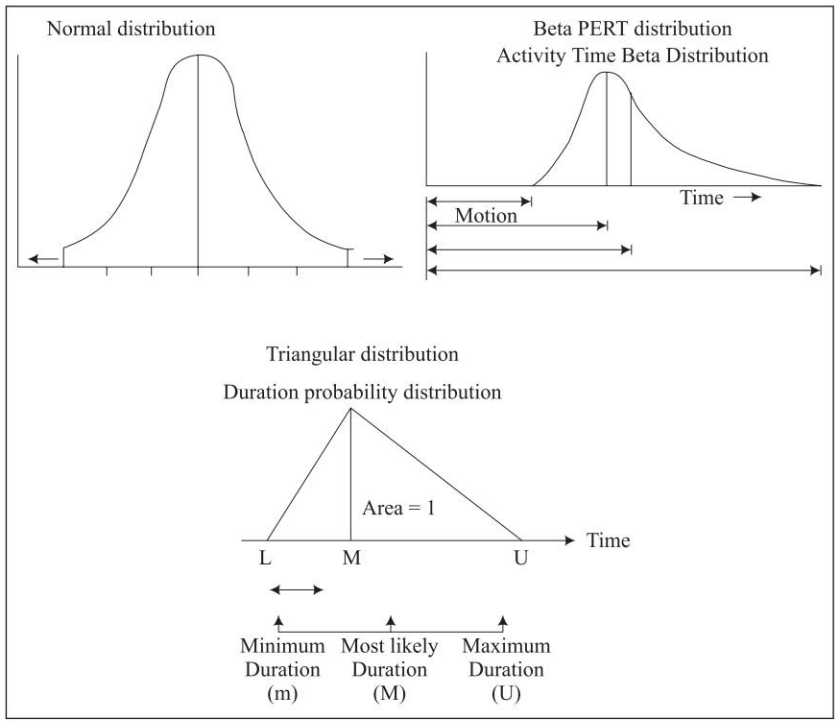
1. INTRODUCTION AND OBJECTIVES

Business decisions are based on future predictions about environment. In the early days of project management, the projects were generally of short duration—about one to three years—and the environment was much more stable. Modern day projects, such as privatised infrastructure BOT projects, have a project life that is spread over many years. With market globalisation under WTO and GATT agreements, projects are becoming larger and more complex. These projects involve large capital outlay, generate unbalanced cash flows and involve complex contractual arrangements. They encounter changing economic and financial situations, face unstable political climates resulting in changing regulatory issues and have to cater to unpredictable environmental changes. The stability of modern projects is thus, constantly subjected to certain sensitive and volatile, external and internal environments. The resulting instability causes uncertainty.



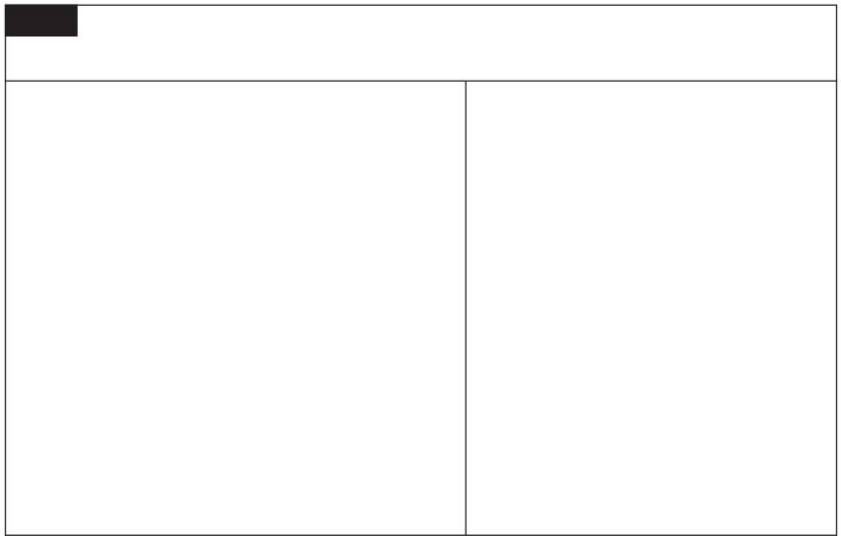


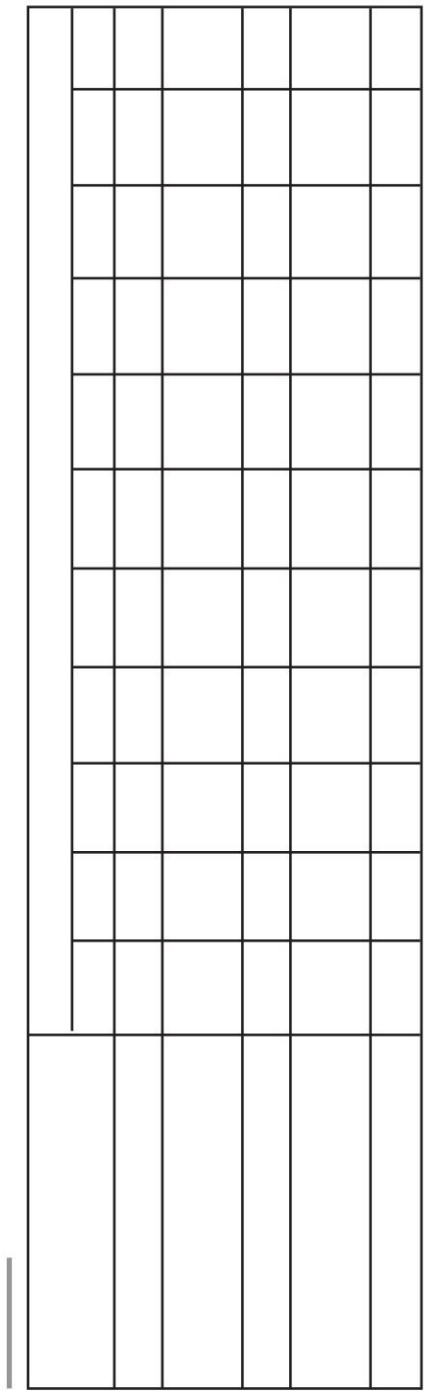

Project Risks
External Environments Predictable Sources
Internal Environments
External Environments Unknown Uncertainties
Political & legal
Design & Specifications
Financial & Economic
Acts of God
Ecological
Safety & Health
Scope Changes
Time Overrun
Costs Overrun
Technology Change
Leadership and Organisational Failures
Resources Failures
Contractor Failures
Quality Failures



$$\bar{\quad}$$

$$\sqrt{\quad}$$



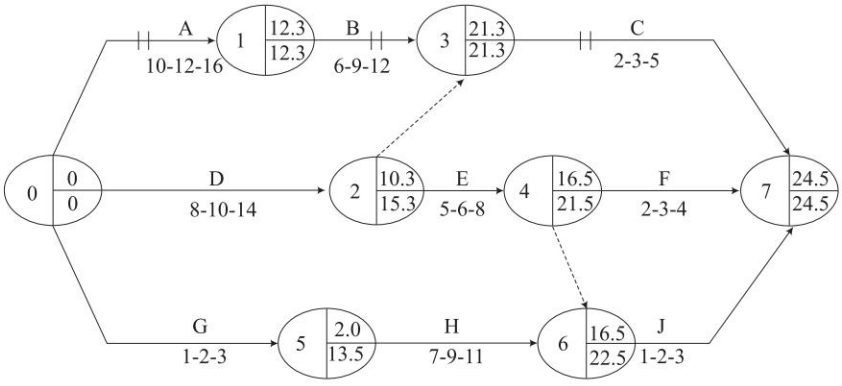


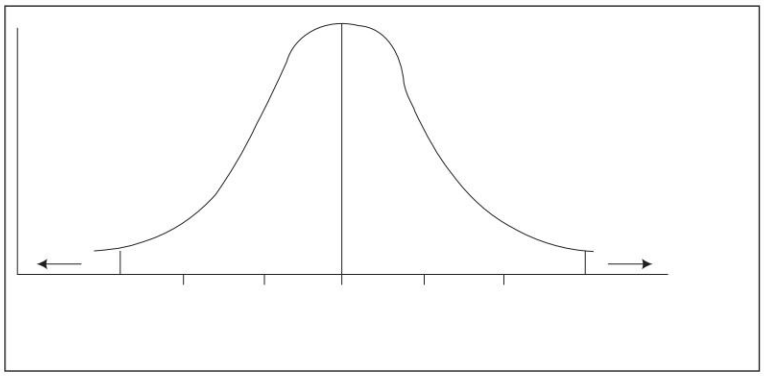
$$\bar{\quad}$$

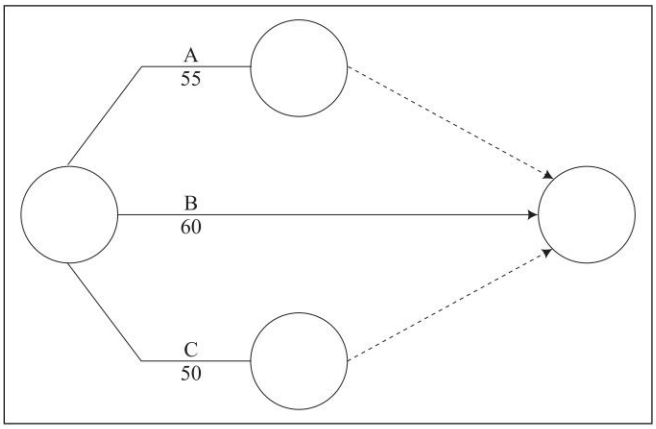
$$\bar{\quad}$$

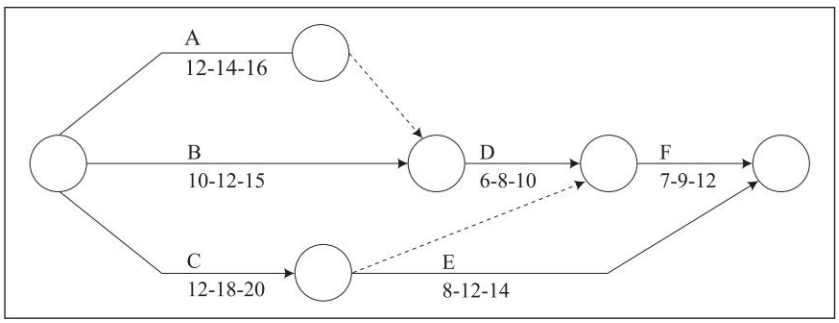
$$\sqrt{\quad}$$

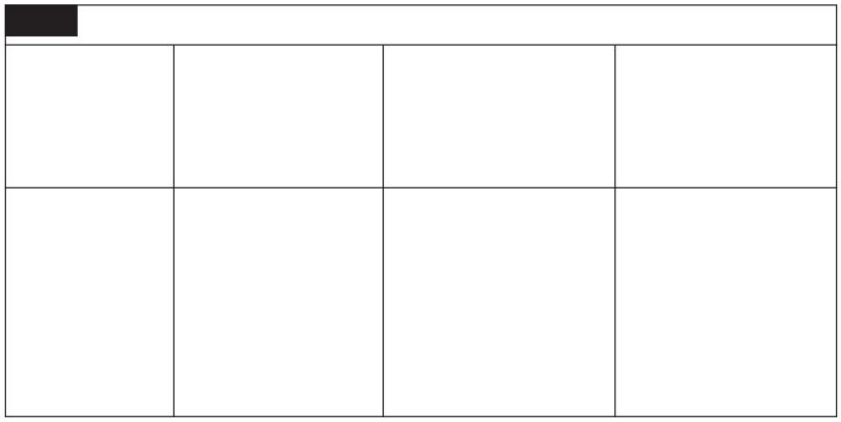
$$\sqrt{=}$$

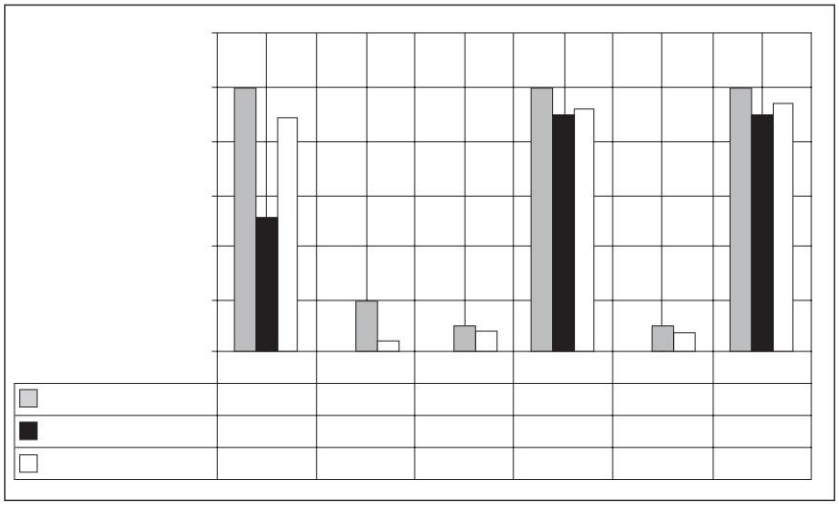

A
10-12-16
1
12.3
12.3
B
6-9-12
3
21.3
21.3
C
2-3-5
0
0
0
D
8-10-14
2
10.3
15.3
E
5-6-8
4
16.5
21.5
F
2-3-4
7
24.5
24.5
G
1-2-3
5
2.0
13.5
H
7-9-11
6
16.5
22.5
J
1-2-3

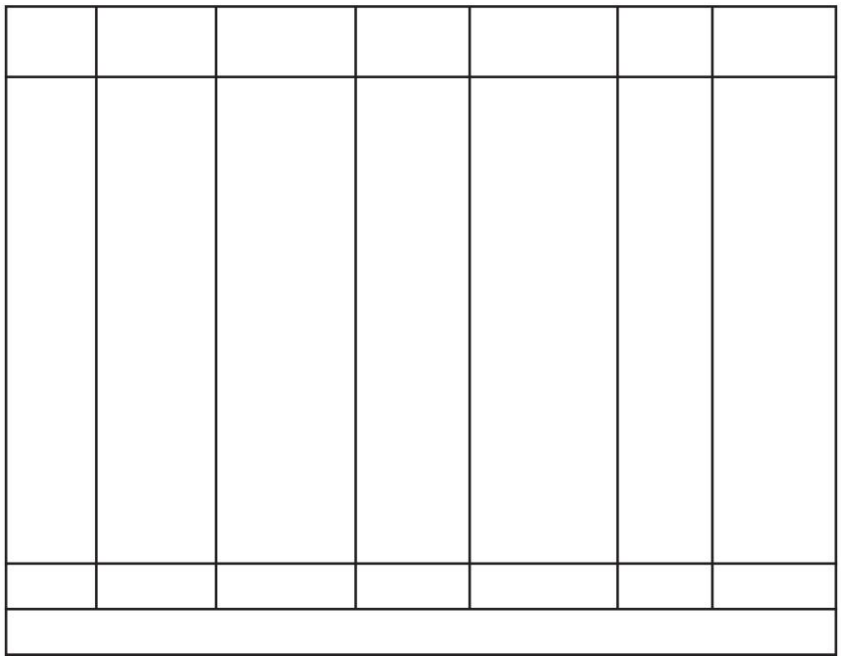


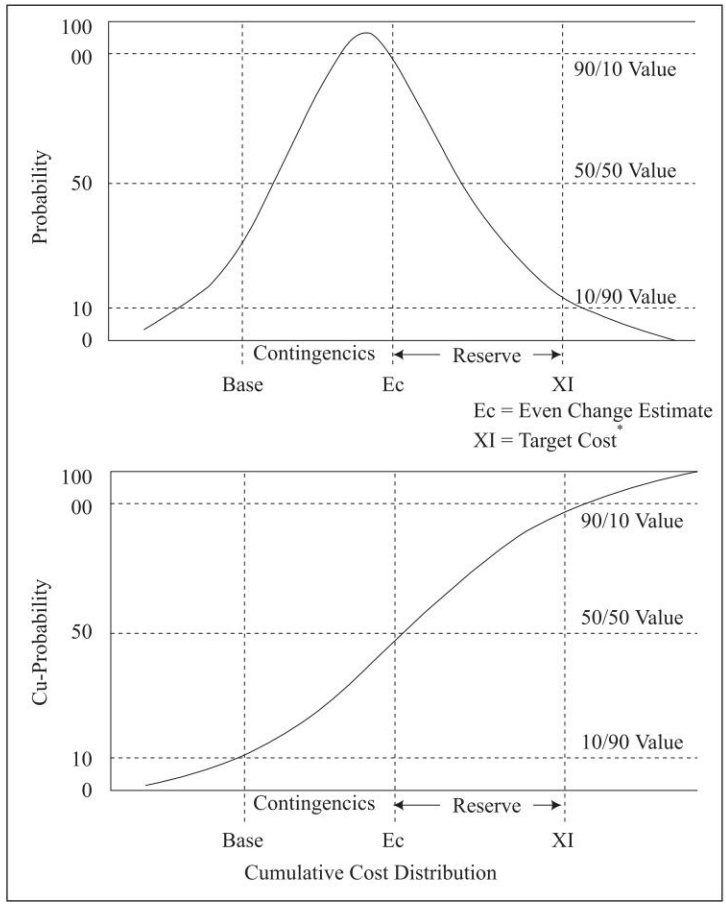

A
55
B
60
C
50

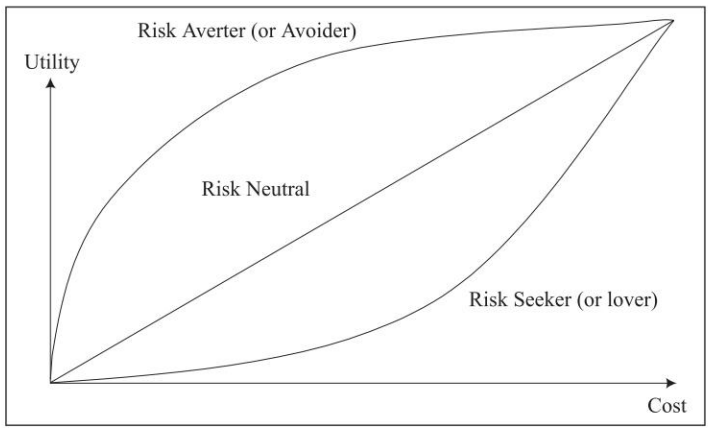

A
12-14-16
B
10-12-15
C
12-18-20
D
6-8-10
E
8-12-14
F
7-9-12







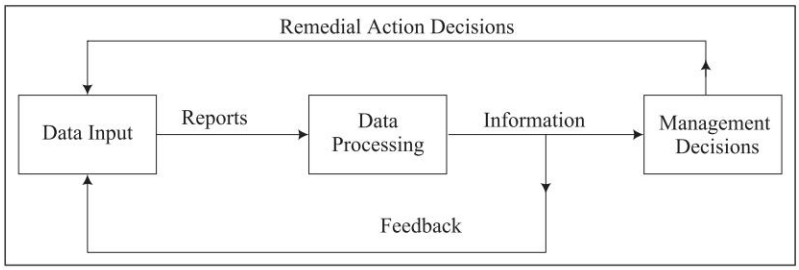

100
00
90/10 Value
Probability
50
50/50 Value
10
10/90 Value
0
Contingencics
Reserve
Base
Ec
XI
Ec = Even Change Estimate
XI = Target Cost
100
00
90/10 Value
Cu-Probability
50
50/50 Value
10
10/90 Value
0
Contingencics
Reserve
Base
Ec
XI
Cumulative Cost Distribution

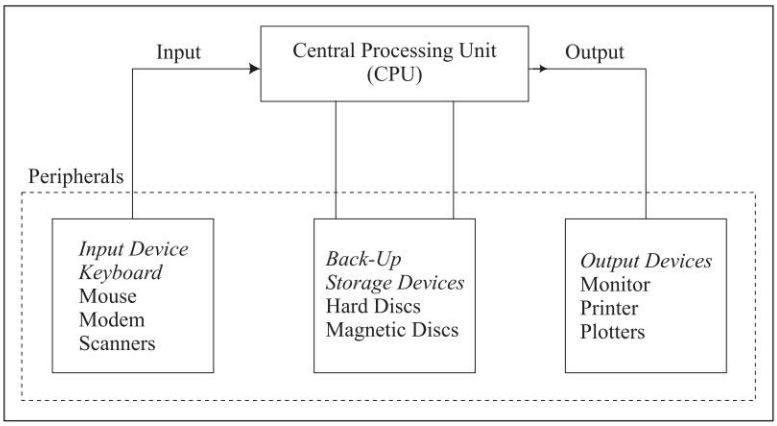


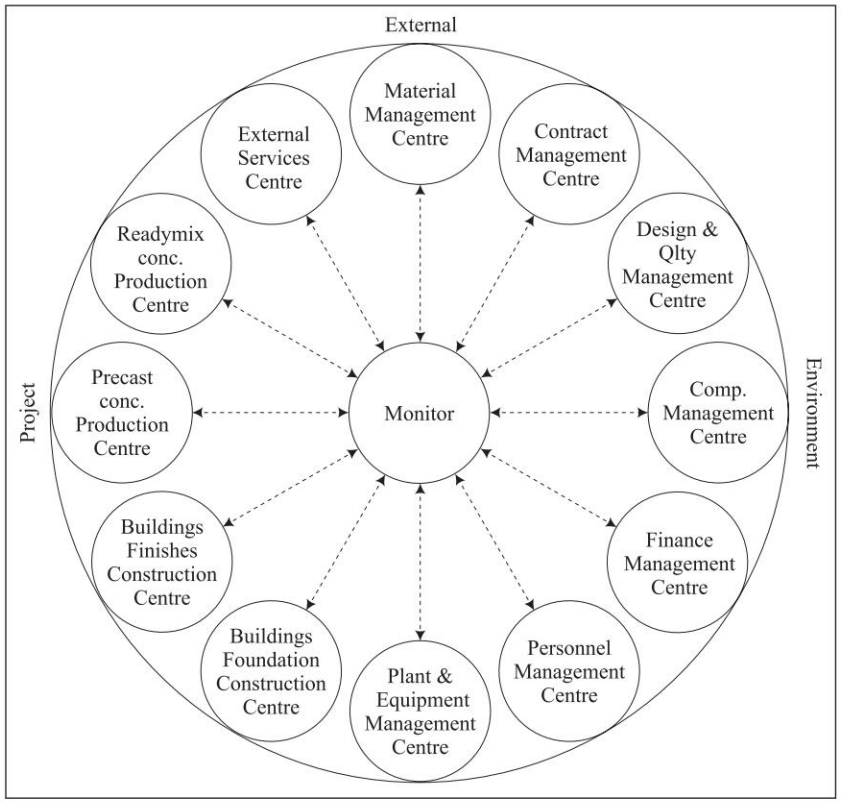
11

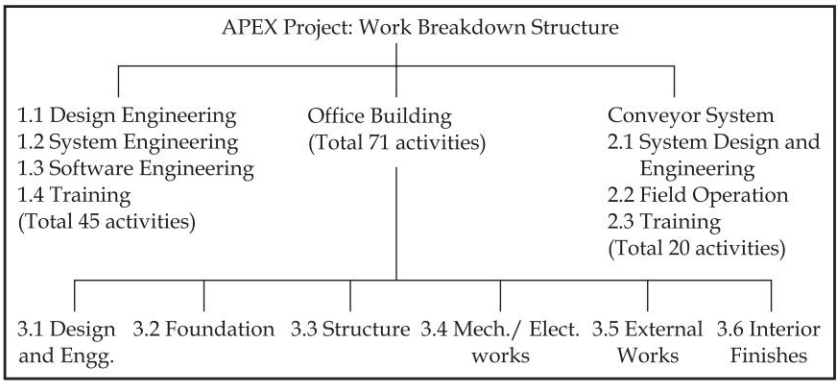
1. INTRODUCTION AND SCOPE

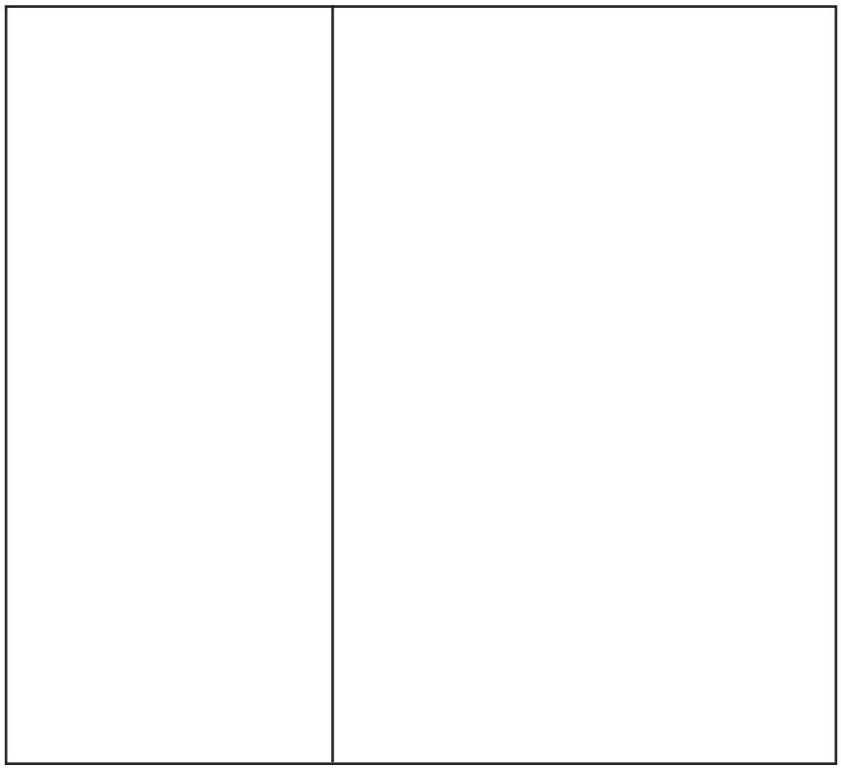
The aim of project management is to achieve the project mission objectives within specified constraints. Project implementation encounters unpredictable problems. Consequently even the best efforts cannot ensure the execution of a project exactly as per the original plan. A project needs an effective control system to continuously monitor the deviations from the planned paths and to apply corrective measures. These unknown factors demand constant vigilance and decisions have to be taken to ensure the smooth progress of the project work. Relevant information is required in order to make timely decisions in modern multi-division, multi-location and multinational projects.

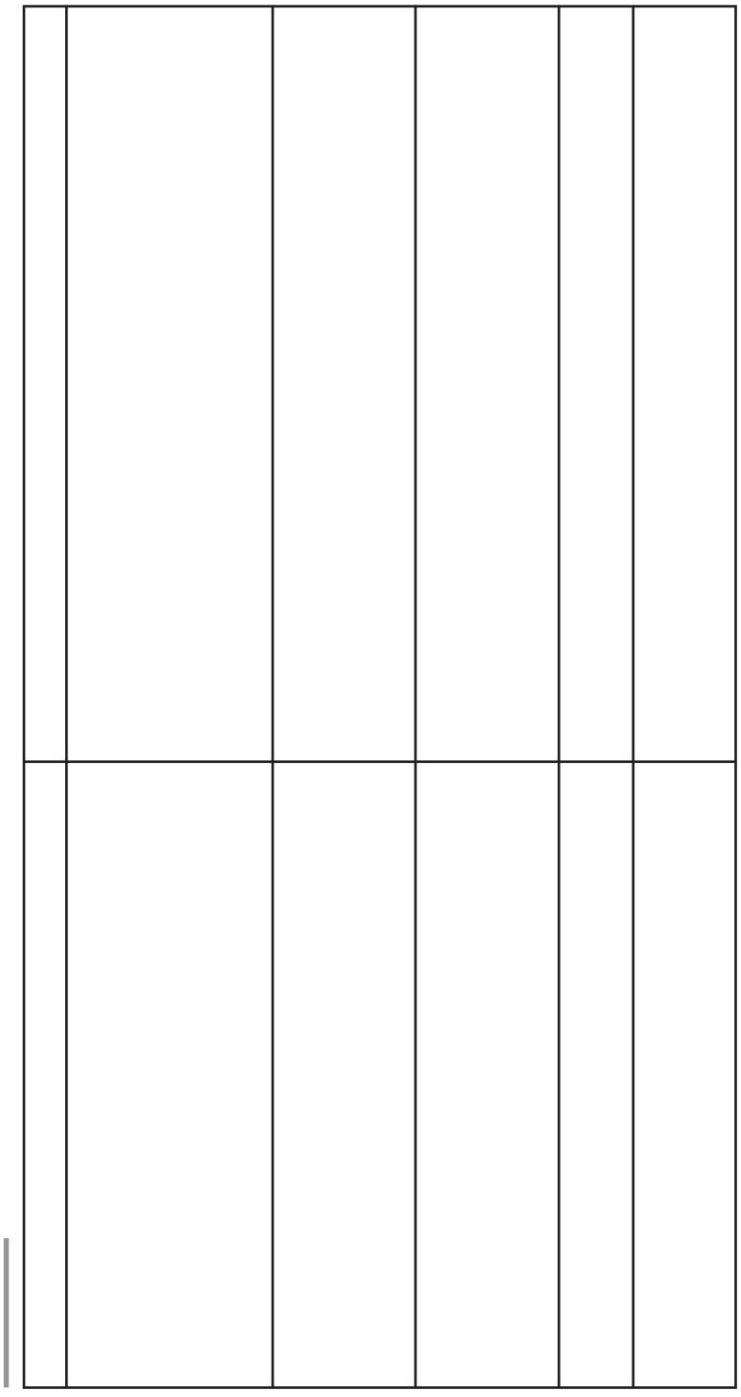

Remedial Action Decisions
Data Input
Reports
Data Processing
Information
Management Decisions
Feedback

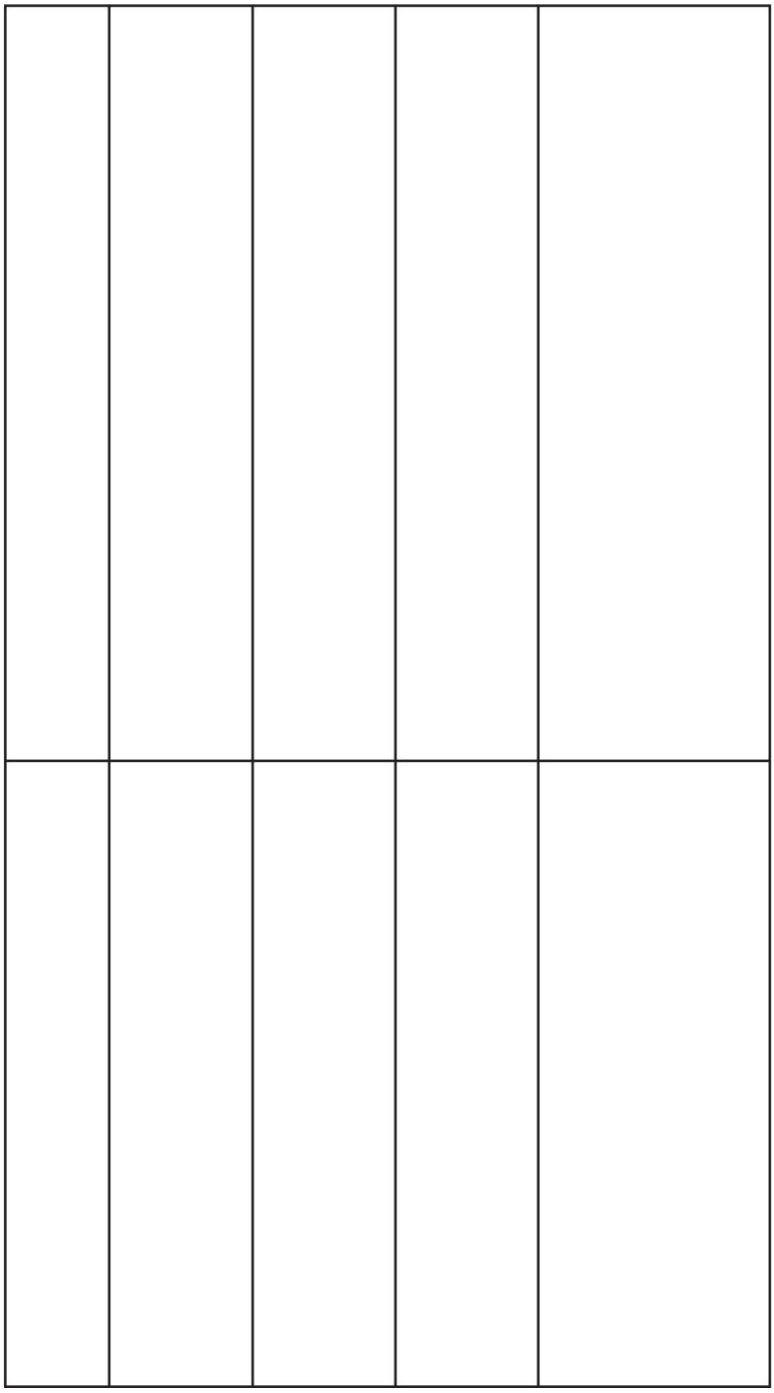

Input
Central Processing Unit (CPU)
Output
Peripherals
Input Device
Keyboard
Mouse
Modem
Scanners
Back-Up
Storage Devices
Hard Discs
Magnetic Discs
Output Devices
Monitor
Printer
Plotters

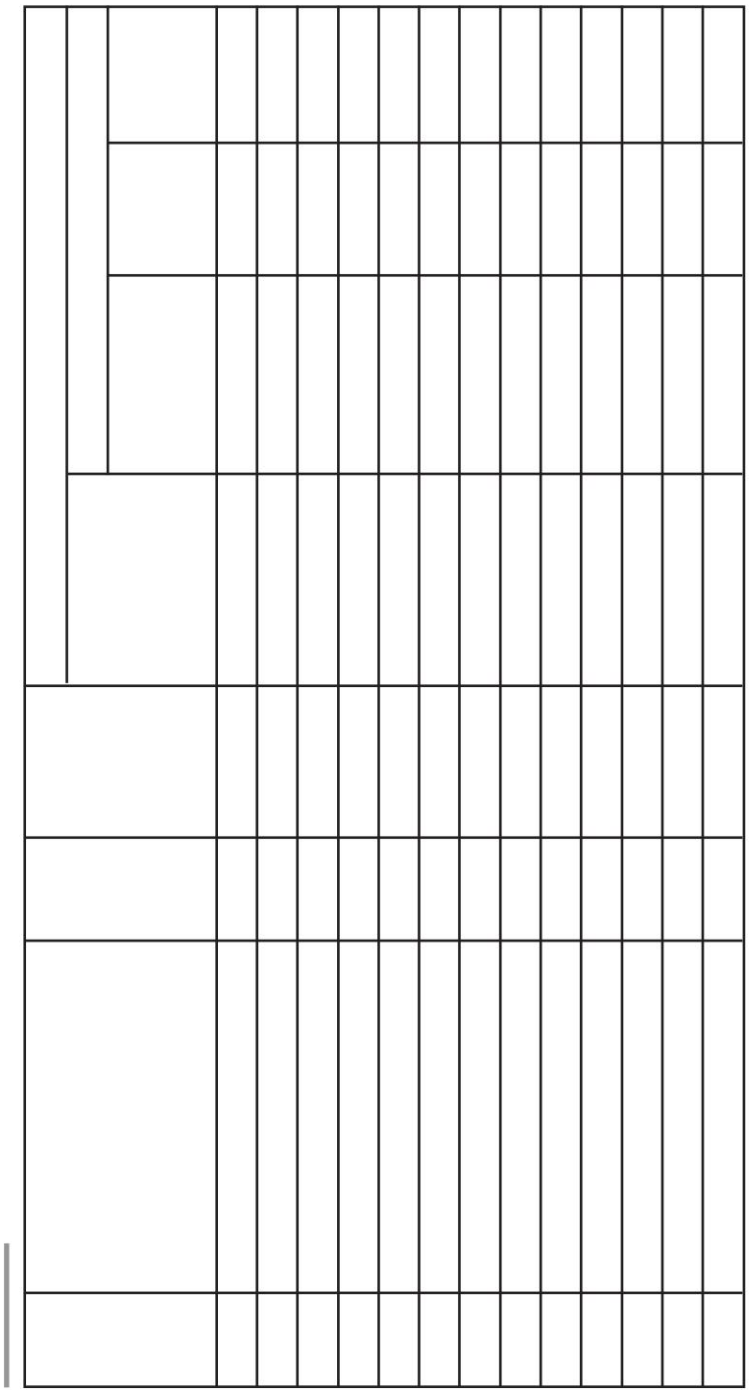


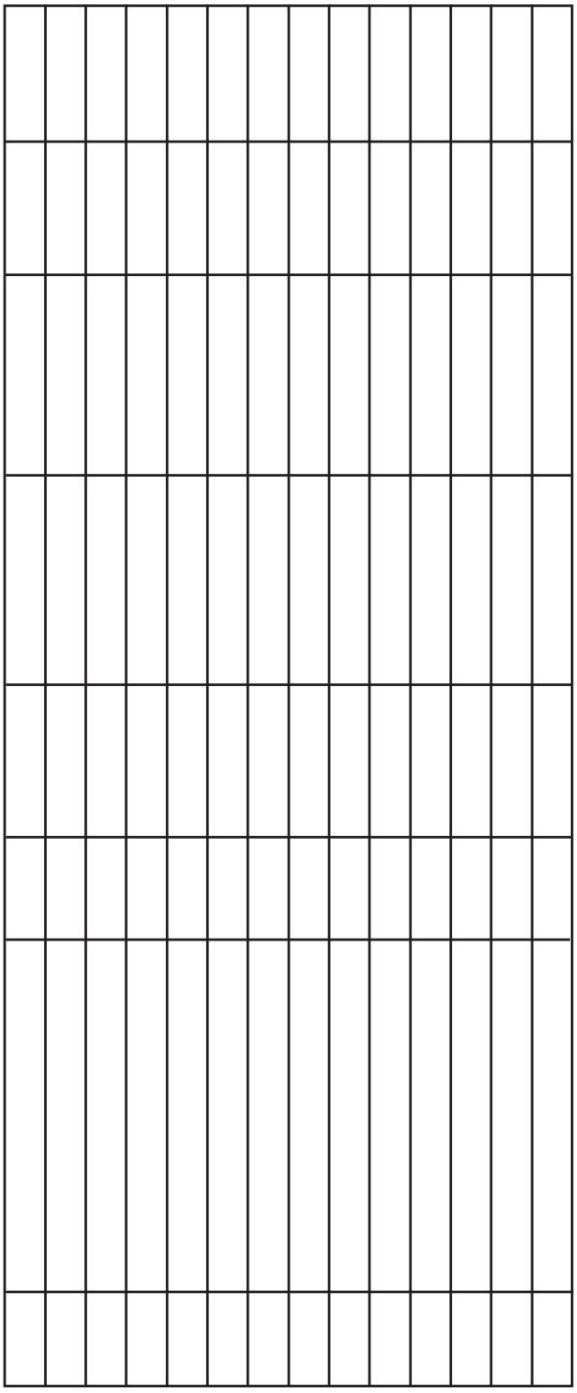

APEX Project: Work Breakdown Structure
1.1 Design Engineering
1.2 System Engineering
1.3 Software Engineering
1.4 Training
(Total 45 activities)
Office Building
(Total 71 activities)
Conveyor System
2.1 System Design and Engineering
2.2 Field Operation
2.3 Training
(Total 20 activities)
3.1 Design and Engg.
3.2 Foundation
3.3 Structure
3.4 Mech./ Elect. works
3.5 External Works
3.6 Interior Finishes

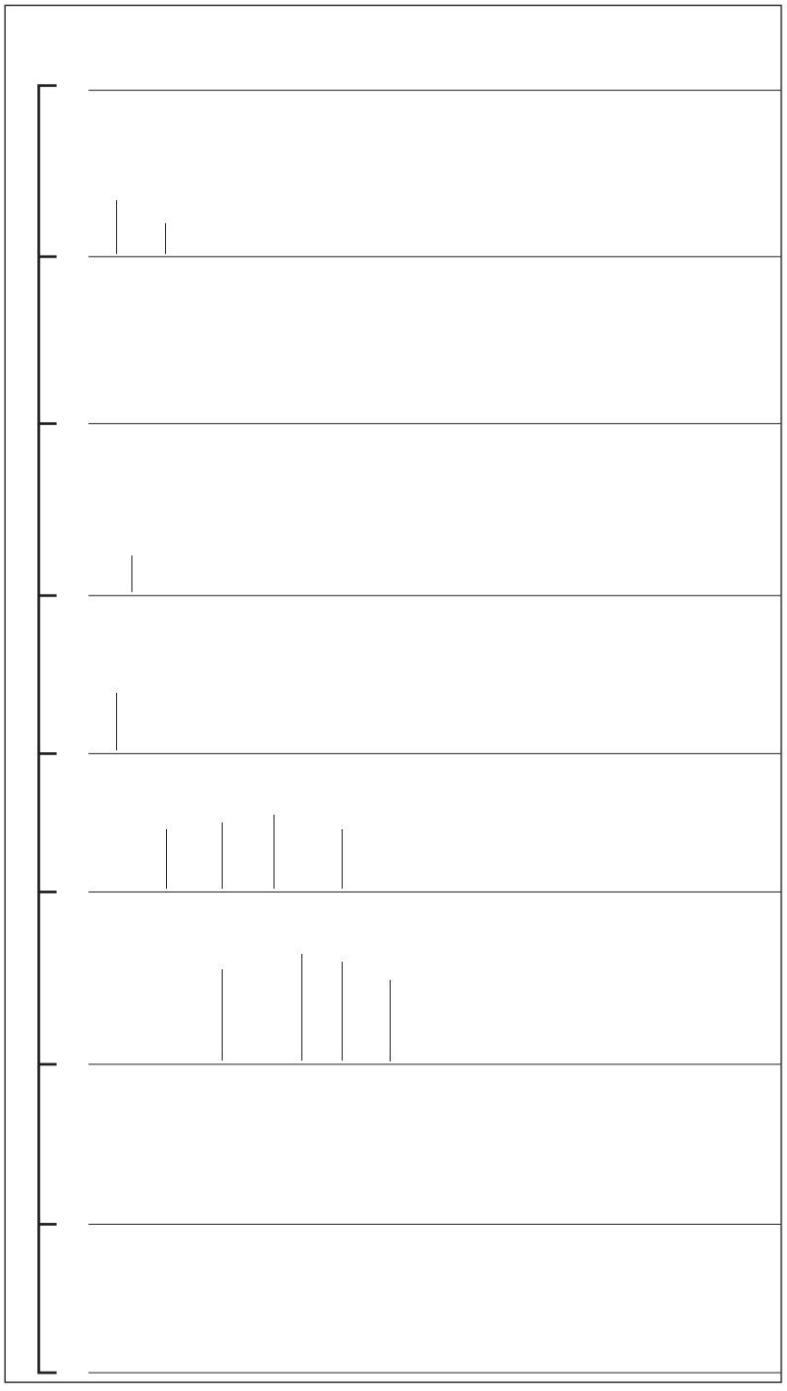


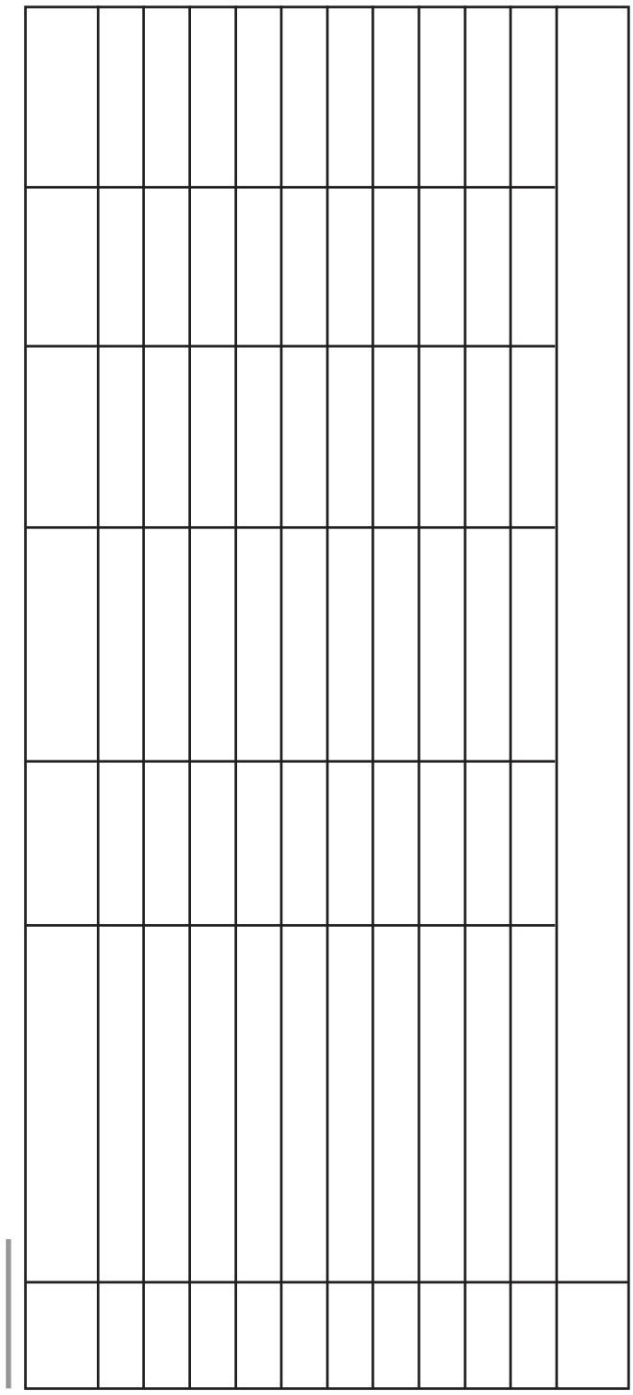












Activity ID	Activity Description	Orig Dur	Predecessors	Successors	RESP	Resource ID	Budgeted Quantity	Budgeted Cost	Cost Account (11)	DEPT	PHAS	Cal ID
BA400	Design Building Addition	20		BA501	MASON	DES ENG	0.00	0.00	13106	ENG	DESGN	1
AS100	Define System	10		AS101	MASON	ANALYST, ATM ENG	120.00	2,960.00	11101, 11101	ENG	DESGN	1
AS101	System Design	20	AS100	AS102, AS204,	MASON	DES ENG, ANALYST,	640.00	16,640.00	11101,	ENG	DESGN	1
AS204	Prepare Drawings for Temp	10	AS101	AS205	MASON	ATM ENG	80.00	1,760.00	11211	ENG	DESGN	1
AS216	Prepare Drawings for System	10	AS101*	AS217*	MASON	ATM ENG	80.00	1,760.00	11231	ENG	DESGN	1
BA501	Review and Approve Designs	14	BA400	BA450*,	ACME	DES ENG	56.00	1,680.00	13106	ENG	DESGN	1
AS102	Approve System Design	10	AS101	AS310*, CS300	MASON	PRG MGR, ANALYST	80.00	2,546.00	11101, 11101	ENG	DESGN	1
AS205	Review and Approve Temp	5	AS204	AS200	EVANS	ATM ENG, PRG	100.00	2,826.00	11211,	ENG	DESGN	1
AS200	Prepare and Solicit Bids for	5	AS205	AS201	FOLEY	ACCTS, ATM ENG	60.00	1,080.00	11213, 11213	PCH	PROCR	1
AS310	Site Preparation	10	AS102*	AS103*,	MILLS	FLD ENG3	40.00	680.00	11213	ISD	SYS1	1
AS240	Installation Begins	0	AS310*		MILLS		0.00	0.00		ISD	SYS1	1
BA450	Assemble Brick Samples	10	BA501*	BA530*	FOLEY		0.00	0.00		PCH	PROCR	1
BA640	Site Preparation	20	BA630*	BA650*	NOLAN	EXCAVATR	960.00	20,640.00	13206	CON	FOUND	1
BA480	Assemble and Submit	10	BA501*	BA560*	FOLEY		0.00	0.00		PCH	PROCR	1
AS202	Award Contract for Temp	1	AS201	AS206*	FOLEY	ACCTS	4.00	64.00	11213	PCH	PROCR	1

Budget | Codes | Constr | Cost | Custom | Dates | Log | Pred | Res | Succ | WBS | Help

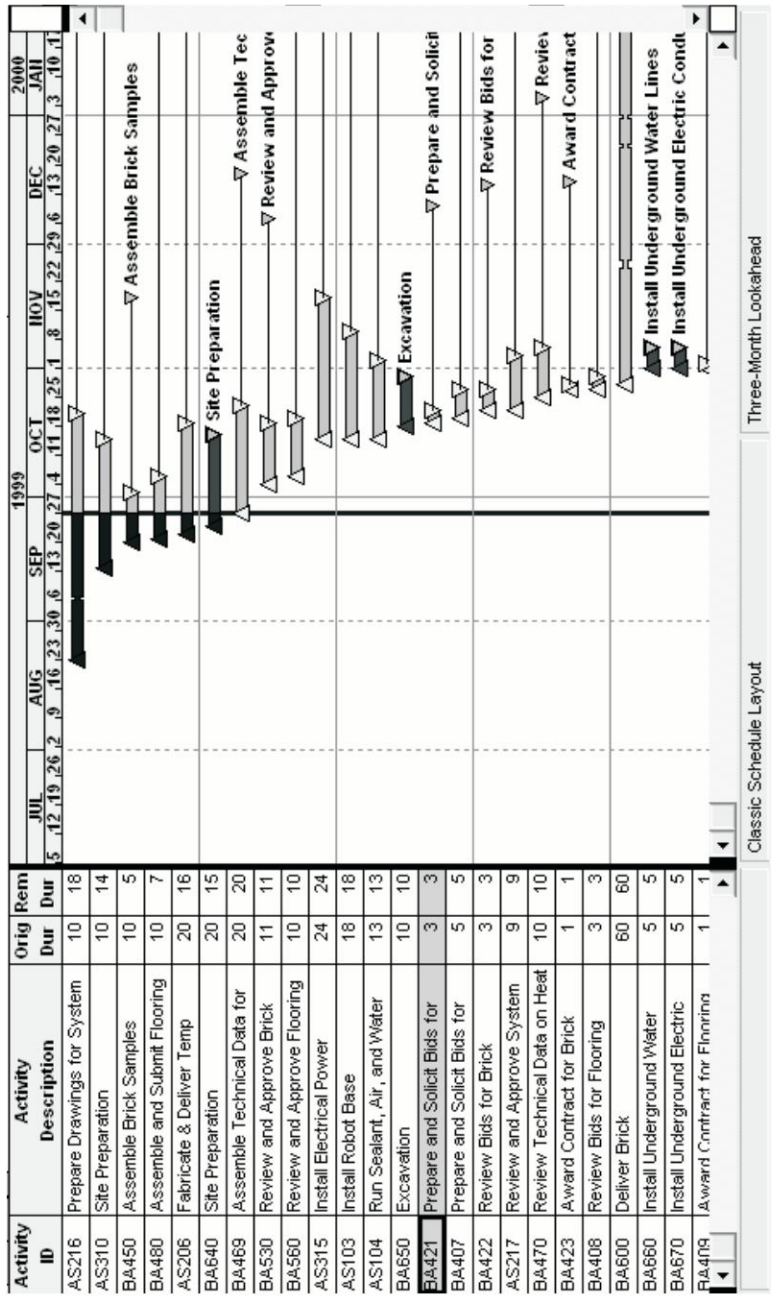
ID: BA400 — Design Building Addition — Previous | Next | <<Less

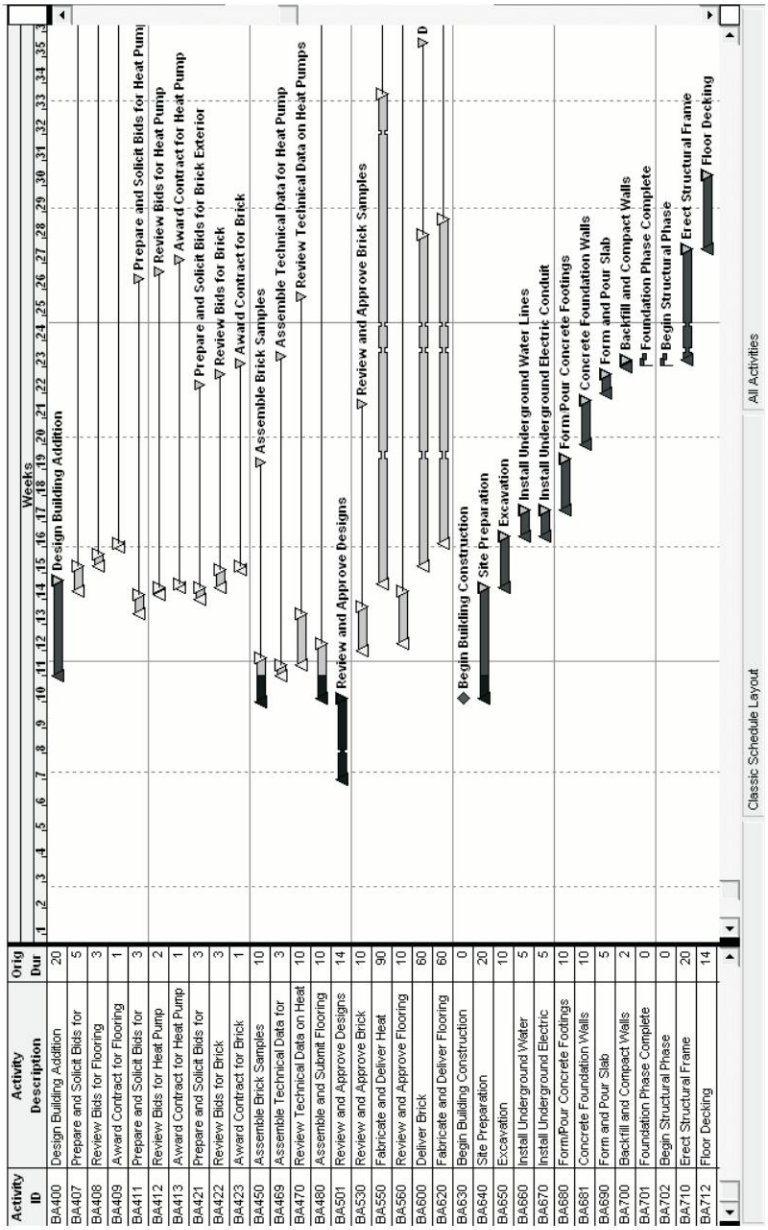
Note: Calendar ID is 5-day/ Week

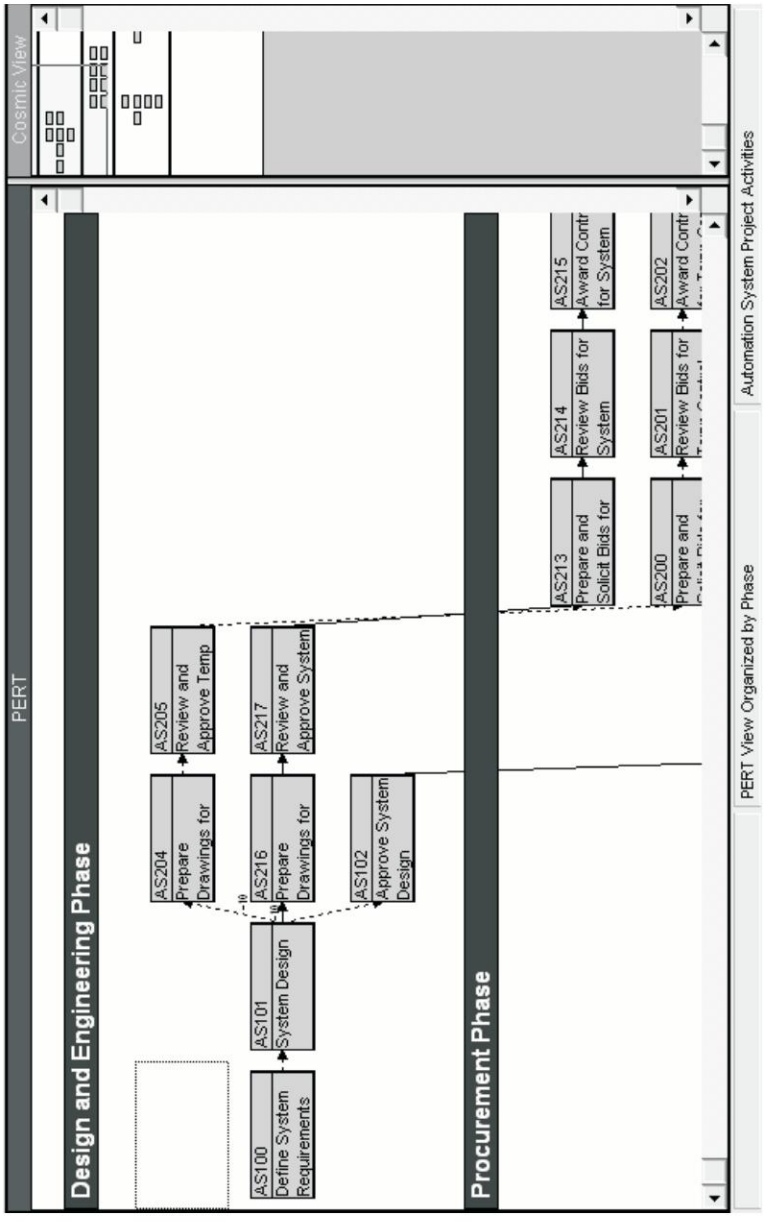
OD: 20 Pct: 0.0 Cal: 1 — ES: 27SEP99 — EF: 22OCT99 — TF: 0

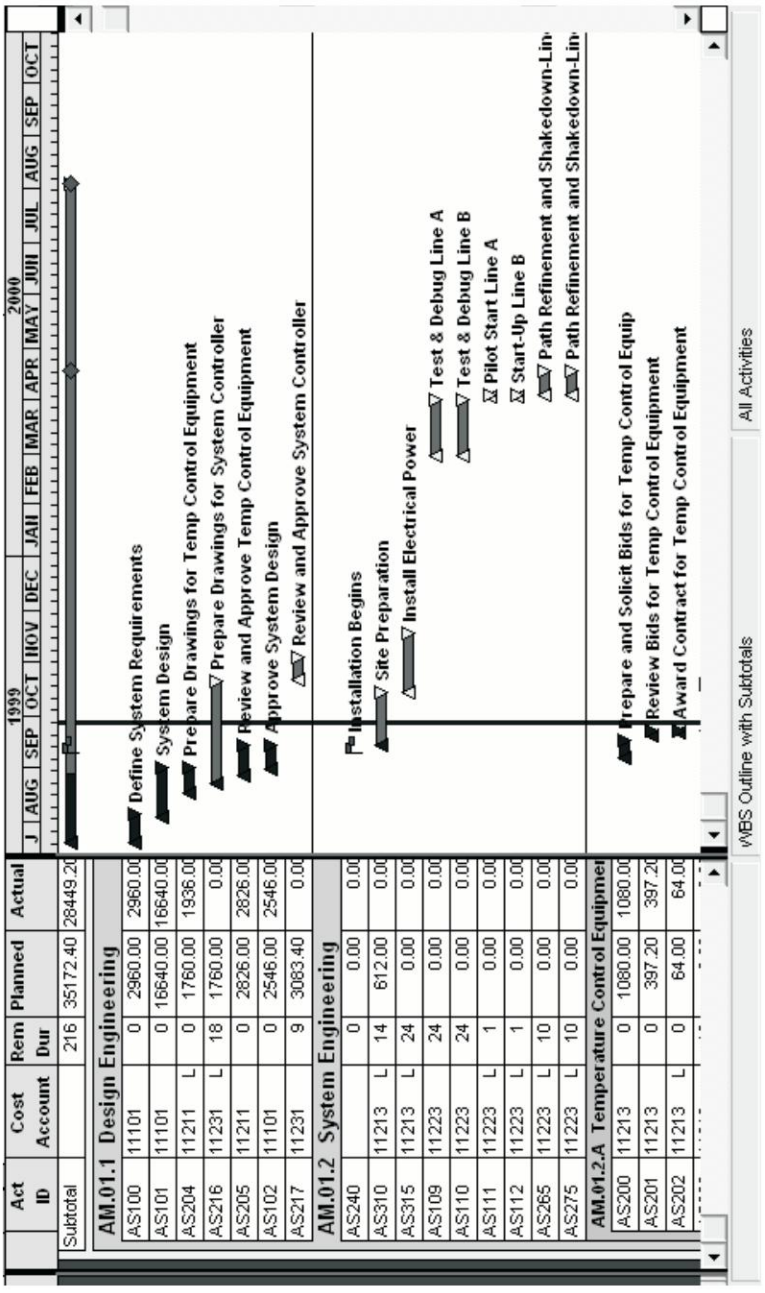
RD: 20 Type: Task — LS: 27SEP99 — LF: 22OCT99 — FF: 0

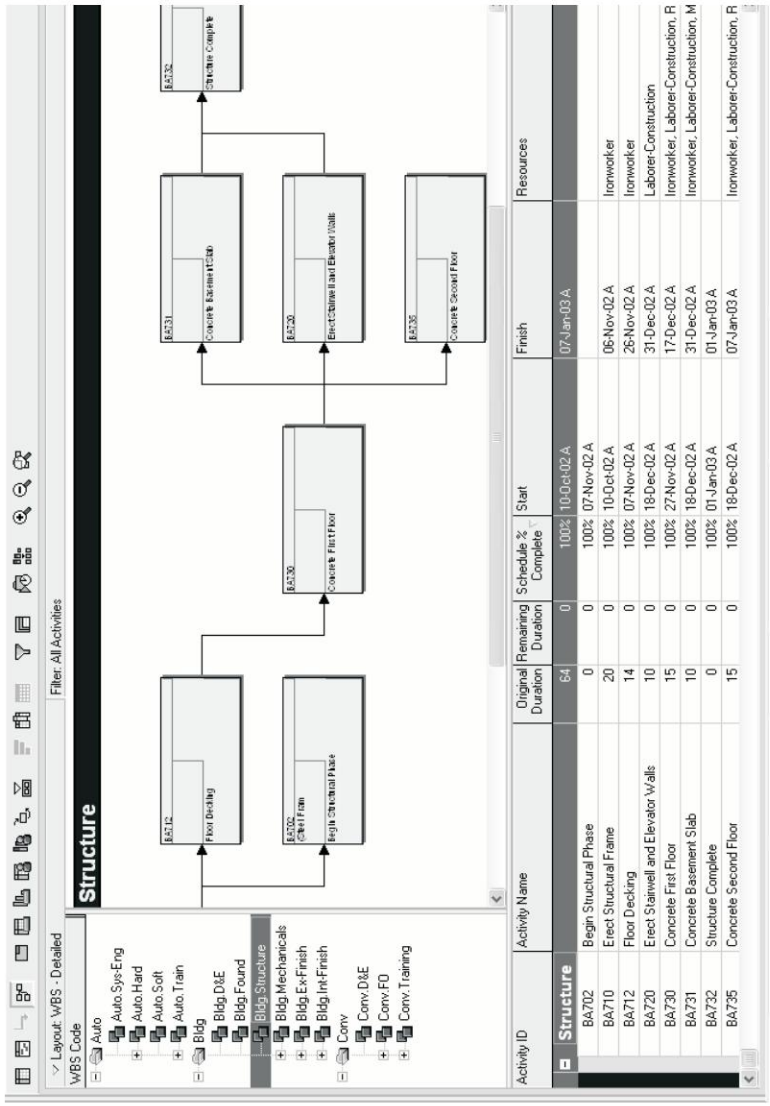
ENG	MASON	DESGN		BADSG	AM.03.1.
Dept	Resp	Phas	Step	Item	WBS

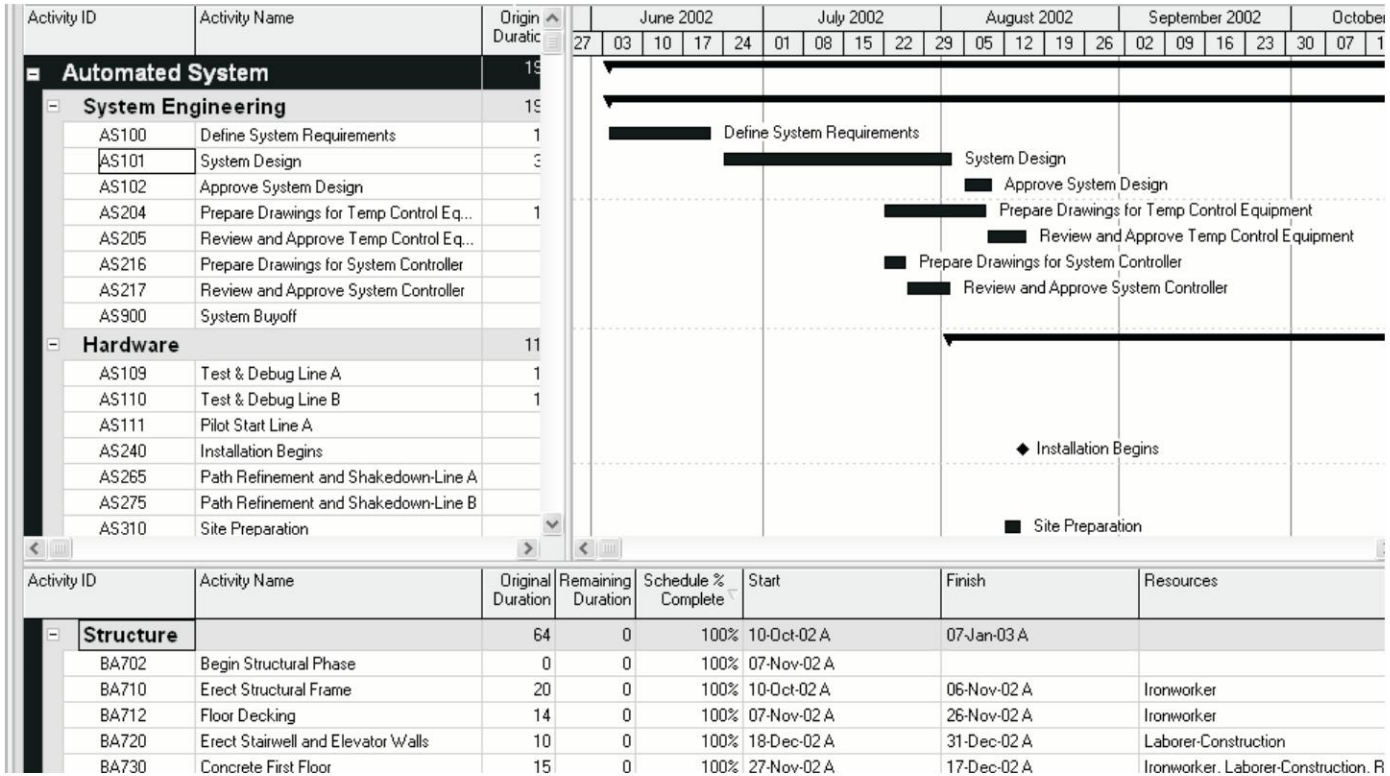

Activity ID
Activity Description
Orig Dur
Rem Dur
1999
2000
JUL
AUG
SEP
OCT
NOV
DEC
JAN
AS216 Prepare Drawings for System 10 18
AS310 Site Preparation 10 14
BA450 Assemble Brick Samples 10 5
BA480 Assemble and Submit Flooring 10 7
AS206 Fabricate & Deliver Temp 20 16
BA640 Site Preparation 20 15
BA469 Assemble Technical Data for 20 20
BA530 Review and Approve Brick 11 11
BA560 Review and Approve Flooring 10 10
AS315 Install Electrical Power 24 24
AS103 Install Robot Base 18 18
AS104 Run Sealant, Air, and Water 13 13
BA650 Excavation 10 10
BA421 Prepare and Solicit Bids for 3 3
BA407 Prepare and Solicit Bids for 5 5
BA422 Review Bids for Brick 3 3
AS217 Review and Approve System 9 9
BA470 Review Technical Data on Heat 10 10
BA423 Award Contract for Brick 1 1
BA408 Review Bids for Flooring 3 3
BA600 Deliver Brick 60 60
BA660 Install Underground Water 5 5
BA670 Install Underground Electric 5 5
BA409 Award Contract for Flooring 1 1
Assemble Brick Samples
Site Preparation
Assemble Tec
Review and Approv
Excavation
Prepare and Solicit
Review Bids for
Revie
Award Contract
Install Underground Water Lines
Install Underground Electric Condu
Classic Schedule Layout
Three-Month Lookahead


Activity ID
Activity Description
Orig Dur
Weeks
BA400 Design Building Addition 20
BA407 Prepare and Solicit Bids for 5
BA408 Review Bids for Flooring 3
BA409 Award Contract for Flooring 1
BA411 Prepare and Solicit Bids for 3
BA412 Review Bids for Heat Pump 2
BA413 Award Contract for Heat Pump 1
BA421 Prepare and Solicit Bids for 3
BA422 Review Bids for Brick 3
BA423 Award Contract for Brick 1
BA450 Assemble Brick Samples 10
BA469 Assemble Technical Data for 3
BA470 Review Technical Data on Heat 10
BA480 Assemble and Submit Flooring 10
BA501 Review and Approve Designs 14
BA530 Review and Approve Brick 10
BA550 Fabricate and Deliver Heat 90
BA560 Review and Approve Flooring 10
BA600 Deliver Brick 60
BA620 Fabricate and Deliver Flooring 60
BA630 Begin Building Construction 0
BA640 Site Preparation 20
BA650 Excavation 10
BA660 Install Underground Water 5
BA670 Install Underground Electric 5
BA680 Form/Pour Concrete Footings 10
BA681 Concrete Foundation Walls 10
BA690 Form and Pour Slab 5
BA700 Backfill and Compact Walls 2
BA701 Foundation Phase Complete 0
BA702 Begin Structural Phase 0
BA710 Erect Structural Frame 20
BA712 Floor Decking 14
Design Building Addition
Prepare and Solicit Bids for Heat Pump
Review Bids for Heat Pump
Award Contract for Heat Pump
Prepare and Solicit Bids for Brick Exterior
Review Bids for Brick
Award Contract for Brick
Assemble Brick Samples
Assemble Technical Data for Heat Pump
Review Technical Data on Heat Pumps
Review and Approve Designs
Review and Approve Brick Samples
Begin Building Construction
Site Preparation
Excavation
Install Underground Water Lines
Install Underground Electric Conduit
Form/Pour Concrete Footings
Concrete Foundation Walls
Form and Pour Slab
Backfill and Compact Walls
Foundation Phase Complete
Begin Structural Phase
Erect Structural Frame
Floor Decking
Classic Schedule Layout
All Activities


Cosmic View
PERT
Design and Engineering Phase
Procurement Phase
AS100 Define System Requirements
AS101 System Design
AS204 Prepare Drawings for
AS205 Review and Approve Temp
AS216 Prepare Drawings for
AS217 Review and Approve System
AS102 Approve System Design
AS213 Prepare and Solicit Bids for
AS214 Review Bids for System
AS215 Award Contr for System
AS200 Prepare and
AS201 Review Bids for
AS202 Award Contr
PERT View Organized by Phase
Automation System Project Activities

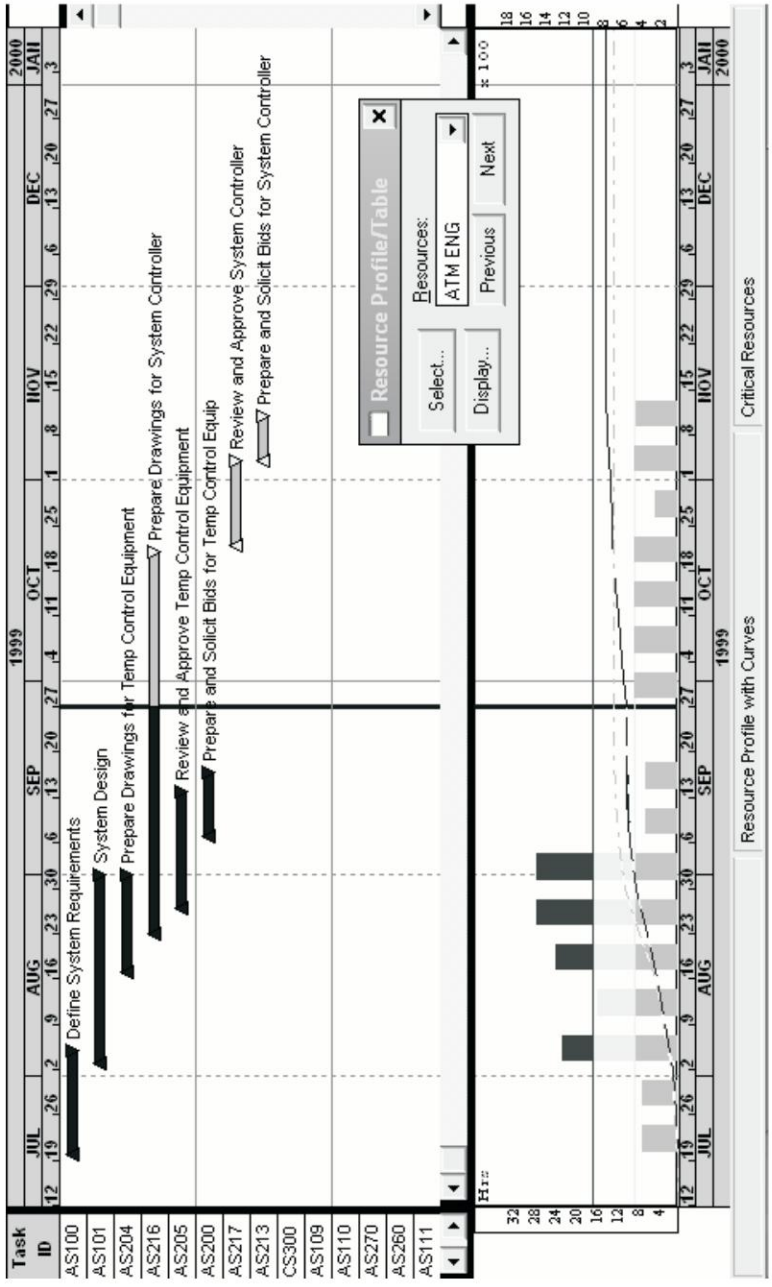

Act ID
Cost Account
Rem Dur
Planned
Actual
1999
2000
J AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT
Subtotal 216 35172.40 28449.20
AM.01.1 Design Engineering
AS100 11101 0 2960.00 2960.00
AS101 11101 0 16640.00 16640.00
AS204 11211 L 0 1760.00 1936.00
AS216 11231 L 18 1760.00 0.00
AS205 11211 0 2826.00 2826.00
AS102 11101 0 2546.00 2546.00
AS217 11231 9 3083.40 0.00
AM.01.2 System Engineering
AS240 0 0.00 0.00
AS310 11213 L 14 612.00 0.00
AS315 11213 L 24 0.00 0.00
AS109 11223 24 0.00 0.00
AS110 11223 24 0.00 0.00
AS111 11223 L 1 0.00 0.00
AS112 11223 L 1 0.00 0.00
AS265 11223 L 10 0.00 0.00
AS275 11223 L 10 0.00 0.00
AM.01.2.A Temperature Control Equipmen
AS200 11213 0 1080.00 1080.00
AS201 11213 0 397.20 397.20
AS202 11213 L 0 64.00 64.00
Define System Requirements
System Design
Prepare Drawings for Temp Control Equipment
Prepare Drawings for System Controller
Review and Approve Temp Control Equipment
Approve System Design
Review and Approve System Controller
Installation Begins
Site Preparation
Install Electrical Power
Test & Debug Line A
Test & Debug Line B
Pilot Start Line A
Start-Up Line B
Path Refinement and Shakedown-Lin
Path Refinement and Shakedown-Lin
Prepare and Solicit Bids for Temp Control Equip
Review Bids for Temp Control Equipment
Award Contract for Temp Control Equipment
WBS Outline with Subtotals
All Activities

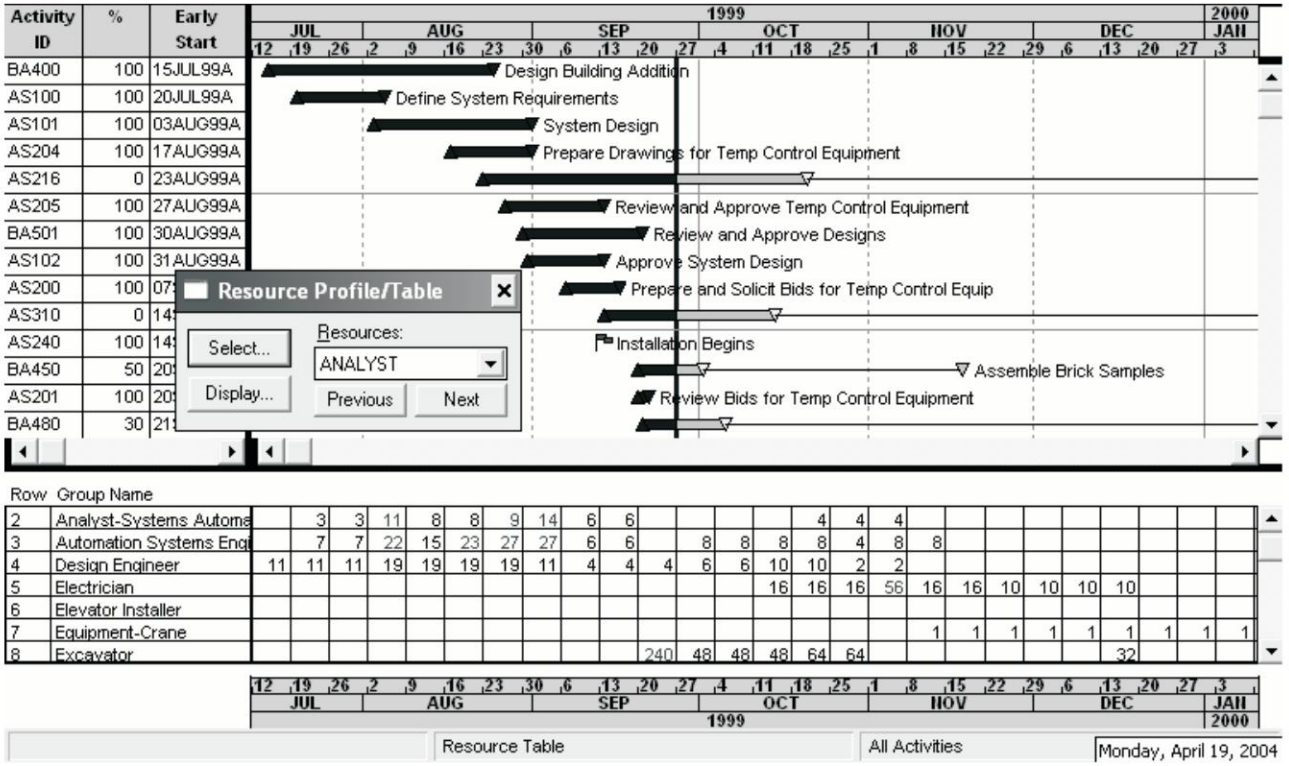

Layout: WBS - Detailed
Filter: All Activities
WBS Code
Auto
Auto.Sys-Eng
Auto.Hard
Auto.Soft
Auto.Train
Bldg
Bldg.D&E
Bldg.Found
Bldg.Structure
Bldg.Mechanicals
Bldg.Ex-Finish
Bldg.Int-Finish
Conv
Conv.D&E
Conv.FO
Conv.Training
Structure
BA712
Floor Decking
BA702
Begin Structural Phase
BA730
Concrete First Floor
BA731
Concrete Basement Slab
BA720
Erect Stairwell and Elevator Walls
BA735
Concrete Second Floor
BA732
Structure Complete
Activity ID
Activity Name
Original Duration
Remaining Duration
Schedule % Complete
Start
Finish
Resources
Structure
64
0
100%
10-Oct-02 A
07-Jan-03 A
BA702 Begin Structural Phase 0 0 100% 07-Nov-02 A
BA710 Erect Structural Frame 20 0 100% 10-Oct-02 A 06-Nov-02 A Ironworker
BA712 Floor Decking 14 0 100% 07-Nov-02 A 26-Nov-02 A Ironworker
BA720 Erect Stairwell and Elevator Walls 10 0 100% 18-Dec-02 A 31-Dec-02 A Laborer-Construction
BA730 Concrete First Floor 15 0 100% 27-Nov-02 A 17-Dec-02 A Ironworker, Laborer-Construction, R
BA731 Concrete Basement Slab 10 0 100% 18-Dec-02 A 31-Dec-02 A Ironworker, Laborer-Construction, M
BA732 Structure Complete 0 0 100% 01-Jan-03 A 01-Jan-03 A
BA735 Concrete Second Floor 15 0 100% 18-Dec-02 A 07-Jan-03 A Ironworker, Laborer-Construction, R

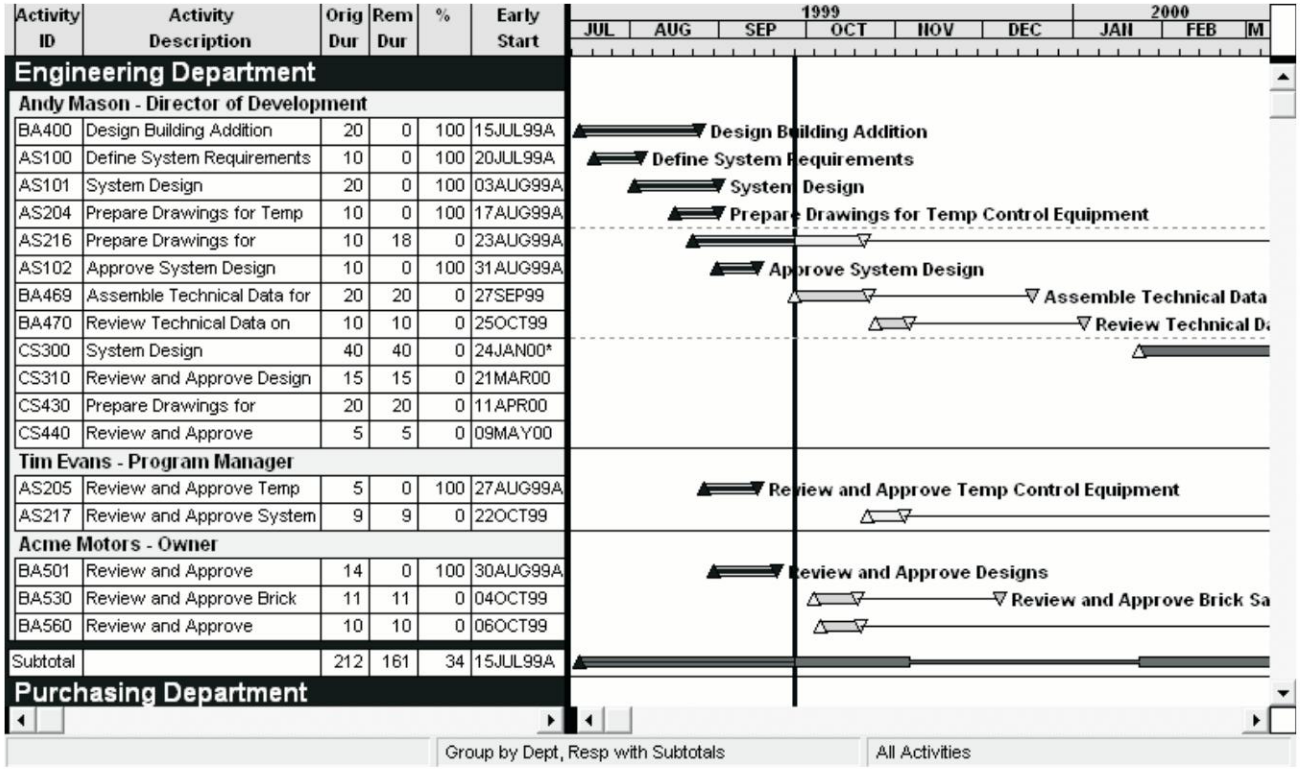


Activity ID	Activity Name	Origin Duratic
Automated System		19
System Engineering		19
AS100	Define System Requirements	1
AS101	System Design	3
AS102	Approve System Design	
AS204	Prepare Drawings for Temp Control Eq...	1
AS205	Review and Approve Temp Control Eq...	
AS216	Prepare Drawings for System Controller	
AS217	Review and Approve System Controller	
AS900	System Buyoff	
Hardware		11
AS109	Test & Debug Line A	1
AS110	Test & Debug Line B	1
AS111	Pilot Start Line A	
AS240	Installation Begins	
AS265	Path Refinement and Shakedown-Line A	
AS275	Path Refinement and Shakedown-Line B	
AS310	Site Preparation	

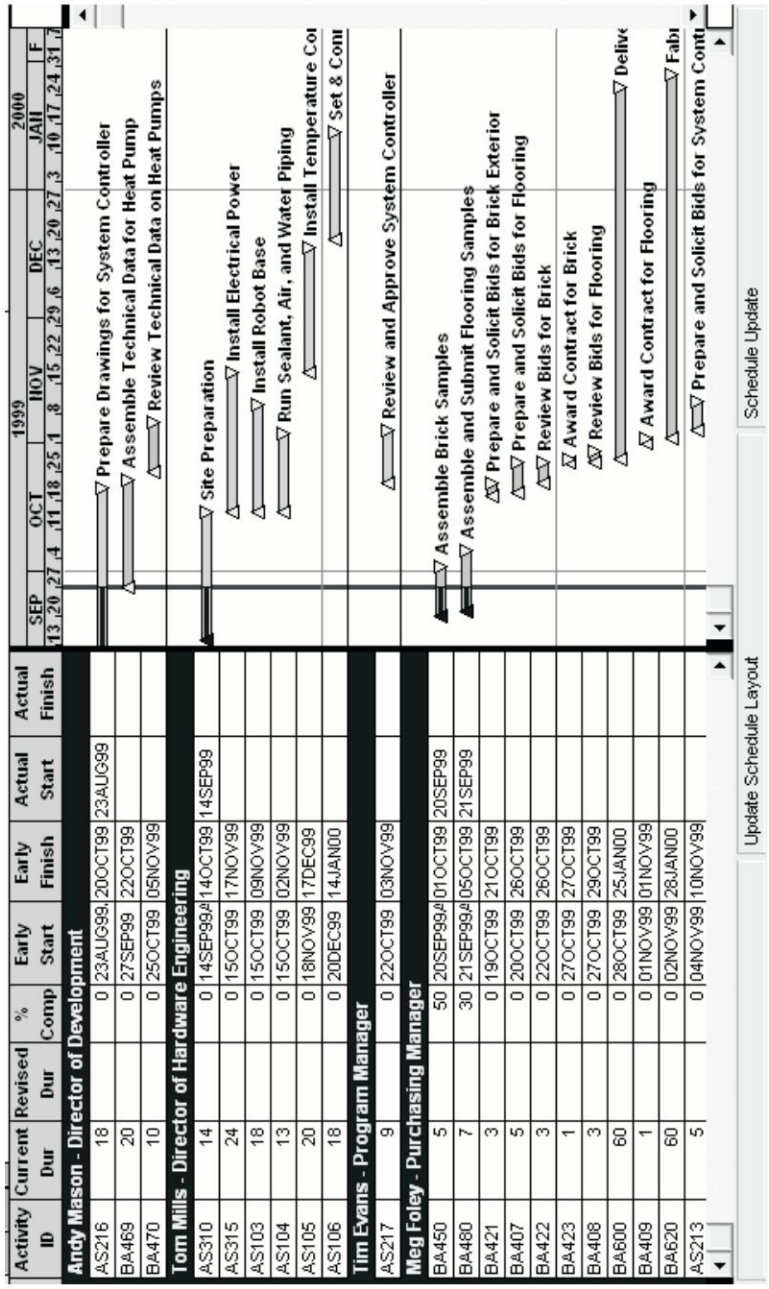
Activity ID	Activity Name	Original Duration	Remaining Duration	Schedule % Complete	Start	Finish	Resources
Structure		64	0	100%	10-Oct-02 A	07-Jan-03 A	
BA702	Begin Structural Phase	0	0	100%	07-Nov-02 A		
BA710	Erect Structural Frame	20	0	100%	10-Oct-02 A	06-Nov-02 A	Ironworker
BA712	Floor Decking	14	0	100%	07-Nov-02 A	26-Nov-02 A	Ironworker
BA720	Erect Stairwell and Elevator Walls	10	0	100%	18-Dec-02 A	31-Dec-02 A	Laborer-Construction
BA730	Concrete First Floor	15	0	100%	27-Nov-02 A	17-Dec-02 A	Ironworker, Laborer-Construction, R

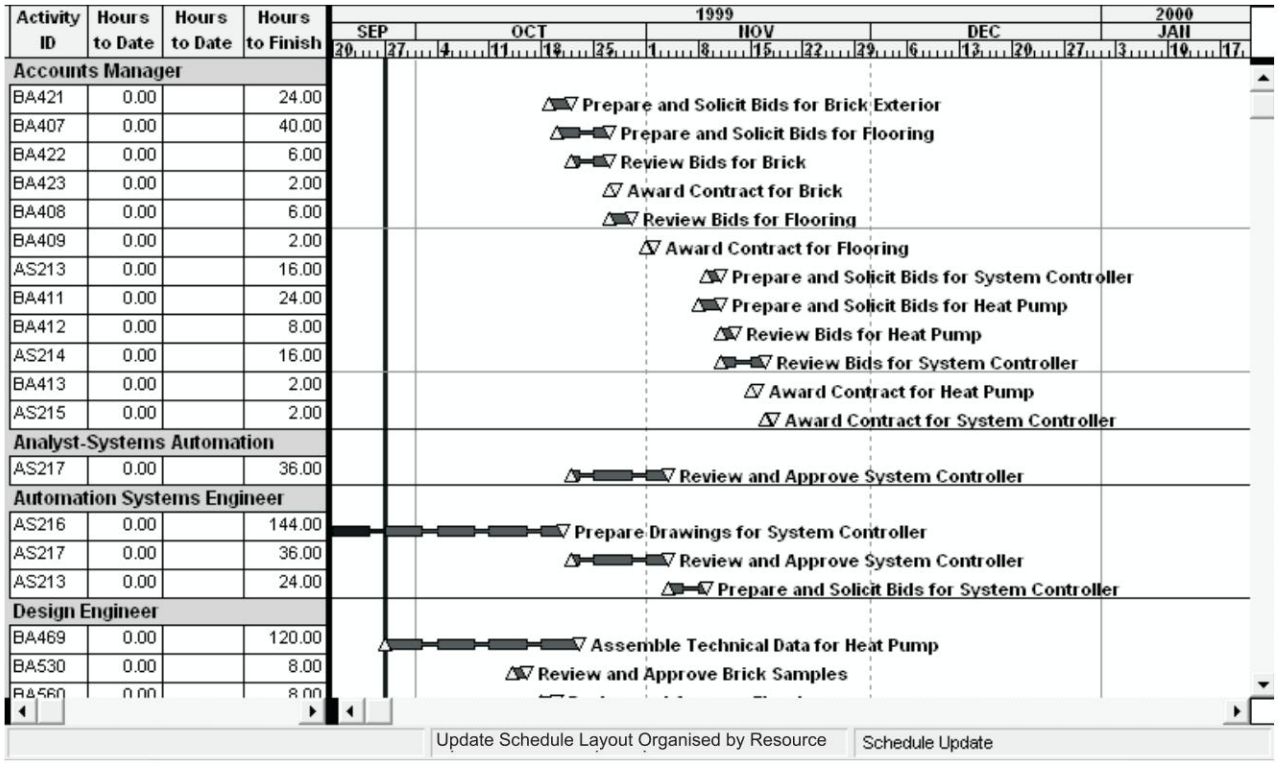

Task ID
1999
2000
JUL
AUG
SEP
OCT
NOV
DEC
JAN
AS100
AS101
AS204
AS216
AS205
AS200
AS217
AS213
CS300
AS109
AS110
AS270
AS260
AS111
Define System Requirements
System Design
Prepare Drawings for Temp Control Equipment
Prepare Drawings for System Controller
Review and Approve Temp Control Equipment
Prepare and Solicit Bids for Temp Control Equip
Review and Approve System Controller
Prepare and Solicit Bids for System Controller
Resource Profile/Table
Select...
Display...
Resources:
ATM ENG
Previous
Next
Resource Profile with Curves
Critical Resources

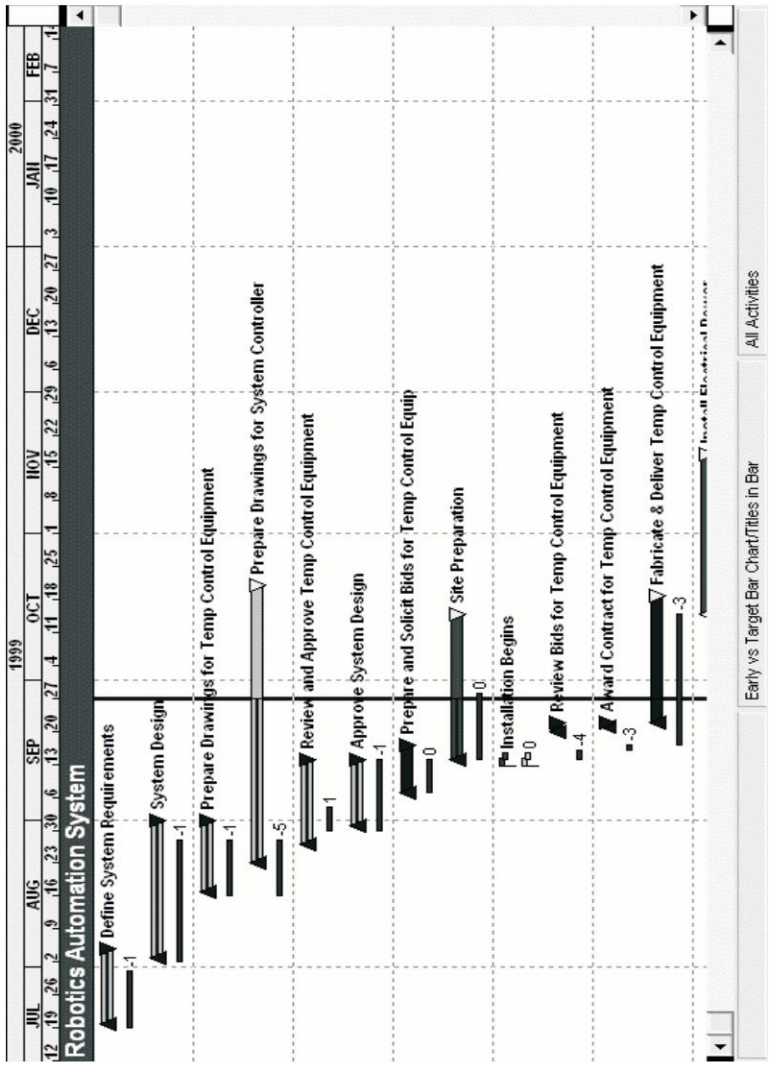

Activity ID
%
Early Start
1999
2000
JUL
AUG
SEP
OCT
NOV
DEC
JAN
BA400 100 15JUL99A Design Building Addition
AS100 100 20JUL99A Define System Requirements
AS101 100 03AUG99A System Design
AS204 100 17AUG99A Prepare Drawings for Temp Control Equipment
AS216 0 23AUG99A
AS205 100 27AUG99A Review and Approve Temp Control Equipment
BA501 100 30AUG99A Review and Approve Designs
AS102 100 31AUG99A Approve System Design
AS200 100 07 Prepare and Solicit Bids for Temp Control Equip
AS310 0 14
AS240 100 14 Installation Begins
BA450 50 20 Assemble Brick Samples
AS201 100 20 Review Bids for Temp Control Equipment
BA480 30 21
Resource Profile/Table
Select...
Display...
Resources:
ANALYST
Previous
Next
Row Group Name
2 Analyst-Systems Automa 3 3 11 8 8 9 14 6 6 4 4 4
3 Automation Systems Engi 7 7 22 15 23 27 27 6 6 8 8 8 8 4 8 8
4 Design Engineer 11 11 11 19 19 19 19 11 4 4 4 6 6 10 10 2 2
5 Electrician 16 16 16 56 16 16 10 10 10 10
6 Elevator Installer
7 Equipment-Crane 1 1 1 1 1 1 1 1
8 Excavator 240 48 48 48 64 64 32
Resource Table
All Activities
Monday, April 19, 2004

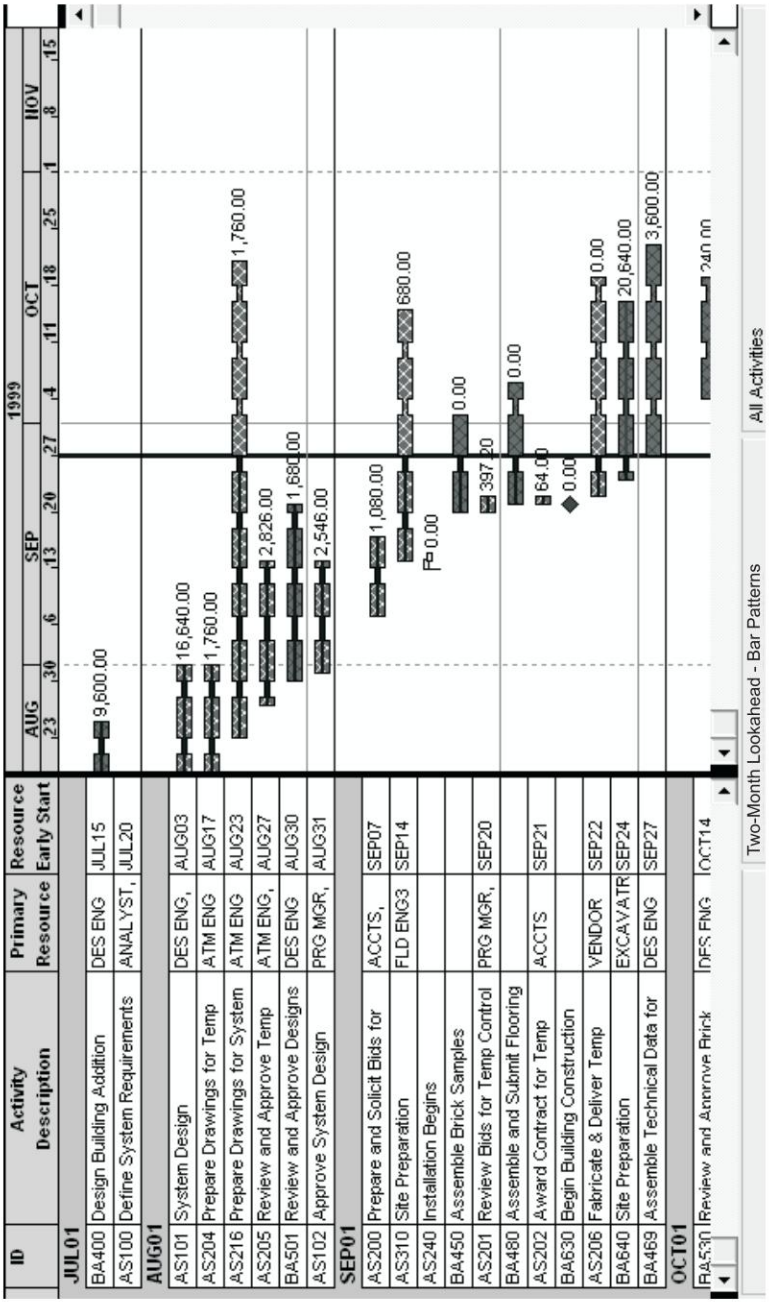


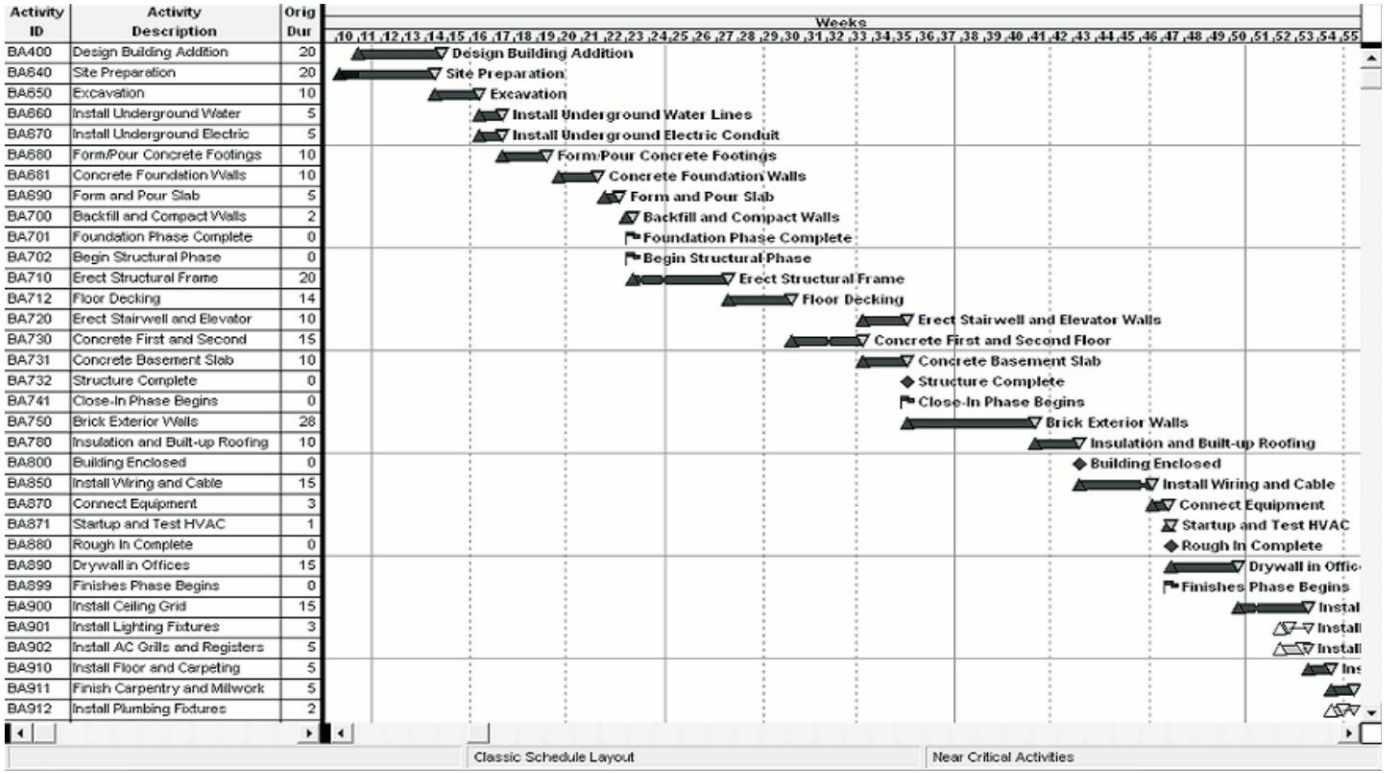
Activity ID	Activity Description	Orig Dur	Rem Dur	%	Early Start
Engineering Department					
Andy Mason - Director of Development					
BA400	Design Building Addition	20	0	100	15JUL99A
AS100	Define System Requirements	10	0	100	20JUL99A
AS101	System Design	20	0	100	03AUG99A
AS204	Prepare Drawings for Temp	10	0	100	17AUG99A
AS216	Prepare Drawings for	10	18	0	23AUG99A
AS102	Approve System Design	10	0	100	31AUG99A
BA469	Assemble Technical Data for	20	20	0	27SEP99
BA470	Review Technical Data on	10	10	0	25OCT99
CS300	System Design	40	40	0	24JAN00*
CS310	Review and Approve Design	15	15	0	21MAR00
CS430	Prepare Drawings for	20	20	0	11APR00
CS440	Review and Approve	5	5	0	09MAY00
Tim Evans - Program Manager					
AS205	Review and Approve Temp	5	0	100	27AUG99A
AS217	Review and Approve System	9	9	0	22OCT99
Acme Motors - Owner					
BA501	Review and Approve	14	0	100	30AUG99A
BA530	Review and Approve Brick	11	11	0	04OCT99
BA560	Review and Approve	10	10	0	06OCT99
Subtotal		212	161	34	15JUL99A
Purchasing Department					


Activity ID
Current Dur
Revised Dur
% Comp
Early Start
Early Finish
Actual Start
Actual Finish
Andy Mason - Director of Development
AS216 18 18 0 23AUG99 20OCT99 23AUG99
BA469 20 20 0 27SEP99 22OCT99
BA470 10 10 0 25OCT99 05NOV99
Tom Mills - Director of Hardware Engineering
AS310 14 14 0 14SEP99A 14OCT99 14SEP99
AS315 24 24 0 15OCT99 17NOV99
AS103 18 18 0 15OCT99 09NOV99
AS104 13 13 0 15OCT99 02NOV99
AS105 20 20 0 18NOV99 17DEC99
AS106 18 18 0 20DEC99 14JAN00
Tim Evans - Program Manager
AS217 9 9 0 22OCT99 03NOV99
Meg Foley - Purchasing Manager
BA450 5 5 50 20SEP99A 01OCT99 20SEP99
BA480 7 7 30 21SEP99A 05OCT99 21SEP99
BA421 3 3 0 19OCT99 21OCT99
BA407 5 5 0 20OCT99 26OCT99
BA422 3 3 0 22OCT99 26OCT99
BA423 1 1 0 27OCT99 27OCT99
BA408 3 3 0 27OCT99 29OCT99
BA600 60 60 0 28OCT99 25JAN00
BA409 1 1 0 01NOV99 01NOV99
BA620 60 60 0 02NOV99 28JAN00
AS213 5 5 0 04NOV99 10NOV99
SEP 13 20 27
OCT 1999 4 11 18 25
NOV 1 8 15 22 29
DEC 6 13 20 27
JAN 2000 3 10 17 24 31
F
Prepare Drawings for System Controller
Assemble Technical Data for Heat Pump
Review Technical Data on Heat Pumps
Site Preparation
Install Electrical Power
Install Robot Base
Run Sealant, Air, and Water Piping
Install Temperature Co
Set & Con
Review and Approve System Controller
Assemble Brick Samples
Assemble and Submit Flooring Samples
Prepare and Solicit Bids for Brick Exterior
Prepare and Solicit Bids for Flooring
Review Bids for Brick
Award Contract for Brick
Review Bids for Flooring
Deliv
Award Contract for Flooring
Fabi
Prepare and Solicit Bids for System Contr
Update Schedule Layout
Schedule Update




1999
2000
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
Robotics Automation System
Define System Requirements
System Design
Prepare Drawings for Temp Control Equipment
Prepare Drawings for System Controller
Review and Approve Temp Control Equipment
Approve System Design
Prepare and Solicit Bids for Temp Control Equip
Site Preparation
Installation Begins
Review Bids for Temp Control Equipment
Award Contract for Temp Control Equipment
Fabricate & Deliver Temp Control Equipment
Early vs Target Bar Chart/Titles in Bar
All Activities


ID
Activity Description
Primary Resource
Resource Early Start
1999
AUG
SEP
OCT
NOV
23
30
6
13
20
27
4
11
18
25
1
8
15
JUL01
BA400 Design Building Addition DES ENG JUL15
AS100 Define System Requirements ANALYST, JUL20
AUG01
AS101 System Design DES ENG, AUG03
AS204 Prepare Drawings for Temp ATM ENG AUG17
AS216 Prepare Drawings for System ATM ENG AUG23
AS205 Review and Approve Temp ATM ENG, AUG27
BA501 Review and Approve Designs DES ENG AUG30
AS102 Approve System Design PRG MGR, AUG31
SEP01
AS200 Prepare and Solicit Bids for ACCTS, SEP07
AS310 Site Preparation FLD ENG3 SEP14
AS240 Installation Begins
BA450 Assemble Brick Samples
AS201 Review Bids for Temp Control PRG MGR, SEP20
BA480 Assemble and Submit Flooring
AS202 Award Contract for Temp ACCTS SEP21
BA630 Begin Building Construction
AS206 Fabricate & Deliver Temp VENDOR SEP22
BA640 Site Preparation EXCAVATR SEP24
BA469 Assemble Technical Data for DES ENG SEP27
OCT01
BA530 Review and Approve Brick DES ENG OCT14
9,600.00
16,640.00
1,760.00
2,826.00
1,680.00
2,546.00
1,080.00
0.00
0.00
397.20
0.00
64.00
0.00
0.00
680.00
20,640.00
3,600.00
240.00
Two-Month Lookahead - Bar Patterns
All Activities



Activity ID	Activity Description	Orig Dur
BA400	Design Building Addition	20
BA840	Site Preparation	20
BA850	Excavation	10
BA860	Install Underground Water	5
BA870	Install Underground Electric	5
BA880	Form/Pour Concrete Footings	10
BA881	Concrete Foundation Walls	10
BA890	Form and Pour Slab	5
BA700	Backfill and Compact Walls	2
BA701	Foundation Phase Complete	0
BA702	Begin Structural Phase	0
BA710	Erect Structural Frame	20
BA712	Floor Decking	14
BA720	Erect Stairwell and Elevator	10
BA730	Concrete First and Second	15
BA731	Concrete Basement Slab	10
BA732	Structure Complete	0
BA741	Close-In Phase Begins	0
BA750	Brick Exterior Walls	28
BA780	Insulation and Built-up Roofing	10
BA800	Building Enclosed	0
BA850	Install Wiring and Cable	15
BA870	Connect Equipment	3
BA871	Startup and Test HVAC	1
BA880	Rough In Complete	0
BA890	Drywall in Offices	15
BA899	Finishes Phase Begins	0
BA900	Install Ceiling Grid	15
BA901	Install Lighting Fixtures	3
BA902	Install AC Grills and Registers	5
BA910	Install Floor and Carpeting	5
BA911	Finish Carpentry and Millwork	5
BA912	Install Plumbing Fixtures	2

Dr. Uddesh Kohli is presently the Chairman, Consultancy Development Centre, Construction Industry Development Council and Engineering Council of India. He is also Secretary General of International Federation of Training & Development Organisations. He is Director on the Board of several leading companies.

He is former- Chairman & Managing Director of Power Finance Corporation (PFC), Adviser, Planning Commission, Chairman of Standing Conference of Public Enterprises (SCOPE), President of the Council of Indian Employers (CIE) and President, All India Management Association.

Dr. Kohli has a unique combination of educational qualifications—a First Class First Hons. Degree in Engineering (IIT, Roorkee), First Class First Post Graduate in Management (Manchester) and Ph.D in Economics (Delhi School of Economics)

Born in December, 1940, Dr Kohli has over 40 years' experience in Corporates, Planning Commission, Consultancy and Training organizations. He has been Adviser/Consultant to international bodies such as Asian Development Bank, UNDP/UNIDO/UNOPS, for various countries such as Papua New Guinea, Tanzania, China, Maldives.

His areas of specialization include Strategic Planning/Corporate Governance/Management, Development Finance, Energy/Environment, Project Management -Feasibility studies, project formulation, appraisal, monitoring and management of investment projects, promoting construction of infrastructure projects, better construction technology, methodology etc. Restructuring, reforms and disinvestment of Public Sector Enterprises, Training & HR and Consultancy -

Krishan K. Chitkara heads the institute of Construction Project Management, Gurgaon. He has over 35 years senior-level experience in directing front-line construction activities, training engineers in project management, conducting seminars and offering consultancy services.

He has executed quite successfully construction assignments for reputed construction establishment in India, Saudi Arabia, Iraq, Sultanate of Oman and United Arab Emirates. The diverse construction tasks executed by him include defence works, residential and commercial complex, precast turn-key jobs, and airfields, treatment plants and lub-oil refinery works.

He is former professor and head of Works Management in the college of Military Engineering, Pune and Director of National Institute of Construction Management and Research, New Delhi. He has been involved with developing distance learning courses and is a visiting faculty at number of engineering and management institutions. He has contributed papers and participated in several national and international seminars; and has organised and conducted number of workshops and in-house programme in Construction Project Management for government, public and private sectors enterprises.

He is the author of *Construction Project Management: Planning, Scheduling and Controlling*, and a CD-ROM titled *CPMT Plus*, both published by McGraw-Hill Education, India.

Lt. Col. (Retd) K.K. Chitkara, AVSM, was commissioned into the Corps of Engineers of Indian Army in the 1954. He graduated in Civil Engineering and secured first class first in MBA. In India, he is Fellow of the Institute of Engineers, Institute of Surveyors and Institute of Valuers, and is life Member of the Indian Road Congress and Indian Society for Training & Development. He was awarded ATI VISHISHT