Planning and Scheduling Projects: Getting Ready For The PSP Exam

Course Instructor
Bassam Samman, PMP, PSP, EVP, CRA

- Mr. Bassam Samman, PMP, PSP, EVP, CRA is a Project Management Consultant with a 26-year service record, who has provided project management consulting services for more than 40 organizations in different sectors including Government, Construction, Engineering, Oil and Gas, Petrochemical, Shipbuilding, Information Technology and New Product Development.
- Mr. Samman is thoroughly experienced in complete project management including project management control systems, computerized PCS software, risk analysis, site management, claims analysis and prevention and alternative dispute resolution.
- Mr. Samman is a Civil Engineer, Kuwait University with a Masters Degree in Engineering Administration from the George Washington University. He is a certified Project Management Professional (PMP) and a certified Planning and Scheduling Professional (PSP) and a Certified Earned Value Professional (EVP). He is a founding member of the Project Management Institute (PMI) Arabian Gulf Chapter and served on their board of directors for more than 6 years. Mr. Samman is the CEO/Founder of CMCS.

Course Agenda

Technical Session	08:30 - 10:00
Break	10:00 - 10:15
Technical Session	10:15 - 12:00
Break	12:00 - 12:15
Technical Session	12:15 - 14:00
Lunch	14:00 - 15:00

DAY ONE

Planning and Scheduling Projects

What Is PSP?

- PSP (Planning & Scheduling Professional) is a very fast growing Professional Certification these days & large Multinational Engineering Companies (specially a couple of Multinational EPC Companies) are preferring candidates who have qualified as a PSP for Project Controls Positions (Project Controls Manager, Project Controls Specialist, Senior Project Planning Engineer etc).

PSP Exam

- **Part I is Basic Knowledge.** It consists of multiple-choice questions concerning the basics of planning and scheduling.
- **Part II is Planning and Scheduling Applications.** It consists of multiple-choice questions involving planning and scheduling scenarios.
- **Part III is a Practical Exercise.** This part entails answering a series of multiple-choice questions concerning various aspects of a single problem.
- **Part IV is a real-time Communications Exercise.** It requires the candidate to draft the equivalent of a one-page typewritten (maximum) memorandum to simulate reporting on planning and scheduling analysis to the project manager, explaining the issues and proposing a solution regarding a given problem.

Understanding Projects Definitions and Characteristics

Project Related Definitions

- What is a Subproject?
- What is a Program?
- What is a Projects Portfolio?
- Project Life Cycle
- Relation Between Product and Project Life Cycle

What Is A Project?

- An organization of people as well as other resources, brought together to meet specific objectives within a finite period of time by carrying out a set of planned activities.

Project Categories

1. Aerospace/Defense Projects
2. Business & Organization Change Projects
3. Communication Systems Projects
4. Event Projects
5. Facilities Projects
6. Information Systems (Software) Projects
7. International Development Projects
8. Media & Entertainment Projects
9. Product and Service Development Projects
10. Research and Development Projects

What Is A Subproject?

- Projects are frequently divided into more manageable components or subprojects.
- Subprojects are often contracted to an external enterprise or to another functional unit in the performing organization.

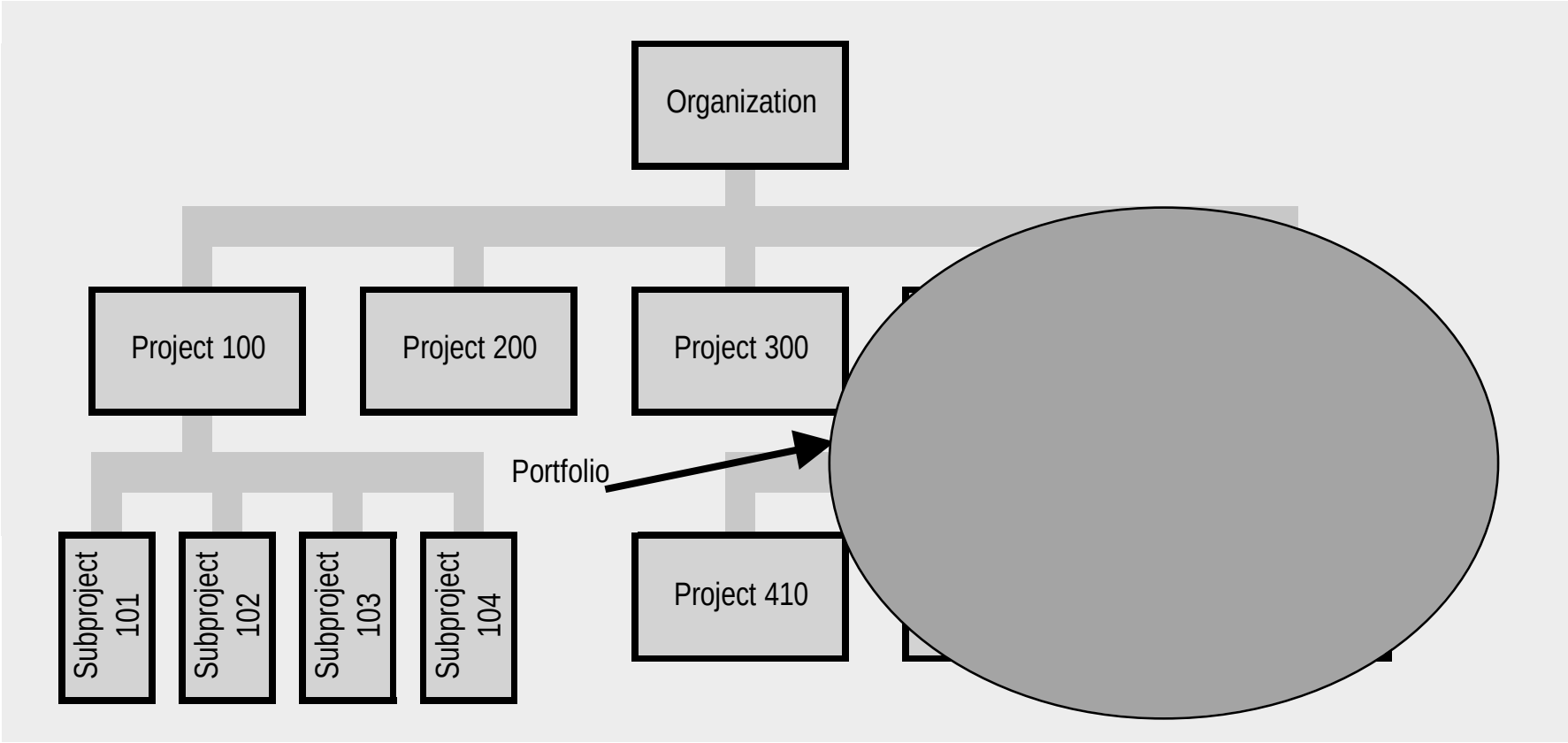
What Is A Program?

- A program is a group of projects managed in a coordinated way to obtain benefits from the projects. It also provides the control not available from managing projects individually.

What Is A Portfolio?

- It is a collection of projects and/or programs and other work that are grouped together to facilitate the effectiveness of that work to meet strategic objectives.

Projects, Subprojects, Programs & Portfolios In An Organization



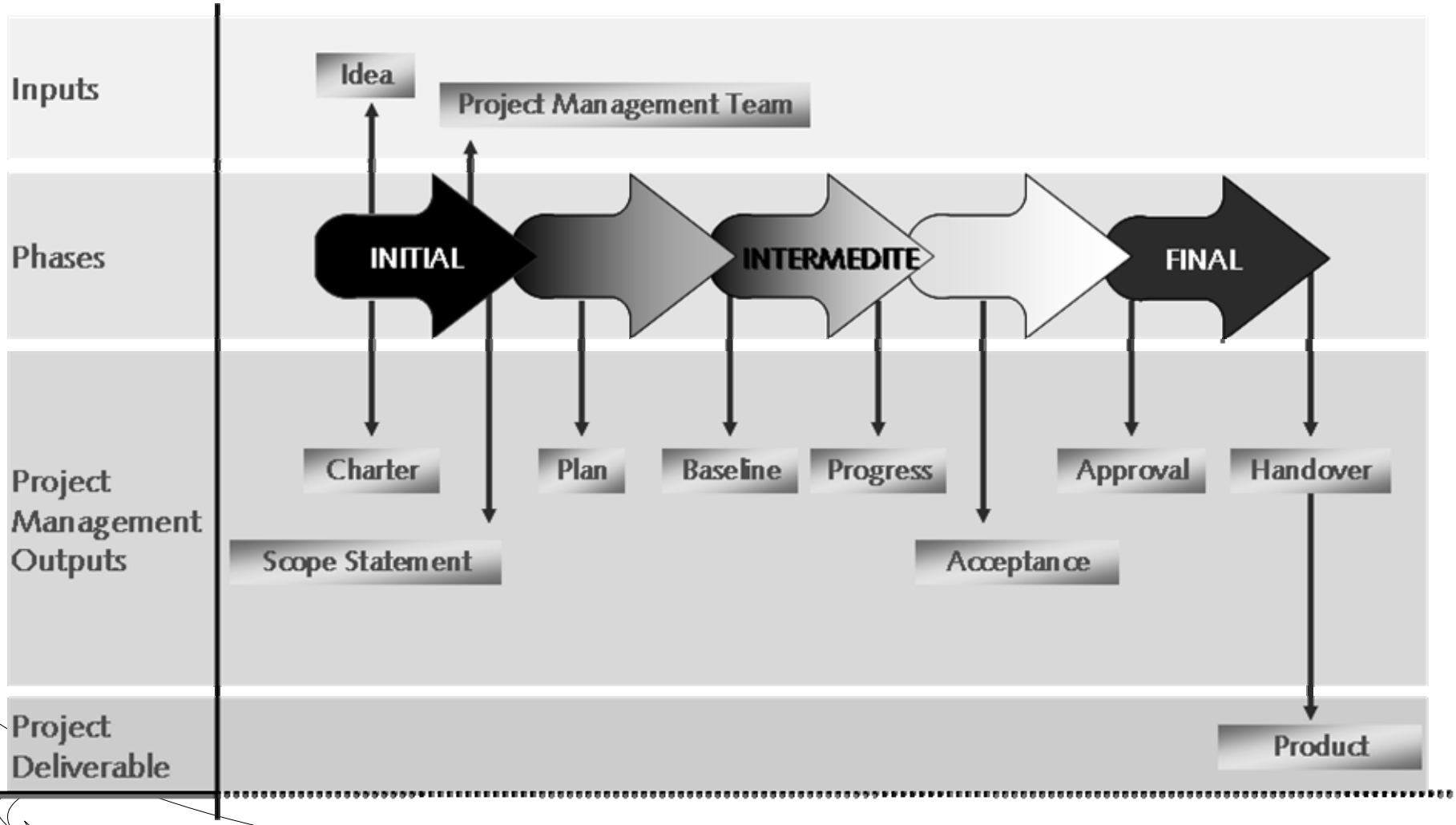
Project Life Cycle

- The project life cycle defines the phases that connect the beginning of a project to its end.
- The transition from one phase to another within a project's life cycle generally involves, and is usually defined by, some technical transfer or handoff.
- Deliverables from one phase are usually reviewed for completeness and accuracy and approved before work starts on the next phase.

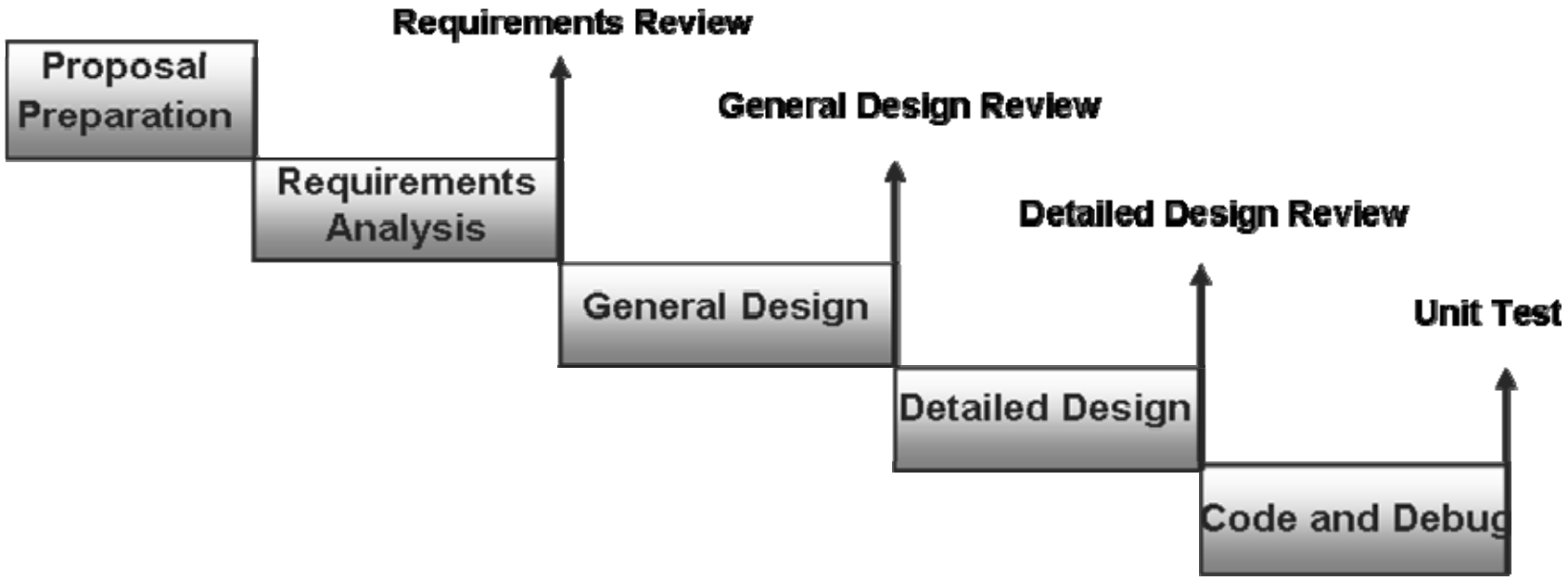
Project Life Cycles Generally Define

- What technical work to do in each phase?
- When the deliverables are to be generated in each phase and how each deliverable is reviewed, verified and validated?
- Who is involved in each phase?
- How to control and approve each phase?

Project Life Cycle



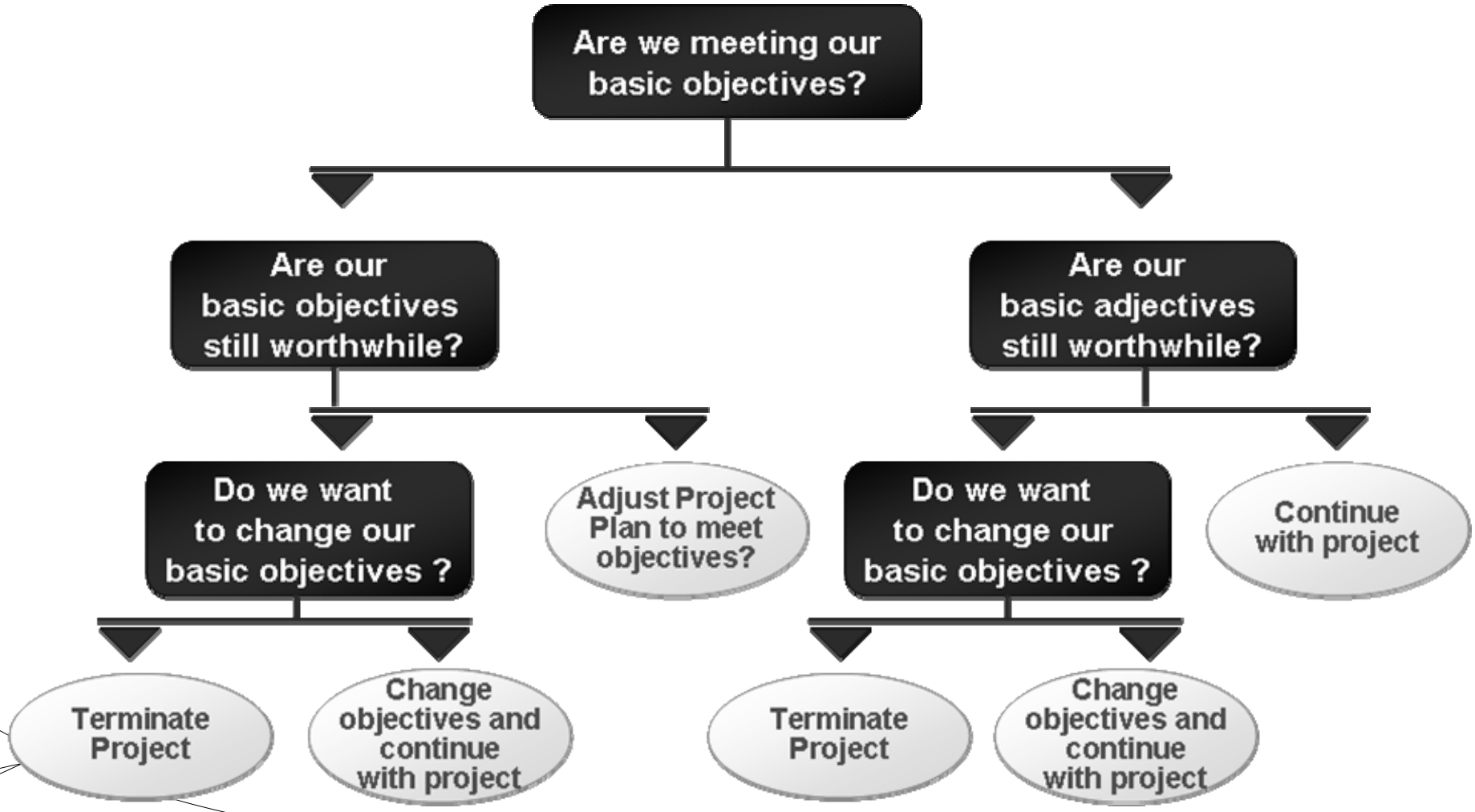
Importance of Phase Reviews



Interim Evaluations

- The main questions that are raised and need to be answered:
  - Are we meeting our basic objectives?
  - Are our basic objectives still worthwhile?
  - Do we want to change our basic objectives?
  - Do we want to terminate the project?
  - Are we ready for the next phase?
  - Have we secured all stakeholders approvals?

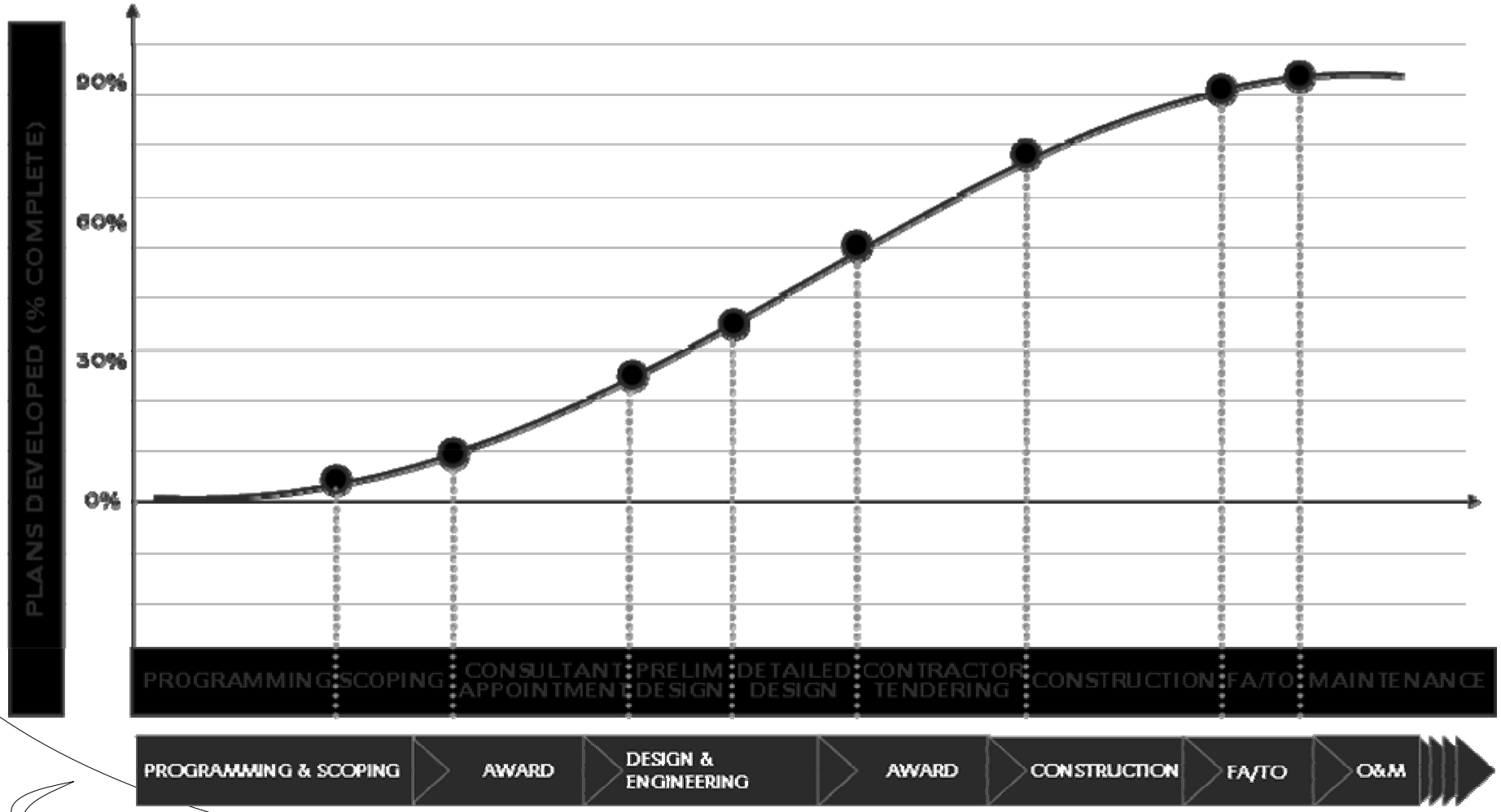
Interim Evaluations



Characteristic Of Project Phases

- The completion and approval of one or more deliverables characterizes a project phase.
- A deliverable is a measurable, verifiable work product such as specifications, drawings, model, etc.

AEC Project Life Cycle

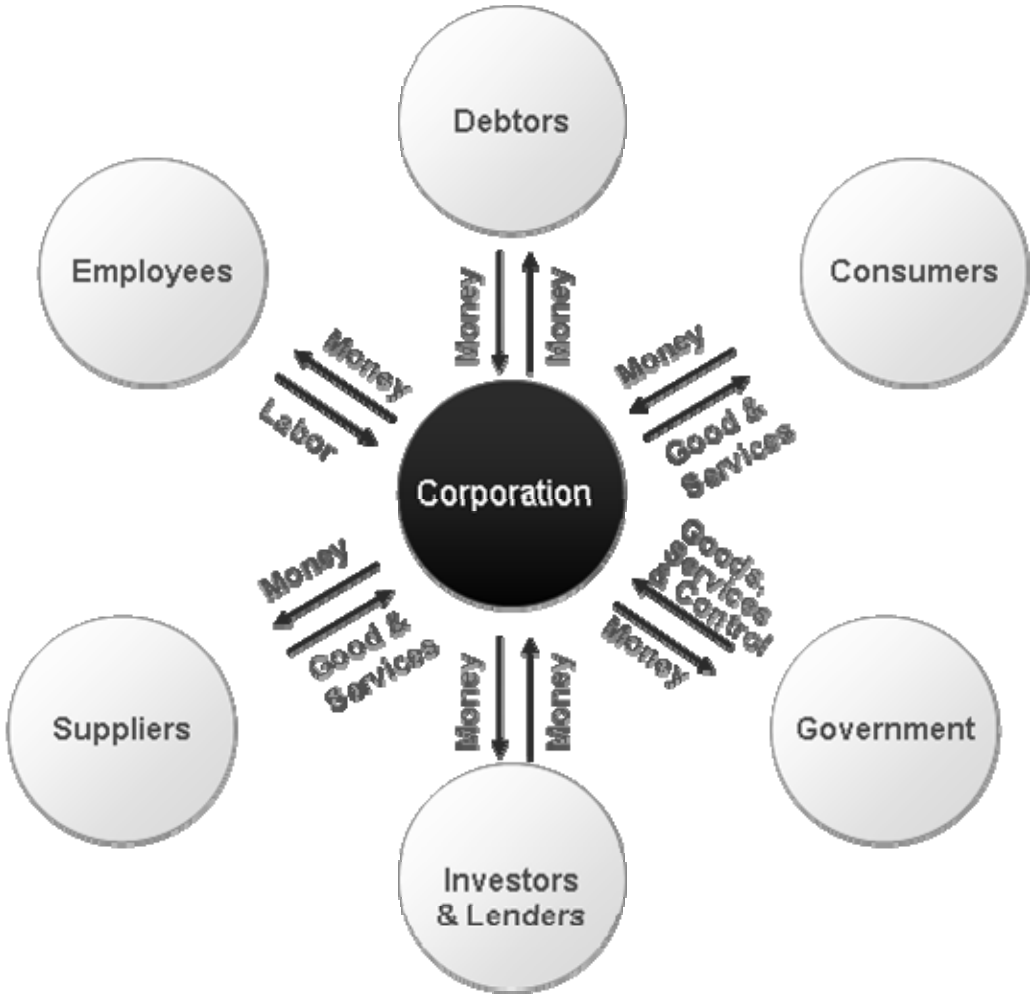


Project Stakeholders

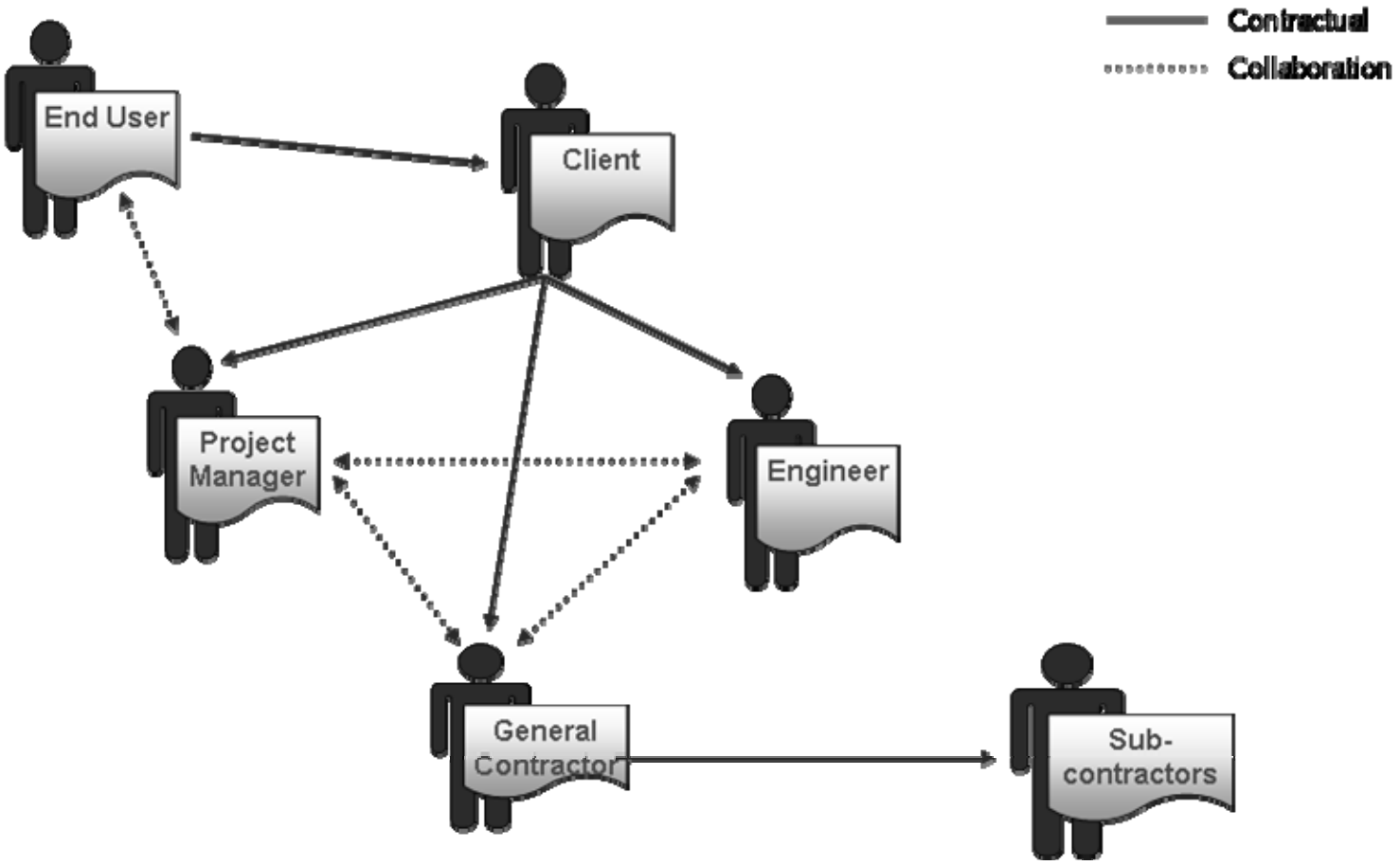
Project Stakeholders

- Project stakeholders are individuals and organizations that are actively involved in the project, or whose interest may be affected, positively or negatively, as a result of project execution of project completion outcomes.

Who Could Be A Stakeholder?



Stakeholders In Construction Project



Project Stakeholders 1/3

- **Steering committee:** A group of high-level executives from functional company areas (and customer representatives) who provide guidance and overall strategic direction. By contributing their functional expertise, they add strategic input to the project.
- **Project champion:** A senior executive who promotes and defends your project within the larger parent organization.
- **Performing organization**: The company or group doing the work.
- **Project organization:** A group that serves the project and participants.

Project Stakeholders 2/3

- **Project manager:** The person who manages the project daily.
- **Customer:** The buyer expected to use the product or service that the project creates.
- **Project Team member:** Anyone performing work on the project. In addition to people loaned from other departments or from resource pools, the team also includes all contractors and consultants.
- **Individual contributor:** Anyone working on the project without a management role but sharing accountability for achieving results.

Project Stakeholders 3/3

- **Functional manager:** Handles the business and technical management of a functional group – in particular their performance review.
- **Project accountant:** Provides cost and budget information for the project. This member of the accounting department ensure that invoices for project work get paid on time and can provide data for your earned value measurements.
- **Project influencer:** Is positively or negatively impacted because of the result of the project or potential changes from the project.
- **Information sources:** Individuals who provide helpful information. They may have special knowledge of the project as a result of their roles in similar projects, or they might be customers of similar products.

Project Planning and Scheduling

Project Planning

- Input/Data
  - Contract
  - Stakeholders' Input
  - Constructibility Analysis
- Considerations/Constraints
- Resources
  - Human
  - Equipment
  - Capital
- Value Engineering
  - Optimize Cost
  - Optimize Schedule
  - Optimize Quality
- Stakeholders
  - Owner
  - Suppliers
  - Contractors
  - Public Agencies
  - Designers
  - Public Groups

- Project Variables
  - Physical Environment
  - Contractor Methods
  - Funding
  - Labor Agreements
  - Delivery Methods
- Output/Deliverables
  - Work Breakdown Structure
  - Schedule Scope of Work
  - Define Project Goals
  - Periodic Forecasts
  - Baseline Plan
  - Recovery Plans

Project Scheduling 1/2

- Input/Data
  - Schedule Scope of Work
  - Work Breakdown Structure
  - Scheduling Specifications
  - Stakeholders Feedback
  - Cost Estimate
- Creating Schedule
- Activities Definition
  - Durations
  - WBS
  - Calendar
  - Coding
- Creating Relationships
  - Type of Logic Tie
  - Lead/Lag Time
  - Recordkeeping
  - Constraints
- Quality Analysis
  - Compliance
  - Open Ends
  - Relationships
  - Recourse Flow
  - Means & Methods
- Cost/Resources-Loading
  - Resource Flow
  - Cash Flow

Project Scheduling 2/2

- Maintaining a Schedule
  - Tracking Progress
  - Logic Changes
  - Record Input
  - Actual Dates
  - Create period
- Change Management
  - Include Changes
  - Identify Changes
  - Track Change Work
- Schedule Acceleration
  - Change Methods
  - Change Logic
  - Change Durations
  - Add Resources
- Seeking Feedback
  - Project Review
  - Client
  - Management
  - Site Staff
- Cost/Resource
  - Resource Leveling
  - Earned Value
- Output/Deliverables
  - Control-Level Schedules
  - Progress Reports
  - Critical Path Analysis
  - Constructibility Analysis
  - Forecasts
  - Recovery Schedules
  - Management Summary

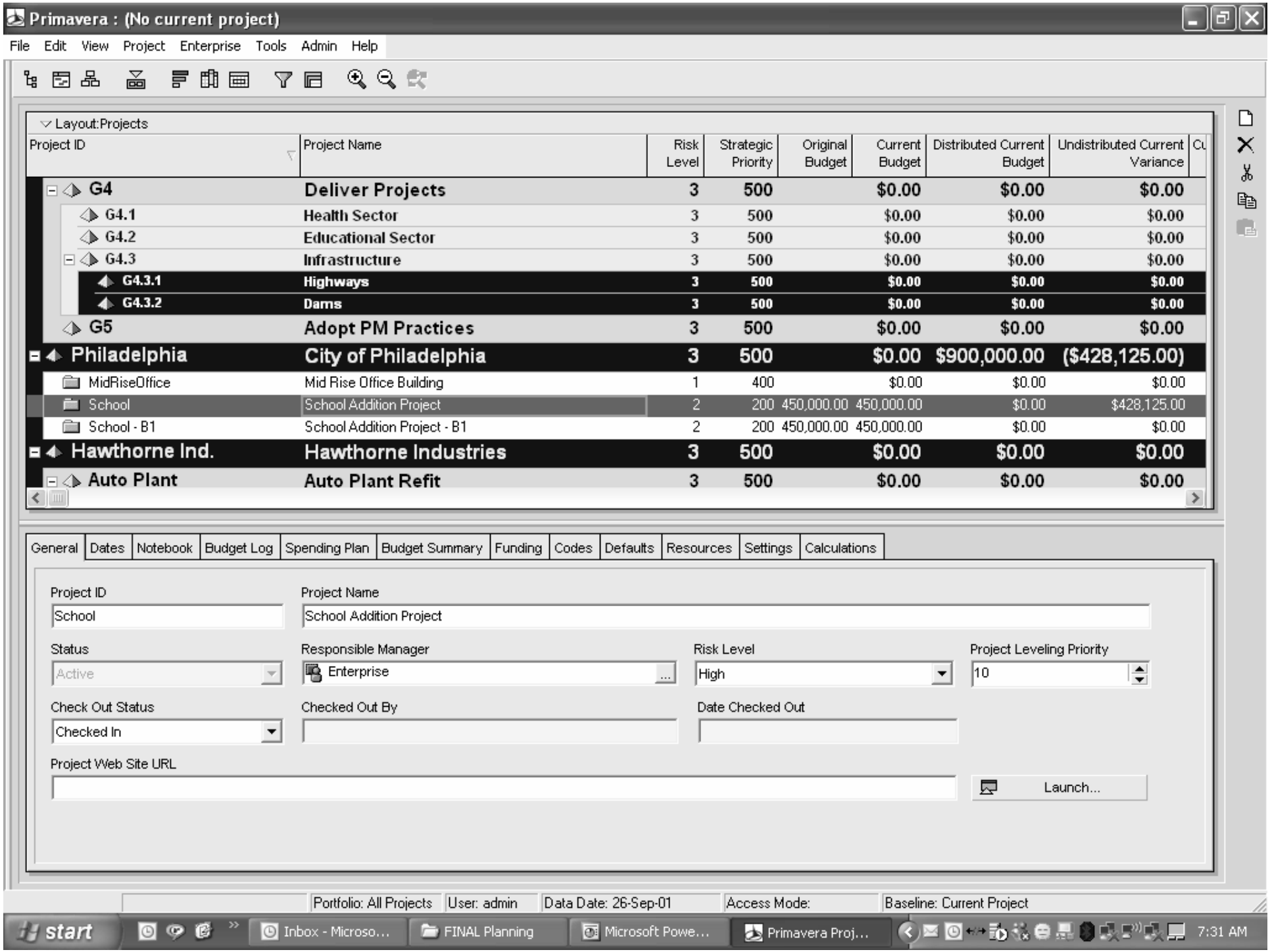
Develop The Baseline Plan

1. Initiating A Project

- Only when a project is authorized by senior management, planning can proceed.
- Initiating a project will detail the project objectives, key assumptions and constraints, key milestones, budget, high-level risks, and other important details.

Defining A Project

- Project ID
- Project Title
- Project Description
- Project Planned Start Date
- Project Planned Finish Date
- Project Planned Duration
- Project Budget
- Project Manager
- Project Risk Level
- Project Leveling Priority
- Funding Sources
- Project Codes
- Project Objectives
- Project Assumptions and Constraints
- Project Performance Measures
- Others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Project Name
Risk Level
Strategic Priority
Original Budget
Current Budget
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Undistributed Current Variance
G4 Deliver Projects 3 500 $0.00 $0.00 $0.00
G4.1 Health Sector 3 500 $0.00 $0.00 $0.00
G4.2 Educational Sector 3 500 $0.00 $0.00 $0.00
G4.3 Infrastructure 3 500 $0.00 $0.00 $0.00
G4.3.1 Highways 3 500 $0.00 $0.00 $0.00
G4.3.2 Dams 3 500 $0.00 $0.00 $0.00
G5 Adopt PM Practices 3 500 $0.00 $0.00 $0.00
Philadelphia City of Philadelphia 3 500 $0.00 $900,000.00 ($428,125.00)
MidRiseOffice Mid Rise Office Building 1 400 $0.00 $0.00 $0.00
School School Addition Project 2 200 450,000.00 450,000.00 $0.00 $428,125.00
School - B1 School Addition Project - B1 2 200 450,000.00 450,000.00 $0.00 $0.00
Hawthorne Ind. Hawthorne Industries 3 500 $0.00 $0.00 $0.00
Auto Plant Auto Plant Refit 3 500 $0.00 $0.00 $0.00
General Dates Notebook Budget Log Spending Plan Budget Summary Funding Codes Defaults Resources Settings Calculations
Project ID
School
Project Name
School Addition Project
Status
Active
Responsible Manager
Enterprise
Risk Level
High
Project Leveling Priority
10
Check Out Status
Checked In
Checked Out By
Date Checked Out
Project Web Site URL
Launch...
Portfolio: All Projects
User: admin
Data Date: 26-Sep-01
Access Mode:
Baseline: Current Project
start
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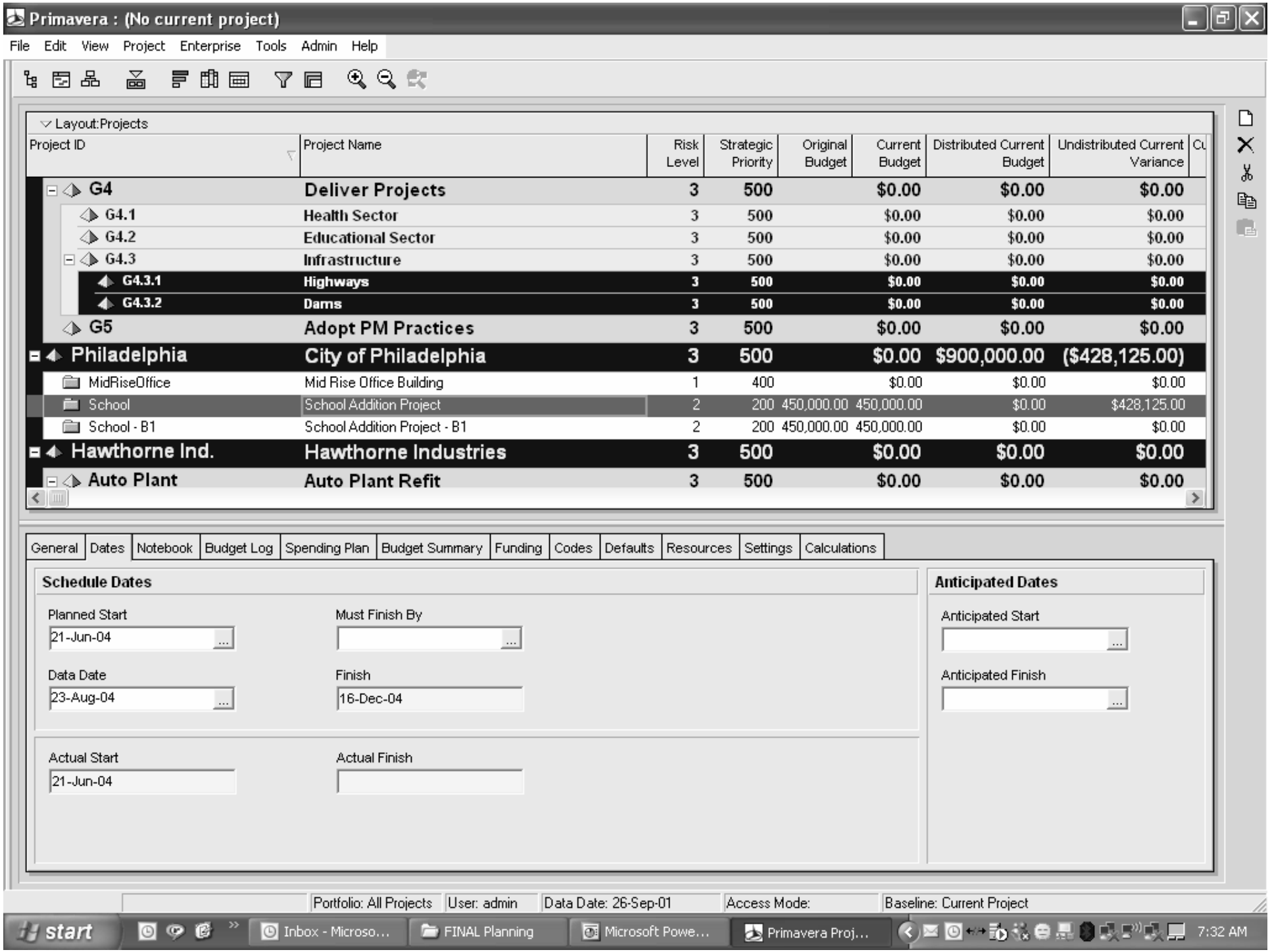
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G4.3.1 Highways 3 500 $0.00 $0.00 $0.00
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Hawthorne Ind. Hawthorne Industries 3 500 $0.00 $0.00 $0.00
Auto Plant Auto Plant Refit 3 500 $0.00 $0.00 $0.00
General Dates Notebook Budget Log Spending Plan Budget Summary Funding Codes Defaults Resources Settings Calculations
Schedule Dates
Planned Start 21-Jun-04
Must Finish By
Data Date 23-Aug-04
Finish 16-Dec-04
Actual Start 21-Jun-04
Actual Finish
Anticipated Dates
Anticipated Start
Anticipated Finish
Portfolio: All Projects
User: admin
Data Date: 26-Sep-01
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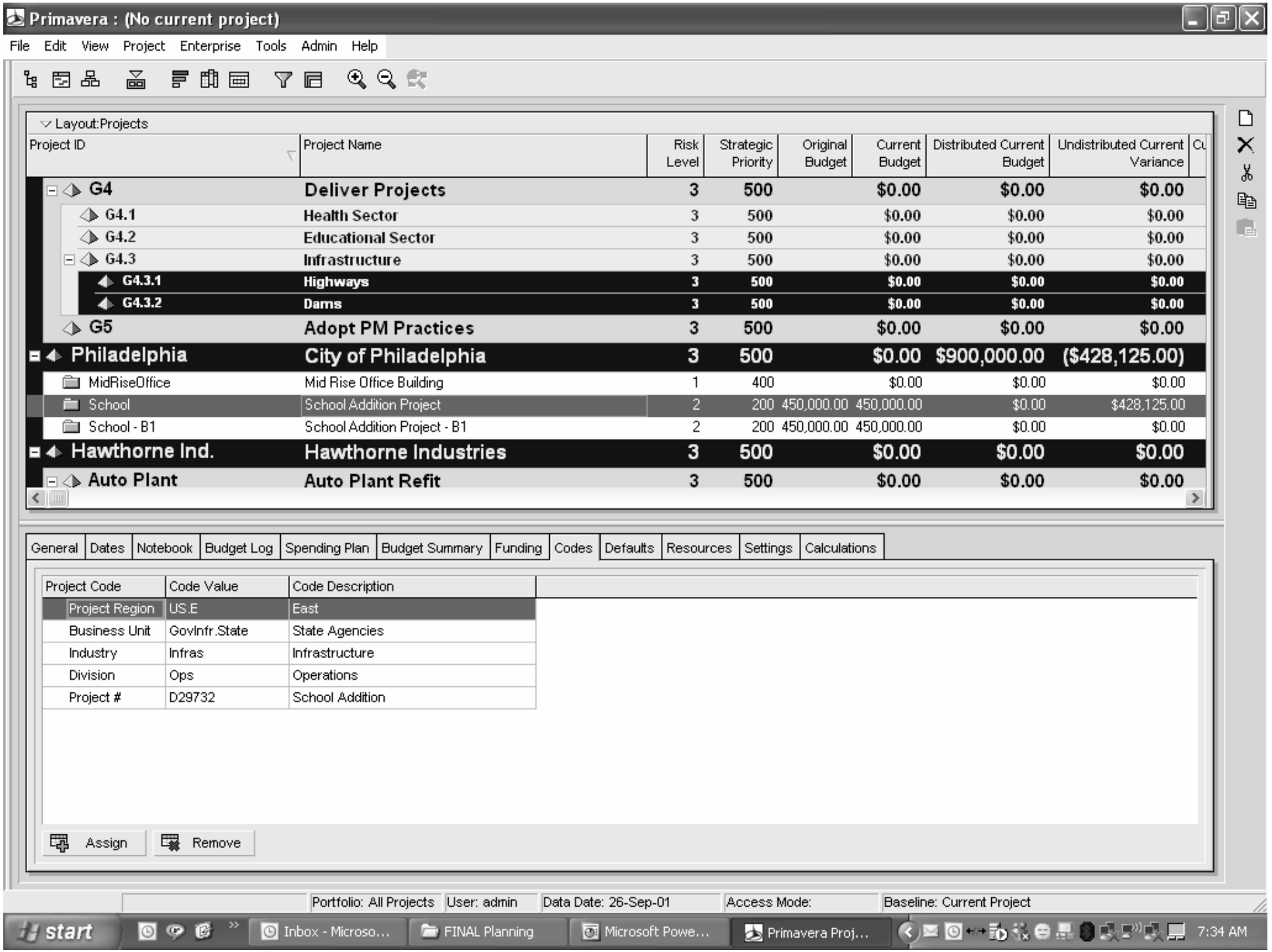
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Project Name
Risk Level
Strategic Priority
Original Budget
Current Budget
Distributed Current Budget
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G4.1 Health Sector 3 500 $0.00 $0.00 $0.00
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Hawthorne Ind. Hawthorne Industries 3 500 $0.00 $0.00 $0.00
Auto Plant Auto Plant Refit 3 500 $0.00 $0.00 $0.00
General Dates Notebook Budget Log Spending Plan Budget Summary Funding Codes Defaults Resources Settings Calculations
Project Code
Code Value
Code Description
Project Region US.E East
Business Unit GovInfr.State State Agencies
Industry Infras Infrastructure
Division Ops Operations
Project # D29732 School Addition
Assign
Remove
Portfolio: All Projects
User: admin
Data Date: 26-Sep-01
Access Mode:
Baseline: Current Project
start
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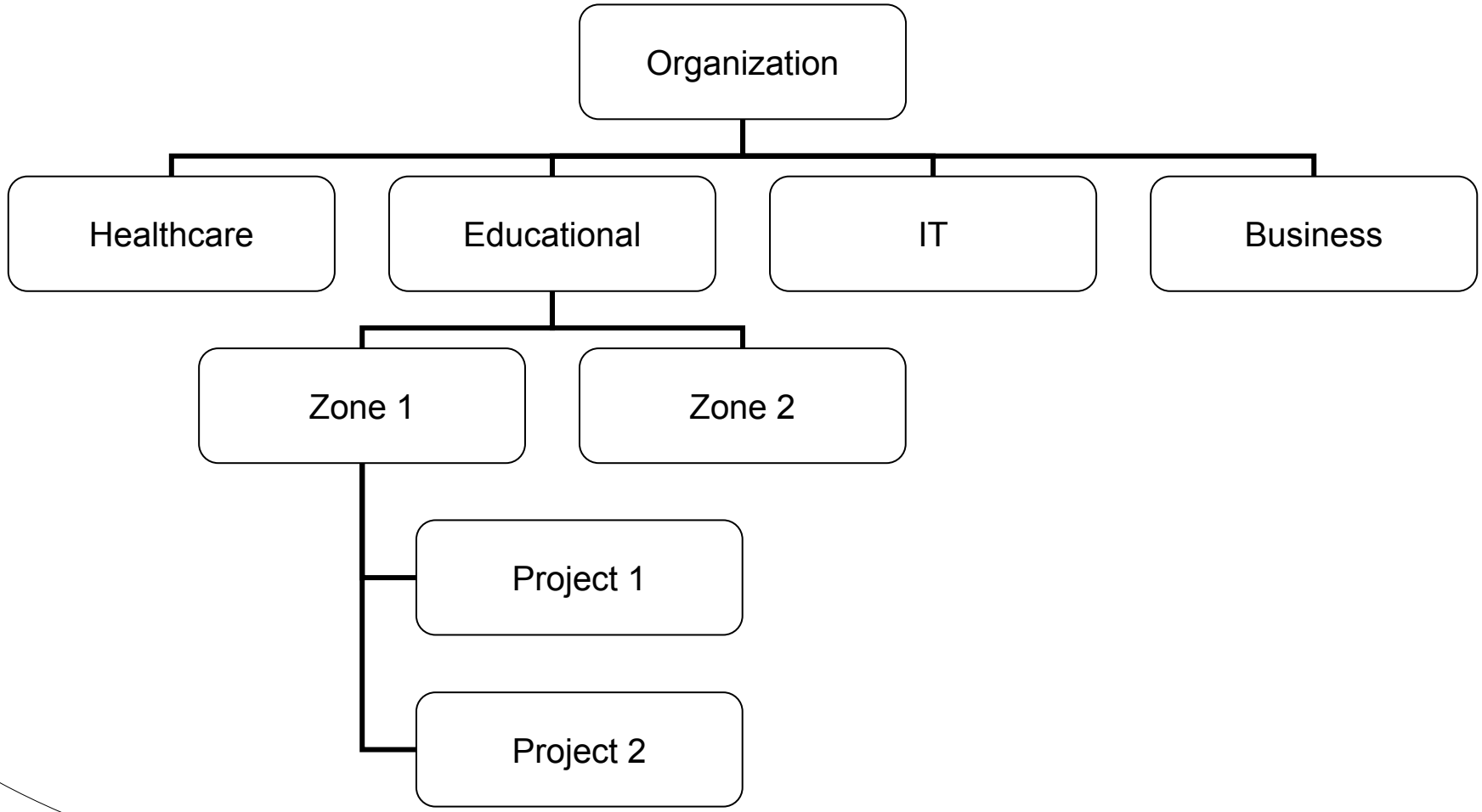
Is The Project Part Of A Program?

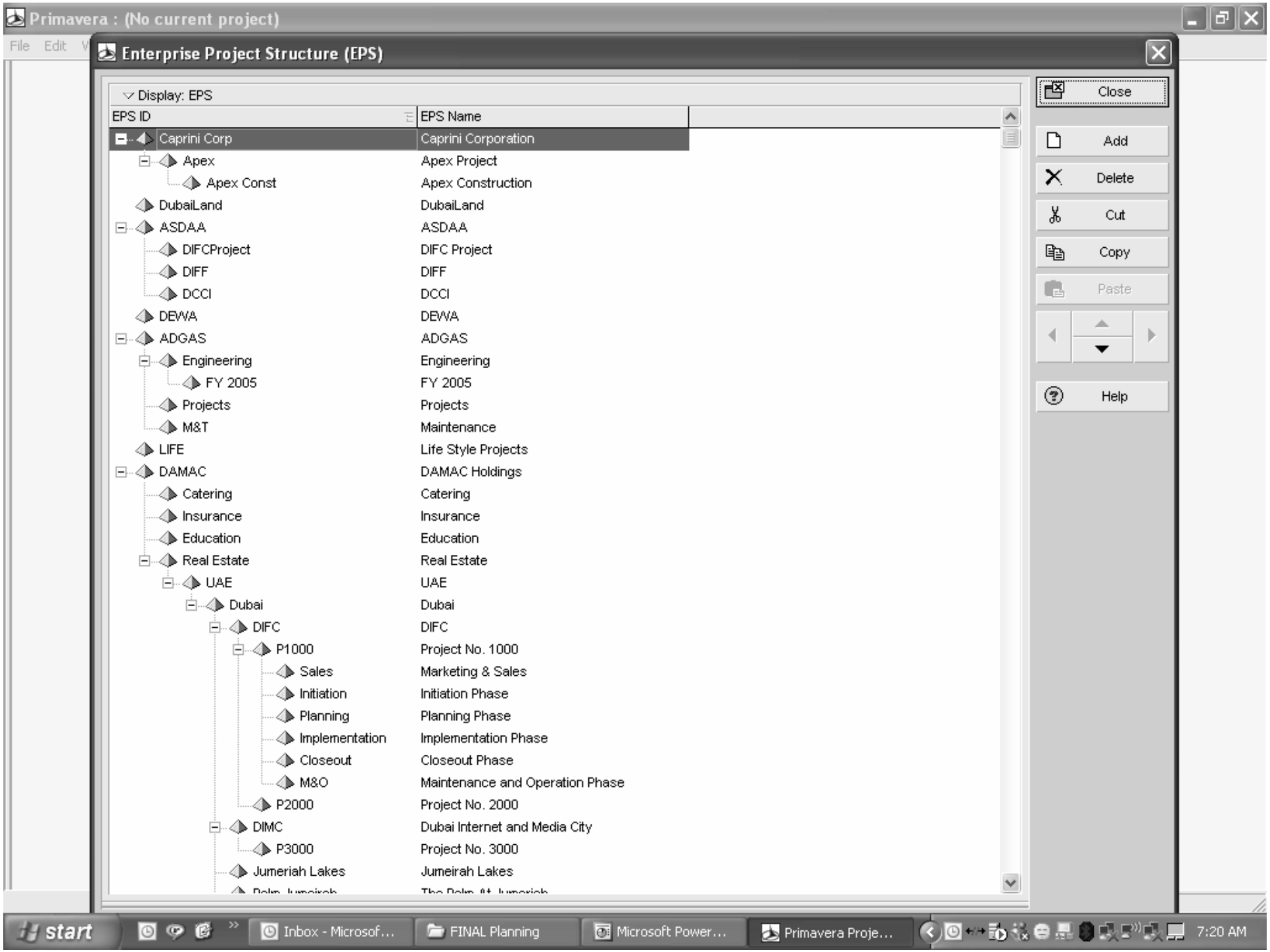
- Sometimes, the project might be part of a program with dependencies and interfaces with other projects.
- This need to defined as it will place constraints on the way the project plan will be created.

Is The Project Part Of A Program?



Enterprise Project Structure (EPS)

- The Enterprise Project Structure (EPS) will provide a hierarchical structure for breaking down programs into projects and showing how projects fit with each other.
- Similarly, it is used to show what programs and projects exist within an organization.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Enterprise Project Structure (EPS)
Display: EPS
EPS ID
EPS Name
Caprini Corp
Caprini Corporation
Apex
Apex Project
Apex Const
Apex Construction
DubaiLand
DubaiLand
ASDAA
ASDAA
DIFCProject
DIFC Project
DIFF
DIFF
DCCI
DCCI
DEWA
DEWA
ADGAS
ADGAS
Engineering
Engineering
FY 2005
FY 2005
Projects
Projects
M&T
Maintenance
LIFE
Life Style Projects
DAMAC
DAMAC Holdings
Catering
Catering
Insurance
Insurance
Education
Education
Real Estate
Real Estate
UAE
UAE
Dubai
Dubai
DIFC
DIFC
P1000
Project No. 1000
Sales
Marketing & Sales
Initiation
Initiation Phase
Planning
Planning Phase
Implementation
Implementation Phase
Closeout
Closeout Phase
M&O
Maintenance and Operation Phase
P2000
Project No. 2000
DIMC
Dubai Internet and Media City
P3000
Project No. 3000
Jumeriah Lakes
Jumeirah Lakes
Close
Add
Delete
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Paste
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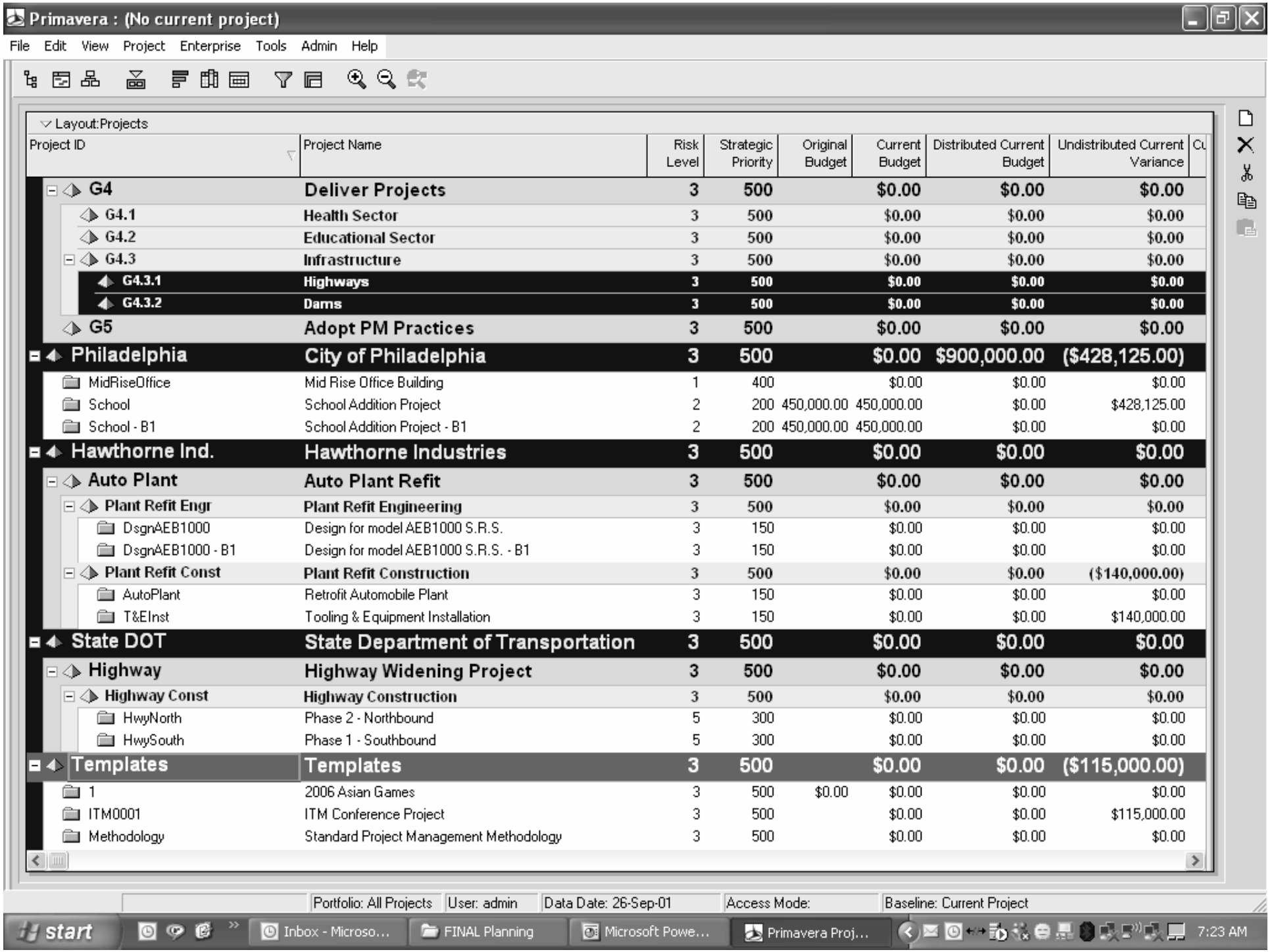
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File Edit View Project Enterprise Tools Admin Help
Layout:Projects
Project ID | Project Name | Risk Level | Strategic Priority | Original Budget | Current Budget | Distributed Current Budget | Undistributed Current Variance | Cu
G4 | Deliver Projects | 3 | 500 | | $0.00 | $0.00 | $0.00
G4.1 | Health Sector | 3 | 500 | | $0.00 | $0.00 | $0.00
G4.2 | Educational Sector | 3 | 500 | | $0.00 | $0.00 | $0.00
G4.3 | Infrastructure | 3 | 500 | | $0.00 | $0.00 | $0.00
G4.3.1 | Highways | 3 | 500 | | $0.00 | $0.00 | $0.00
G4.3.2 | Dams | 3 | 500 | | $0.00 | $0.00 | $0.00
G5 | Adopt PM Practices | 3 | 500 | | $0.00 | $0.00 | $0.00
Philadelphia | City of Philadelphia | 3 | 500 | | $0.00 | $900,000.00 | ($428,125.00)
MidRiseOffice | Mid Rise Office Building | 1 | 400 | | $0.00 | $0.00 | $0.00
School | School Addition Project | 2 | 200 | 450,000.00 | 450,000.00 | $0.00 | $428,125.00
School - B1 | School Addition Project - B1 | 2 | 200 | 450,000.00 | 450,000.00 | $0.00 | $0.00
Hawthorne Ind. | Hawthorne Industries | 3 | 500 | | $0.00 | $0.00 | $0.00
Auto Plant | Auto Plant Refit | 3 | 500 | | $0.00 | $0.00 | $0.00
Plant Refit Engr | Plant Refit Engineering | 3 | 500 | | $0.00 | $0.00 | $0.00
DsgnAEB1000 | Design for model AEB1000 S.R.S. | 3 | 150 | | $0.00 | $0.00 | $0.00
DsgnAEB1000 - B1 | Design for model AEB1000 S.R.S. - B1 | 3 | 150 | | $0.00 | $0.00 | $0.00
Plant Refit Const | Plant Refit Construction | 3 | 500 | | $0.00 | $0.00 | ($140,000.00)
AutoPlant | Retrofit Automobile Plant | 3 | 150 | | $0.00 | $0.00 | $0.00
T&EInst | Tooling & Equipment Installation | 3 | 150 | | $0.00 | $0.00 | $140,000.00
State DOT | State Department of Transportation | 3 | 500 | | $0.00 | $0.00 | $0.00
Highway | Highway Widening Project | 3 | 500 | | $0.00 | $0.00 | $0.00
Highway Const | Highway Construction | 3 | 500 | | $0.00 | $0.00 | $0.00
HwyNorth | Phase 2 - Northbound | 5 | 300 | | $0.00 | $0.00 | $0.00
HwySouth | Phase 1 - Southbound | 5 | 300 | | $0.00 | $0.00 | $0.00
Templates | Templates | 3 | 500 | | $0.00 | $0.00 | ($115,000.00)
1 | 2006 Asian Games | 3 | 500 | $0.00 | $0.00 | $0.00 | $0.00
ITM0001 | ITM Conference Project | 3 | 500 | | $0.00 | $0.00 | $115,000.00
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Portfolio: All Projects
User: admin
Data Date: 26-Sep-01
Access Mode:
Baseline: Current Project
start
Inbox - Microso...
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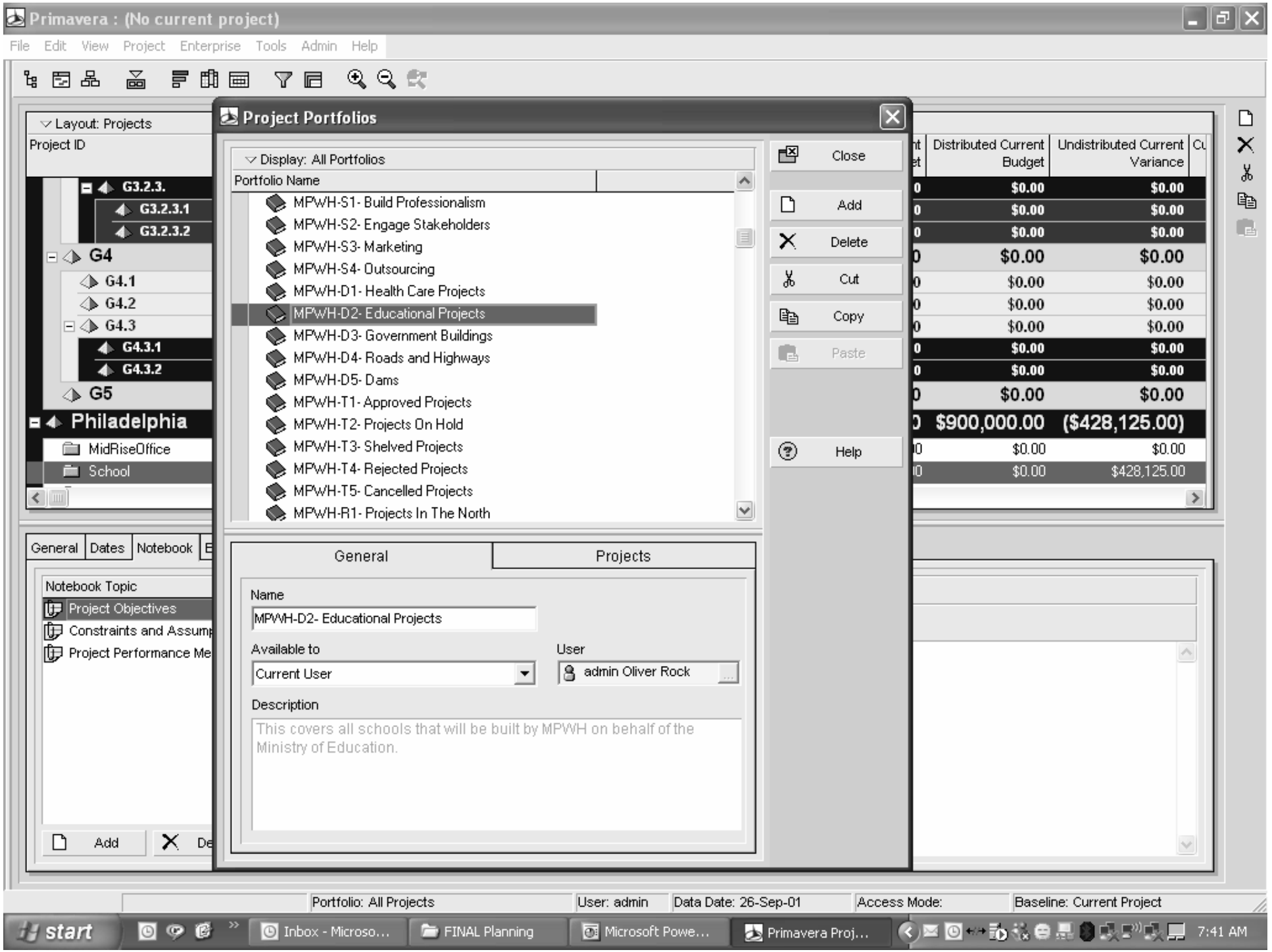
To Which Portfolio Does This Project Belongs?

- Projects and Programs can be part of one or many portfolios. Accordingly, the project need to assigned to those portfolios.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Project Portfolios
Display: All Portfolios
Portfolio Name
MPWH-S1- Build Professionalism
MPWH-S2- Engage Stakeholders
MPWH-S3- Marketing
MPWH-S4- Outsourcing
MPWH-D1- Health Care Projects
MPWH-D2- Educational Projects
MPWH-D3- Government Buildings
MPWH-D4- Roads and Highways
MPWH-D5- Dams
MPWH-T1- Approved Projects
MPWH-T2- Projects On Hold
MPWH-T3- Shelved Projects
MPWH-T4- Rejected Projects
MPWH-T5- Cancelled Projects
MPWH-R1- Projects In The North
Close
Add
Delete
Cut
Copy
Paste
Help
General
Projects
Name
MPWH-D2- Educational Projects
Available to
Current User
User
admin Oliver Rock
Description
This covers all schools that will be built by MPWH on behalf of the Ministry of Education.
Layout: Projects
Project ID
G3.2.3.
G3.2.3.1
G3.2.3.2
G4
G4.1
G4.2
G4.3
G4.3.1
G4.3.2
G5
Philadelphia
MidRiseOffice
School
Distributed Current Budget
Undistributed Current Variance
$0.00
$900,000.00
($428,125.00)
$428,125.00
General
Dates
Notebook
Notebook Topic
Project Objectives
Constraints and Assump
Project Performance Me
Add
Portfolio: All Projects
User: admin
Data Date: 26-Sep-01
Access Mode:
Baseline: Current Project
start
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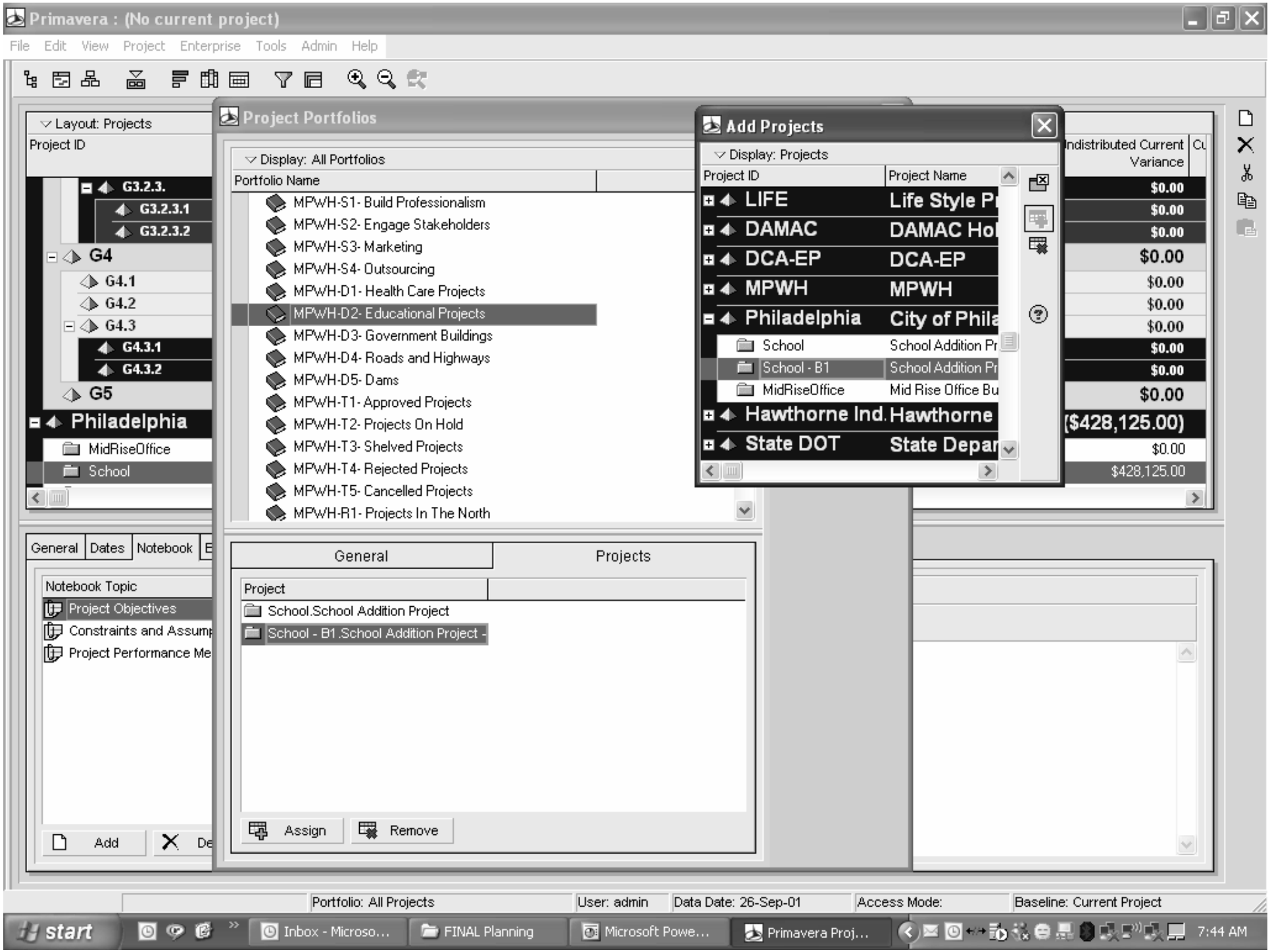
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Layout: Projects
Project ID
G3.2.3.
G3.2.3.1
G3.2.3.2
G4
G4.1
G4.2
G4.3
G4.3.1
G4.3.2
G5
Philadelphia
MidRiseOffice
School
Project Portfolios
Display: All Portfolios
Portfolio Name
MPWH-S1- Build Professionalism
MPWH-S2- Engage Stakeholders
MPWH-S3- Marketing
MPWH-S4- Outsourcing
MPWH-D1- Health Care Projects
MPWH-D2- Educational Projects
MPWH-D3- Government Buildings
MPWH-D4- Roads and Highways
MPWH-D5- Dams
MPWH-T1- Approved Projects
MPWH-T2- Projects On Hold
MPWH-T3- Shelved Projects
MPWH-T4- Rejected Projects
MPWH-T5- Cancelled Projects
MPWH-R1- Projects In The North
Add Projects
Display: Projects
Project ID
Project Name
LIFE
Life Style Pr
DAMAC
DAMAC Hol
DCA-EP
DCA-EP
MPWH
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Philadelphia
City of Phila
School
School Addition Pr
School - B1
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Remove
Portfolio: All Projects
User: admin
Data Date: 26-Sep-01
Access Mode:
Baseline: Current Project
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2. Decompose The Project Scope

- Subdividing the major project deliverables and project work into smaller, more manageable components, also known as scope decomposition.

Translating Project Requirements

- List all deliverables
- Use an experienced team to help decompose and refine each of the task requirement
- Develop WBS
- Identify risks
- Develop strategies for completing the project

Planning Requirements In Contract Documents

- Each project has requirements for Planning and Schedule reporting. The level of Planning and Schedule reporting could widely vary depending on the client requirements.

Specification Sections Relevant To Planning[1]

- Section 01310. Project Management and Coordination
  - Project schedule: Baseline, Updates and Revised
  - Project schedule reports
  - Cost-Loaded Schedule
  - Schedule delays
  - Material and drawings submittal and approval
  - Material Procurement
  - Daily, Weekly and Monthly Progress reports
  - Project meetings
  - Project Planner/Scheduler
  - Construction Photographs
  - Accidents and other reports

[1] The Appendix include sample specifications from current projects in the region

What to Check?

- Milestones
- WBS Requirements
- Schedule Level of Detail
- Activity Durations
- Cost loaded schedule
- External Dependencies
- Owner Activities
- Approval Periods
- Reporting Requirements
- Time Extension Application
- Updating the schedule
- Baseline Schedule Submission
- Revised Schedule Submission
- Quality Control Forms
- Safety Checklists
- Document Workflow
- Staff requirements
- Software requirements
- Training Requirements
- Others

Sample Approval Periods

RFI's	7 Calendar Days
Material Submittals	14 Calendar Days
Method Statements	14 Calendar Days
Calculations	21 Calendar Days
Shop Drawings	21 Calendar Days
Specifications	21 Calendar Days
Schedules	28 Calendar Days

Deliverables and Objectives

- **Product Deliverables.** A list of features that the product or service will have. Delivering these features makes the project successful.
- **Project Objectives.** Quantifiable criteria (metrics) to meet for the project to be considered successful.

Deliverables

- A deliverable is any unique and verifiable product, result or capability to perform a service that is identified in the project management plan, and must be produced and provided to complete the project.

Requirements for Scope Decomposition

- The project scope shall be decomposed into a WBS
- The WBS shall include the entire scope of work for the project
- The scope of work elements shall be mutually exclusive

WBS
Meaning

- **Work.** Sustained physical or mental effort to overcome obstacles and achieve and objective or result; a specific activity, duty, function or assignment often being a part of some larger undertaking; something produced or accomplished by effort, exertion, or exercise or skill.
- **Breakdown.** To divide into parts or categories; to separate into simpler substances; to undergo decomposition.
- **Structure.** Something arranged in a definite pattern of organization.

WBS Characteristics

- It is a representative of work as an activity, and this work has a tangible result
- It is arranged in a hierarchical structure
- It has an objective or tangible result, which is referred to as a deliverable.

Benefits of WBS

- Helps prevent work from slipping through the cracks.
- Provides the project team with an understanding of where their pieces fit into the overall project plan and gives them an indication of the impact of their work on the project as a whole.
- Facilitates communications and cooperation between and among the project team and stakeholders.
- Helps prevent changes.
- Gets team buy-in and builds the team.
- Provides the basis for estimating staff, cost and time.
- Focuses the team's experience on what needs to be done, resulting in higher quality and an easier project.

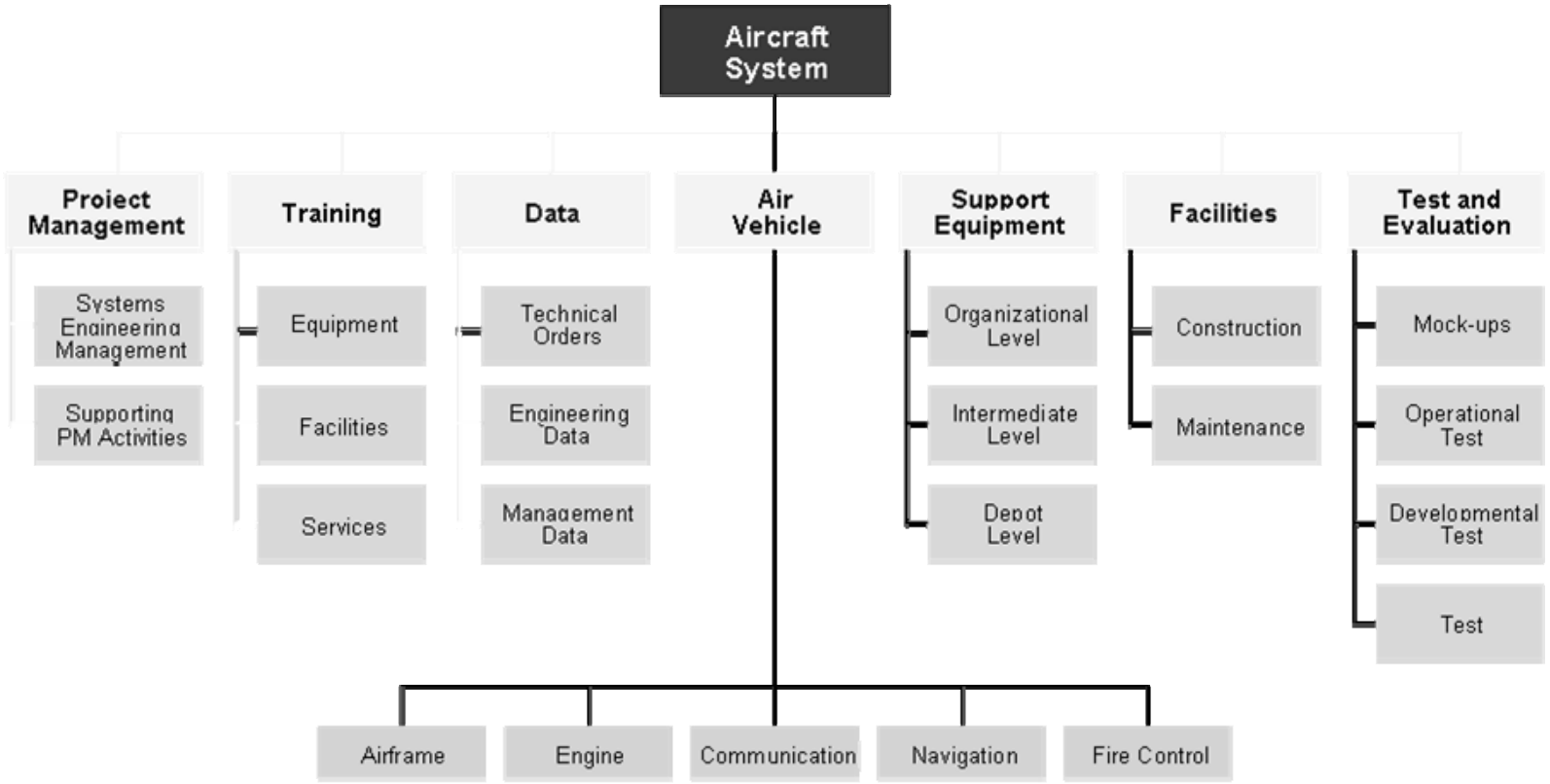
Developing A WBS

- Use any category that makes sense for the project
- Do not be constrained by sequence
- The diagram does not have to be symmetrical
- Each box is a summary of the boxes in levels below it
- Final box in each branch must end in a product or deliverable
- Boxes in the lowest level are called work packages.
- Sum total of boxes must represent the complete project.
- Project team should be involved in developing the WBS.
- The WBS needs to be reviewed with the Client.

Overlooked WBS Boxes

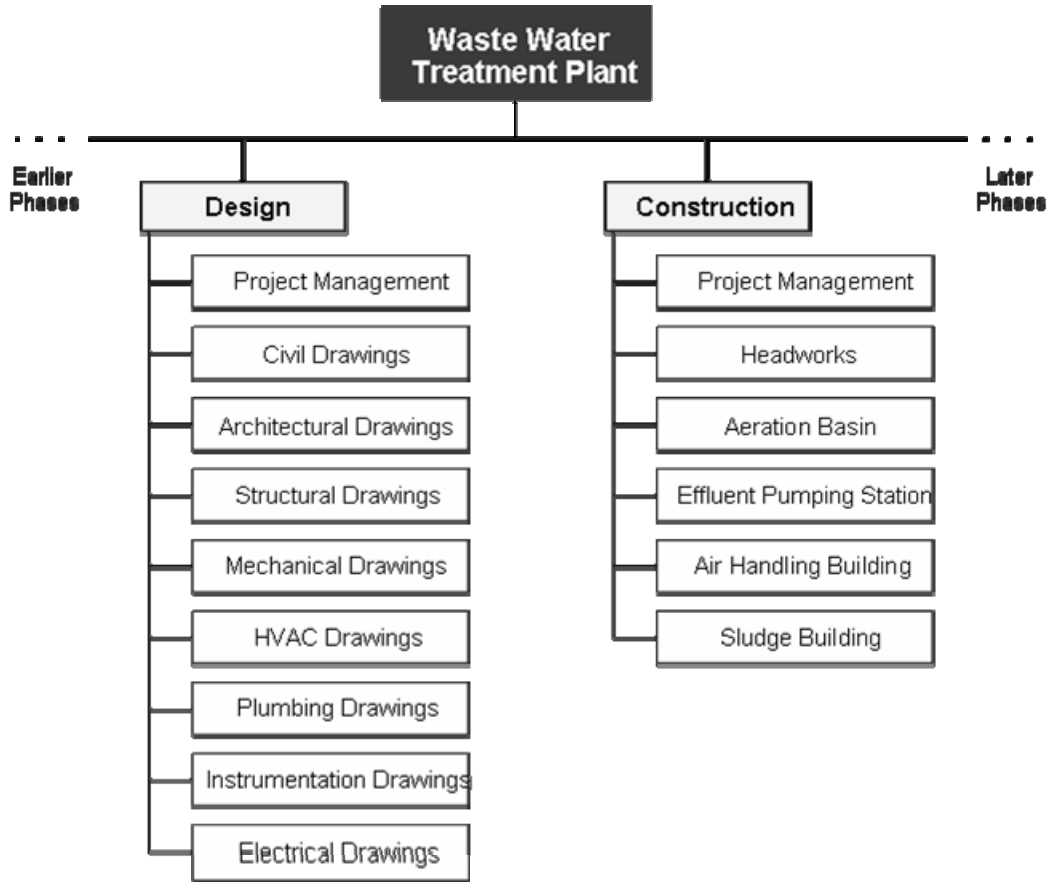
- Project management
- Documentation
  - As Built Documents
- Product implementation
  - Training and Operations
- End product evaluation
- Project closure

WBS By Product

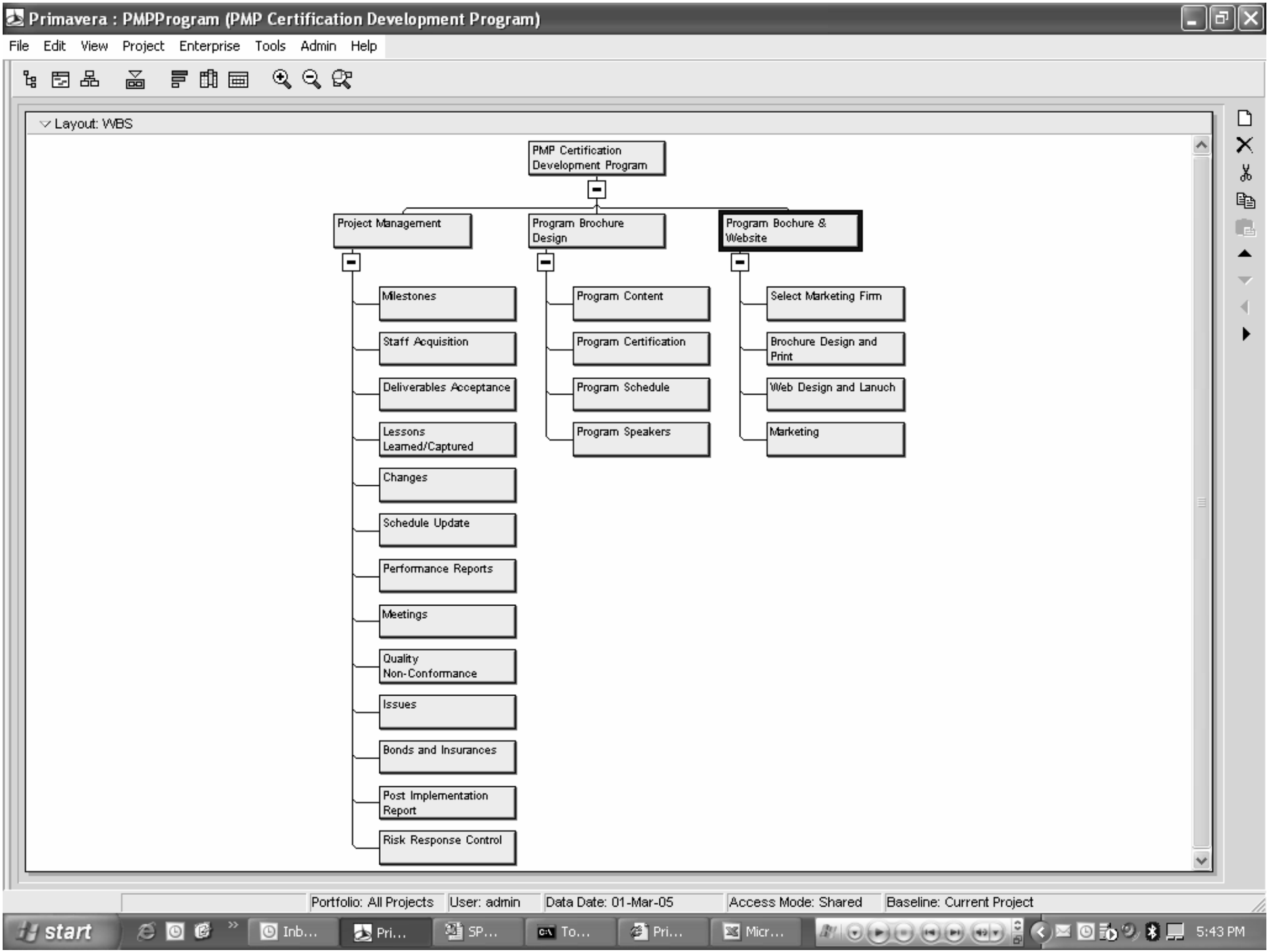


This WBS is illustrative only. It is not intended to represent the full project scope of any specific project, nor to imply that this is the only way to organize a WBS on this type of project.

WBS By Phase



This WBS is illustrative only. It is not intended to represent the full project scope of any specific project, nor to imply that this is the only way to organize a WBS on this type of project.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Layout: WBS
PMP Certification Development Program
Project Management
Program Brochure Design
Program Bochure & Website
Milestones
Staff Acquisition
Deliverables Acceptance
Lessons Learned/Captured
Changes
Schedule Update
Performance Reports
Meetings
Quality Non-Conformance
Issues
Bonds and Insurances
Post Implementation Report
Risk Response Control
Program Content
Program Certification
Program Schedule
Program Speakers
Select Marketing Firm
Brochure Design and Print
Web Design and Lanuch
Marketing
Portfolio: All Projects
User: admin
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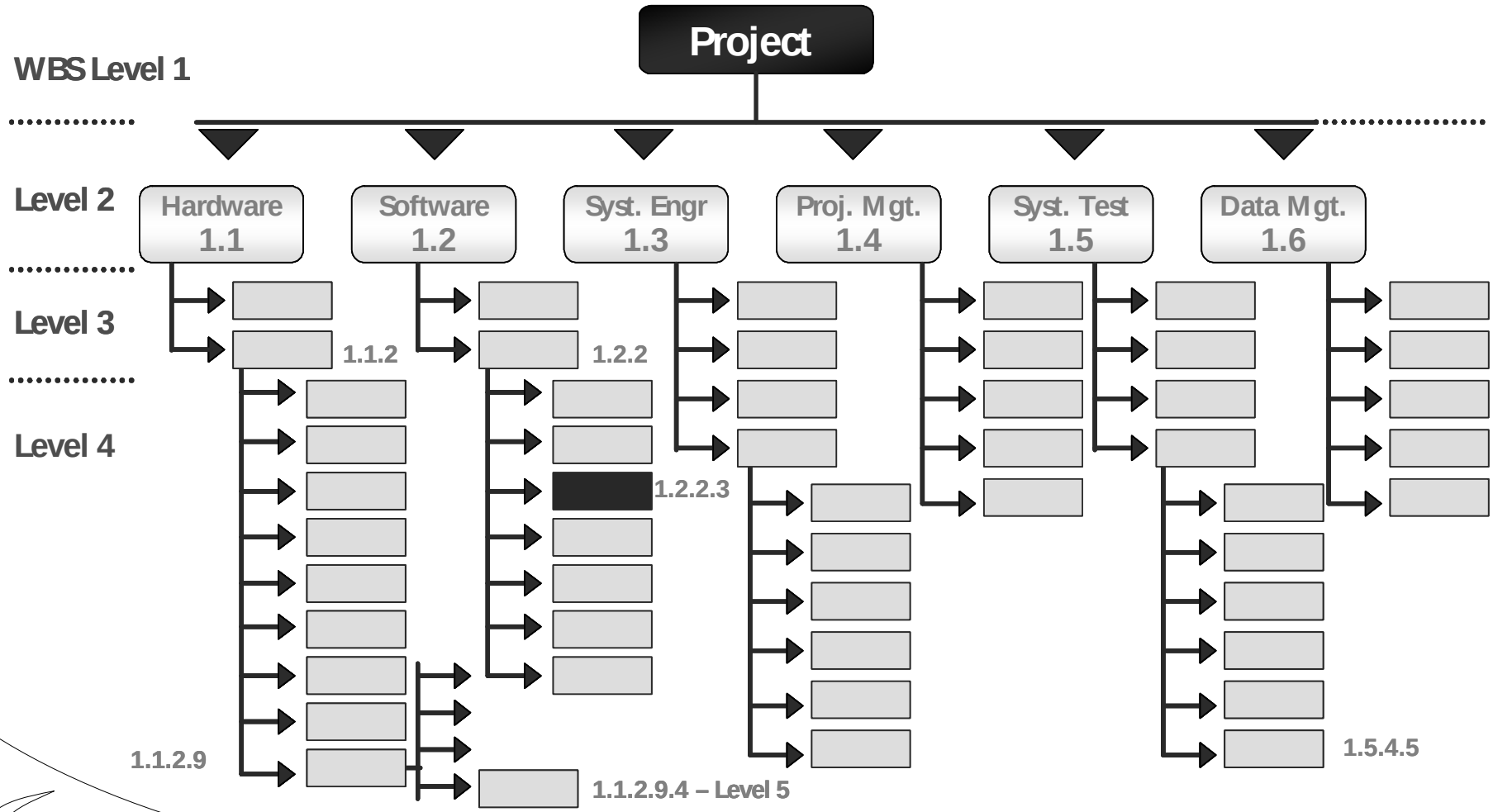
WBS Levels



The 100% Rule

- The next level decomposition of a WBS element (child level) must represent 100% of the work applicable to next higher (parent) element.

Should WBS Be Decomposed Further? 1/2

- Is there a need to improve the accuracy of the cost and duration estimates?
- Is more than one individual responsible for the work contents?
- Is there a need to know precisely the timing of activities internal to the work package?
- Is there a need to cost-out activities internal to the work package?
- Are there any dependencies between the internal activities and other work packages?
- Are there any significant time breaks in the execution of the work processes internal to the work elements?

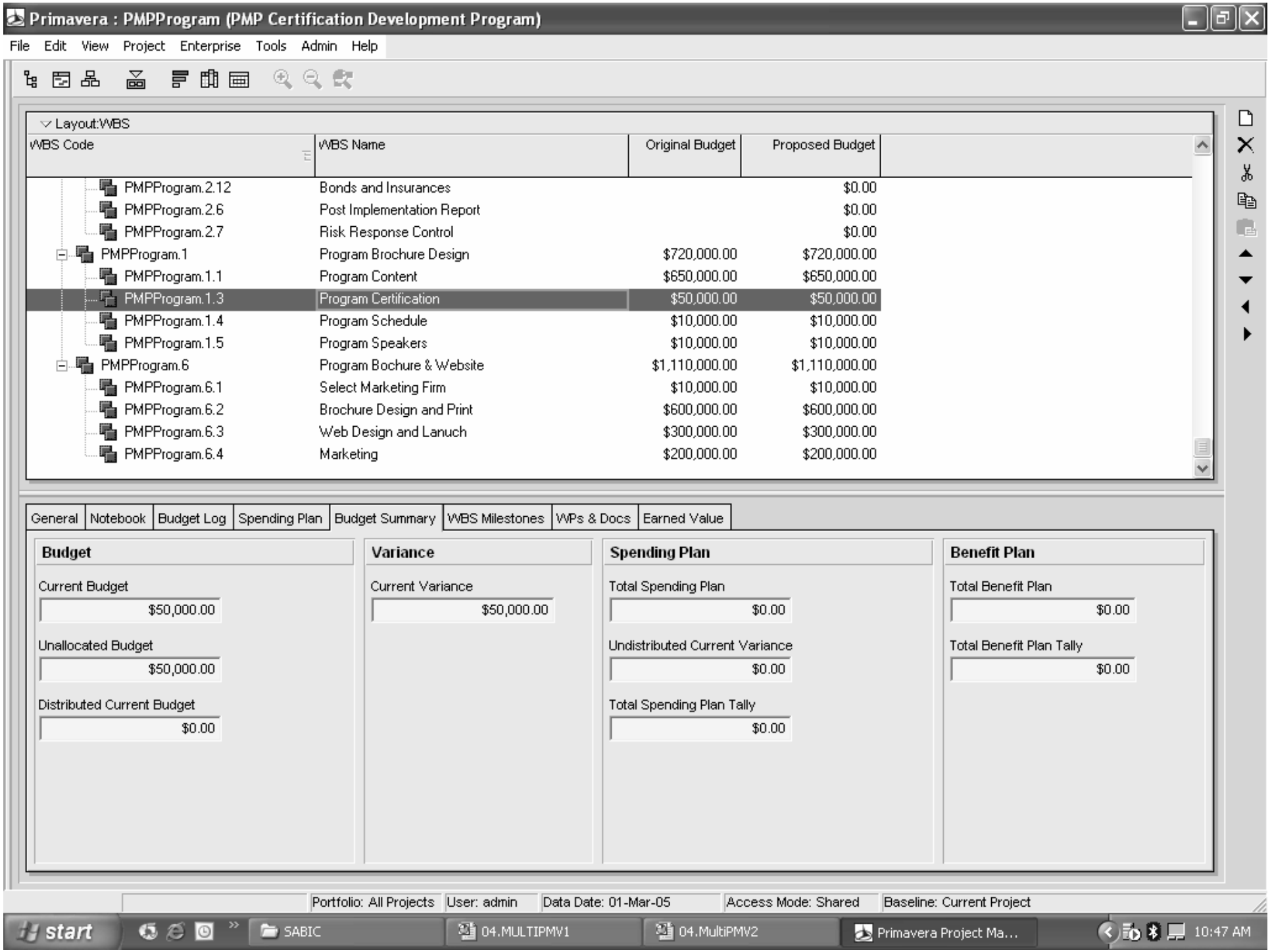
Should WBS Be Decomposed Further? 2/2

- Do resource requirements within the work package change over time?
- Do the prerequisites differ among the internal deliverables within the work element?
- Are there any acceptance criteria applicable before completion of the entire work package?
- Can a portion of the work to be performed within the work package be scheduled as a unit?
- Are there any specific risks that require focused attention to a portion of the work package, requiring further division to separate them?
- Is the work package understood clearly and completely to the satisfaction of the various stakeholders?

Source: T. Raz and S. Globerson, “Effective Sizing and Content Definition of Work Packages”, Project Management Journal, December 1998: 17-23

WBS Dictionary

- A document that describes each component in the work breakdown structure (WBS).
- A WBS dictionary is designed to control what work is done and when, to prevent scope creep and to increase understanding of the effort of each task.
- For each WBS component, the WBS dictionary includes a brief definition of the scope or statement of work, defined deliverable(s), a list of associated activities, and a list of milestones.
- Other information may include: responsible organization, start and end dates, resources required, an estimate of cost, charge number, contract information, quality requirements, and technical references to facilitate performance of the work.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WBS Name
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Proposed Budget
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PMPProgram.2.6 Post Implementation Report $0.00
PMPProgram.2.7 Risk Response Control $0.00
PMPProgram.1 Program Brochure Design $720,000.00 $720,000.00
PMPProgram.1.1 Program Content $650,000.00 $650,000.00
PMPProgram.1.3 Program Certification $50,000.00 $50,000.00
PMPProgram.1.4 Program Schedule $10,000.00 $10,000.00
PMPProgram.1.5 Program Speakers $10,000.00 $10,000.00
PMPProgram.6 Program Bochure & Website $1,110,000.00 $1,110,000.00
PMPProgram.6.1 Select Marketing Firm $10,000.00 $10,000.00
PMPProgram.6.2 Brochure Design and Print $600,000.00 $600,000.00
PMPProgram.6.3 Web Design and Lanuch $300,000.00 $300,000.00
PMPProgram.6.4 Marketing $200,000.00 $200,000.00
General Notebook Budget Log Spending Plan Budget Summary WBS Milestones WPs & Docs Earned Value
Budget
Current Budget $50,000.00
Unallocated Budget $50,000.00
Distributed Current Budget $0.00
Variance
Current Variance $50,000.00
Spending Plan
Total Spending Plan $0.00
Undistributed Current Variance $0.00
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Benefit Plan
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Total Benefit Plan Tally $0.00
Portfolio: All Projects
User: admin
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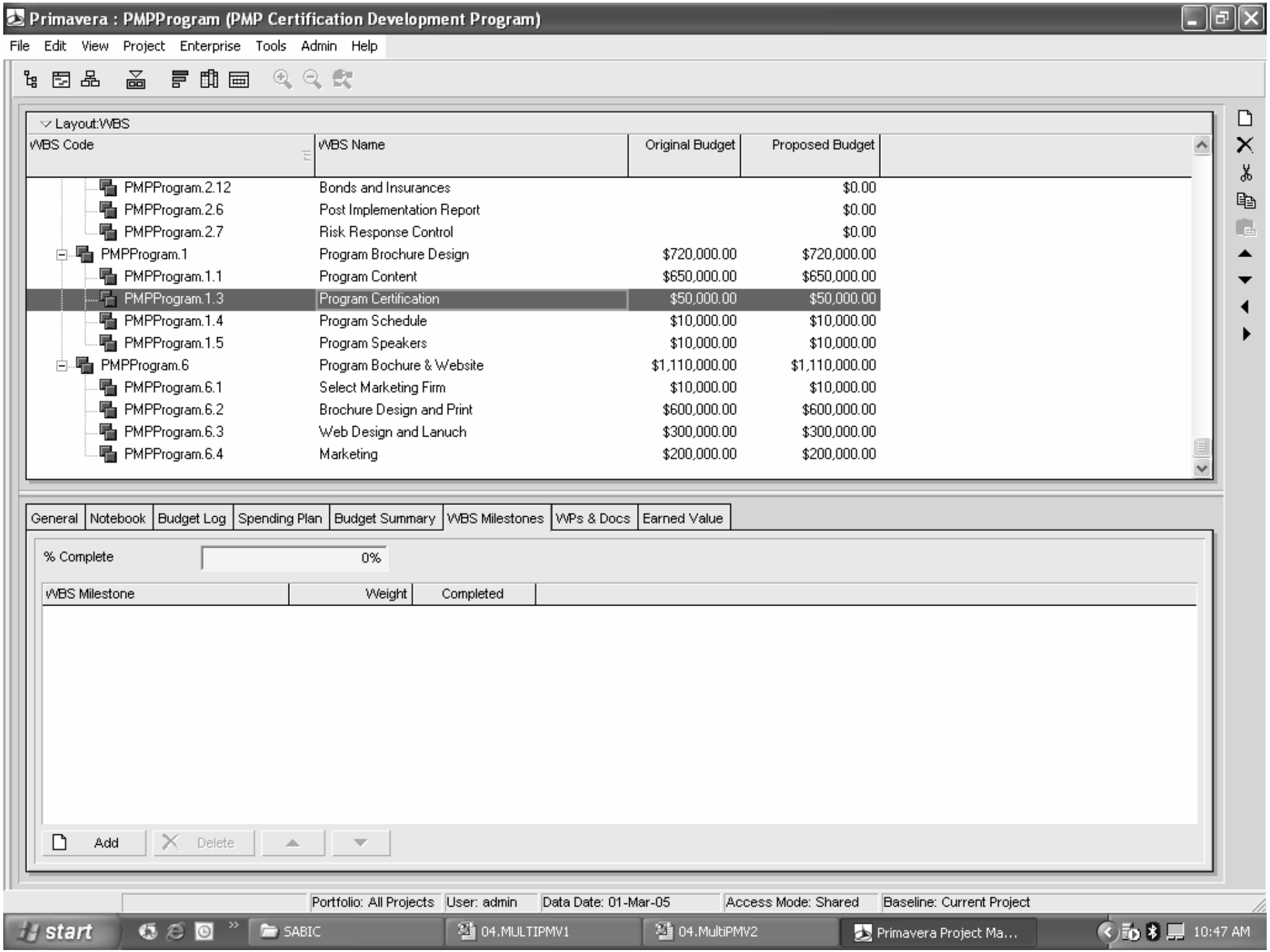
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PMPProgram.1 Program Brochure Design $720,000.00 $720,000.00
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PMPProgram.1.3 Program Certification $50,000.00 $50,000.00
PMPProgram.1.4 Program Schedule $10,000.00 $10,000.00
PMPProgram.1.5 Program Speakers $10,000.00 $10,000.00
PMPProgram.6 Program Bochure & Website $1,110,000.00 $1,110,000.00
PMPProgram.6.1 Select Marketing Firm $10,000.00 $10,000.00
PMPProgram.6.2 Brochure Design and Print $600,000.00 $600,000.00
PMPProgram.6.3 Web Design and Lanuch $300,000.00 $300,000.00
PMPProgram.6.4 Marketing $200,000.00 $200,000.00
General Notebook Budget Log Spending Plan Budget Summary WBS Milestones WPs & Docs Earned Value
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WBS Milestone
Weight
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Delete
Portfolio: All Projects
User: admin
Data Date: 01-Mar-05
Access Mode: Shared
Baseline: Current Project
start
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04.MULTIPMV1
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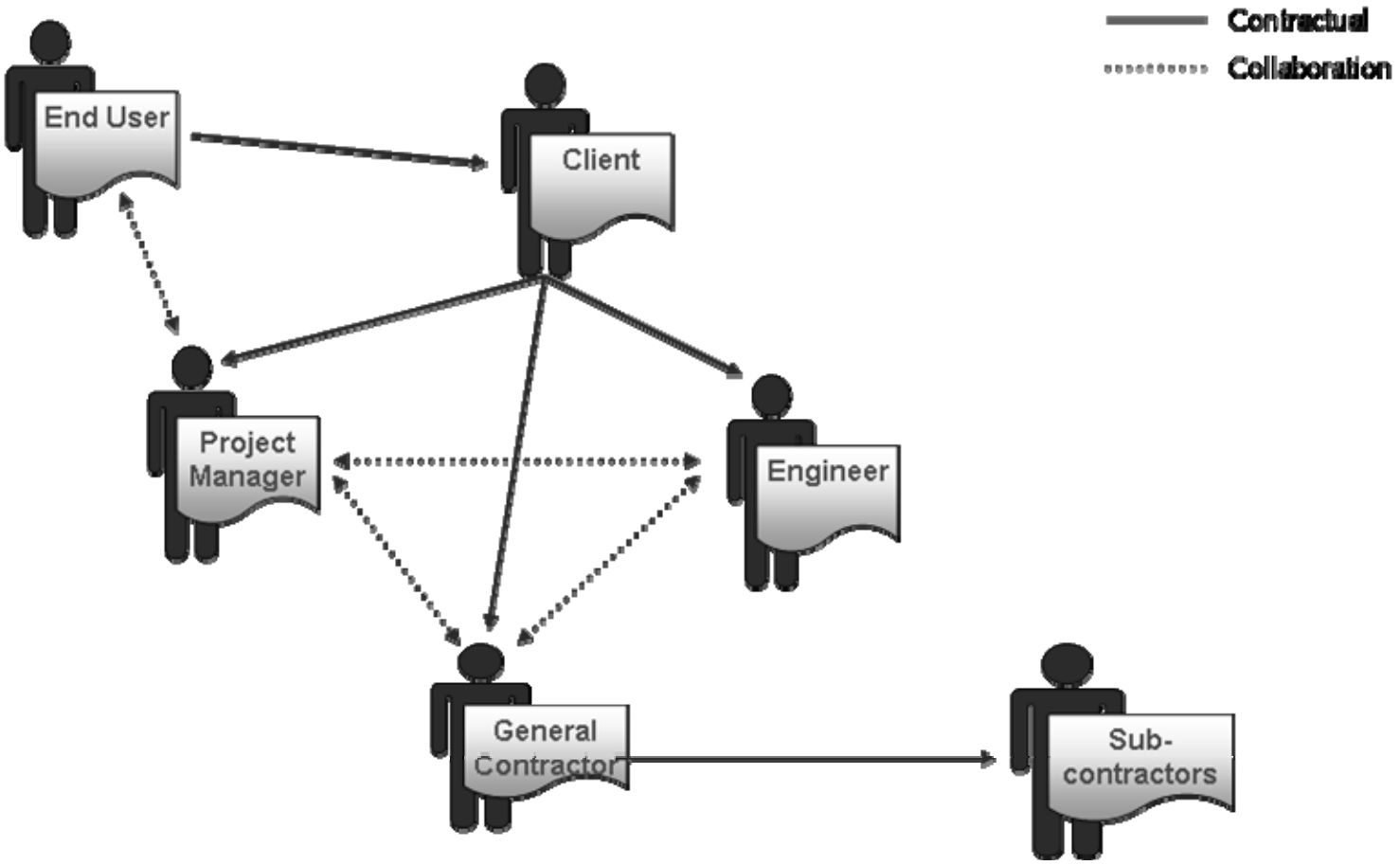
Stakeholder Analysis

- Stakeholder analysis identified the influence and interest of the various stakeholder and document their needs, wants and expectation.
- The analysis then selects, prioritized and quantifies the needs, wants and expectations to create requirements. Unquantifiable expectations, such as customer satisfaction, are subjective and entail a high risk of being successfully accomplished.
- Stakeholders interests may be positively or negatively affected by execution or completion of the project and they may also exert influence over the project its deliverables.

Stakeholders In Construction Project



Dynamics Of Stakeholders Needs

- A project's stakeholder needs do not remain static throughout the project and needs to be identified, re-assessed, tracked and managed appropriately throughout the project lifecycle.

Stakeholder Analysis

STAKEHOLDER ANALYSIS						
Name of Project New Premises			Made By Project Manager 4-Nov-04		Approved By Project Owner 30-Nov-04	
Stakeholder	Area Of Interest	Contributions	Expectations	Power	Strategy	Responsible
CEO	Finance, Outcome of Project	Decision on project scope	Increased revenue and better market position	Can stop project	Must be involved	Project Manager

Integrating WBS With Project Documents

- One of the key objectives of WBS is to define what is included in the project scope and what is excluded.
- Contract documents provide the source for contractually identifying the project scope.
- Accordingly, the WBS must be closely coordinated with the different project documentation to ensure integrity.

Document Categories

- Specifications
- Method Statements
- Drawings
- Contract Documents
- QA/QC Records
- Safety Records
- Material brochures
- Permits and approvals

Construction Contract Documents

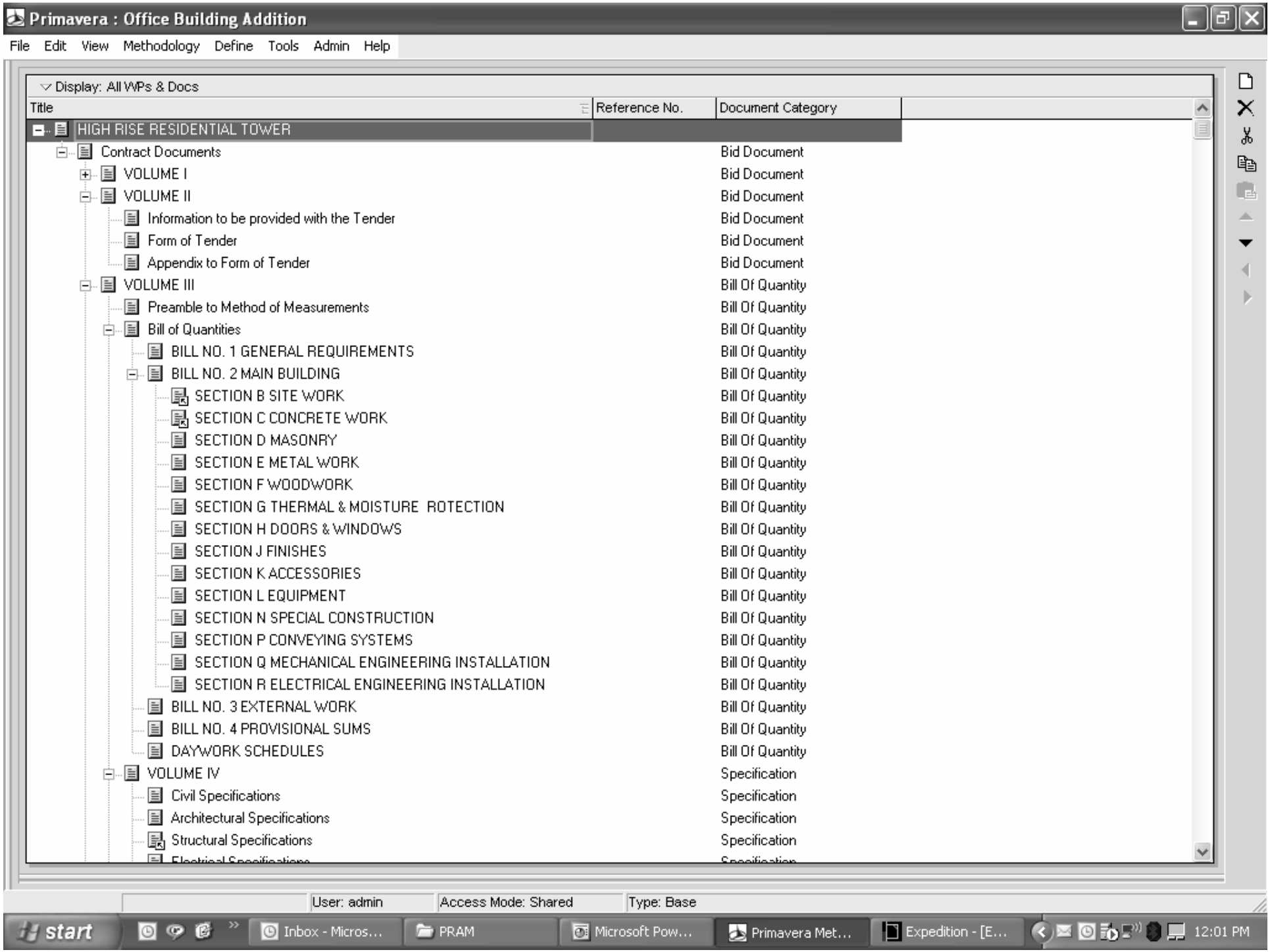
- Volume I
  - Instruction to Tenderers
  - Conditions of Contract
  - Form of Agreement
  - Model of Performance Bond
  - Preamble and List of Drawings
  - Soil Investigation Report
- Volume II
  - Information to be provided with the Tender
  - Form of Tender
  - Appendix to Form of Tender
- Volume III
  - Preamble to Method of Measurements
  - Bill of Quantities
- Volume IV
  - Architectural Specifications
  - Structural Specifications
  - Electrical Specifications
  - Mechanical Specifications
- Volume V
  - Architectural Drawings
  - Structural Drawings
  - Electrical Drawings
  - Mechanical Drawings

Sample Bill Of Quantity For A Construction Contract

- BILL NO. 1 GENERAL REQUIREMENTS
- BILL NO. 2 MAIN BUILDING
  - SECTION B – SITE WORK
  - SECTION C – CONCRETE WORK
  - SECTION D – MASONRY
  - SECTION E – METAL WORK
  - SECTION F – WOODWORK
  - SECTION G – THERMAL & MOISTURE ROTECTION
  - SECTION H – DOORS & WINDOWS
  - SECTION J – FINISHES
  - SECTION K – ACCESSORIES
  - SECTION L – EQUIPMENT SECTION N – SPECIAL CONSTRUCTION
  - SECTION P – CONVEYING SYSTEMS
  - SECTION Q – MECHANICAL ENGINEERING INSTALLATION
  - SECTION R – ELECTRICAL ENGINEERING INSTALLATION
- BILL NO. 3 EXTERNAL WORK
- BILL NO. 4 PROVISIONAL SUMS
- DAYWORK SCHEDULES

Document Breakdown Structure (DBS)

- The Document Breakdown Structure is used to identify all documents that are needed for the proper delivery of a project.
- It allows organizing those documents in a structured format that will ease accessing and reviewing the same.
- It will help in identifying missing documents and maintaining track of latest revisions.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Reference No.
Document Category
HIGH RISE RESIDENTIAL TOWER
Contract Documents
Bid Document
VOLUME I
Bid Document
VOLUME II
Bid Document
Information to be provided with the Tender
Bid Document
Form of Tender
Bid Document
Appendix to Form of Tender
Bid Document
VOLUME III
Bill Of Quantity
Preamble to Method of Measurements
Bill Of Quantity
Bill of Quantities
Bill Of Quantity
BILL NO. 1 GENERAL REQUIREMENTS
Bill Of Quantity
BILL NO. 2 MAIN BUILDING
Bill Of Quantity
SECTION B SITE WORK
Bill Of Quantity
SECTION C CONCRETE WORK
Bill Of Quantity
SECTION D MASONRY
Bill Of Quantity
SECTION E METAL WORK
Bill Of Quantity
SECTION F WOODWORK
Bill Of Quantity
SECTION G THERMAL & MOISTURE ROTECTION
Bill Of Quantity
SECTION H DOORS & WINDOWS
Bill Of Quantity
SECTION J FINISHES
Bill Of Quantity
SECTION K ACCESSORIES
Bill Of Quantity
SECTION L EQUIPMENT
Bill Of Quantity
SECTION N SPECIAL CONSTRUCTION
Bill Of Quantity
SECTION P CONVEYING SYSTEMS
Bill Of Quantity
SECTION Q MECHANICAL ENGINEERING INSTALLATION
Bill Of Quantity
SECTION R ELECTRICAL ENGINEERING INSTALLATION
Bill Of Quantity
BILL NO. 3 EXTERNAL WORK
Bill Of Quantity
BILL NO. 4 PROVISIONAL SUMS
Bill Of Quantity
DAYWORK SCHEDULES
Bill Of Quantity
VOLUME IV
Specification
Civil Specifications
Specification
Architectural Specifications
Specification
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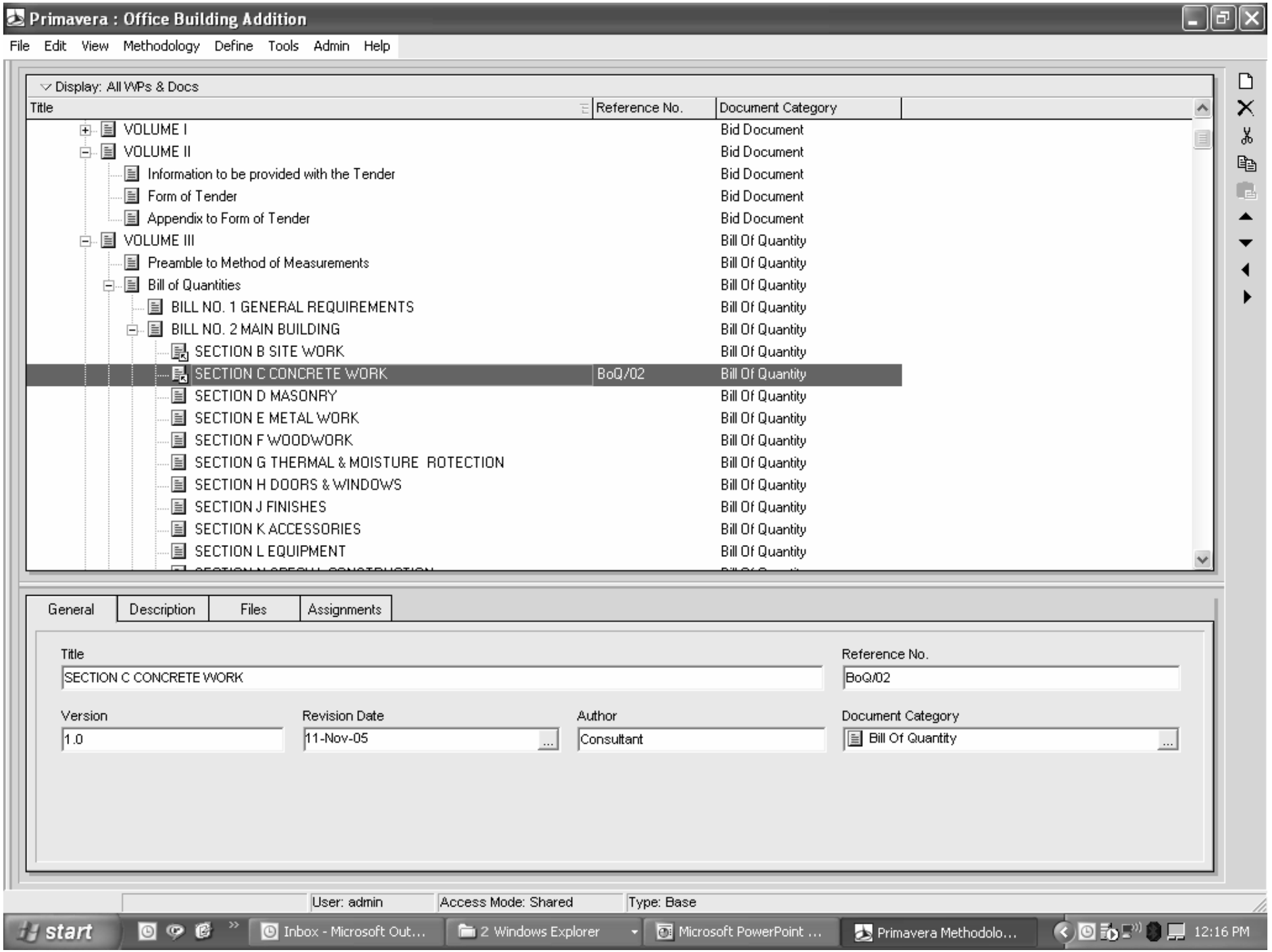
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Bid Document
VOLUME II
Bid Document
Information to be provided with the Tender
Bid Document
Form of Tender
Bid Document
Appendix to Form of Tender
Bid Document
VOLUME III
Bill Of Quantity
Preamble to Method of Measurements
Bill Of Quantity
Bill of Quantities
Bill Of Quantity
BILL NO. 1 GENERAL REQUIREMENTS
Bill Of Quantity
BILL NO. 2 MAIN BUILDING
Bill Of Quantity
SECTION B SITE WORK
Bill Of Quantity
SECTION C CONCRETE WORK
BoQ/02
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SECTION D MASONRY
Bill Of Quantity
SECTION E METAL WORK
Bill Of Quantity
SECTION F WOODWORK
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SECTION J FINISHES
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SECTION L EQUIPMENT
Bill Of Quantity
General
Description
Files
Assignments
Title
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Reference No.
BoQ/02
Version
1.0
Revision Date
11-Nov-05
Author
Consultant
Document Category
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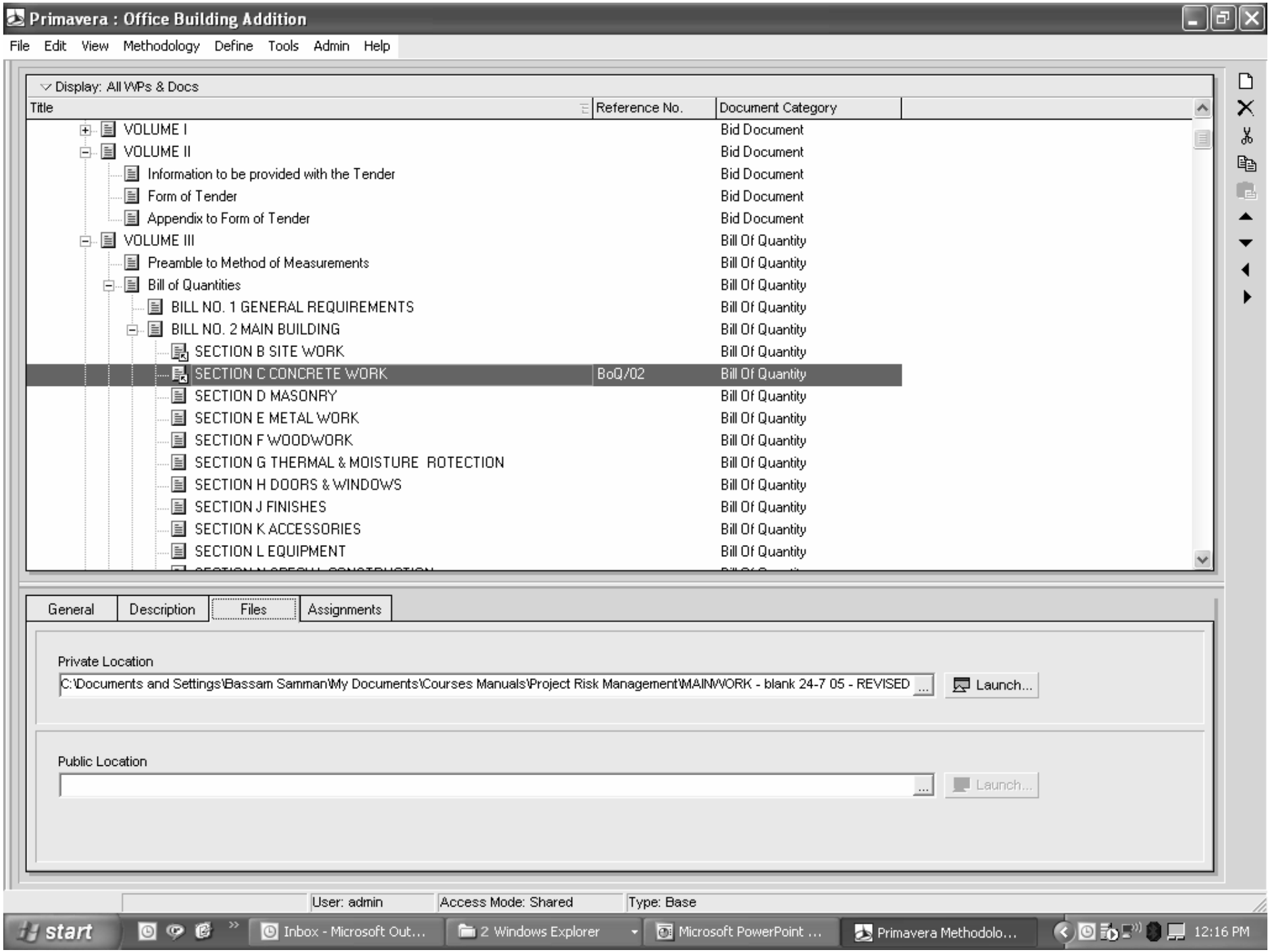
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Information to be provided with the Tender
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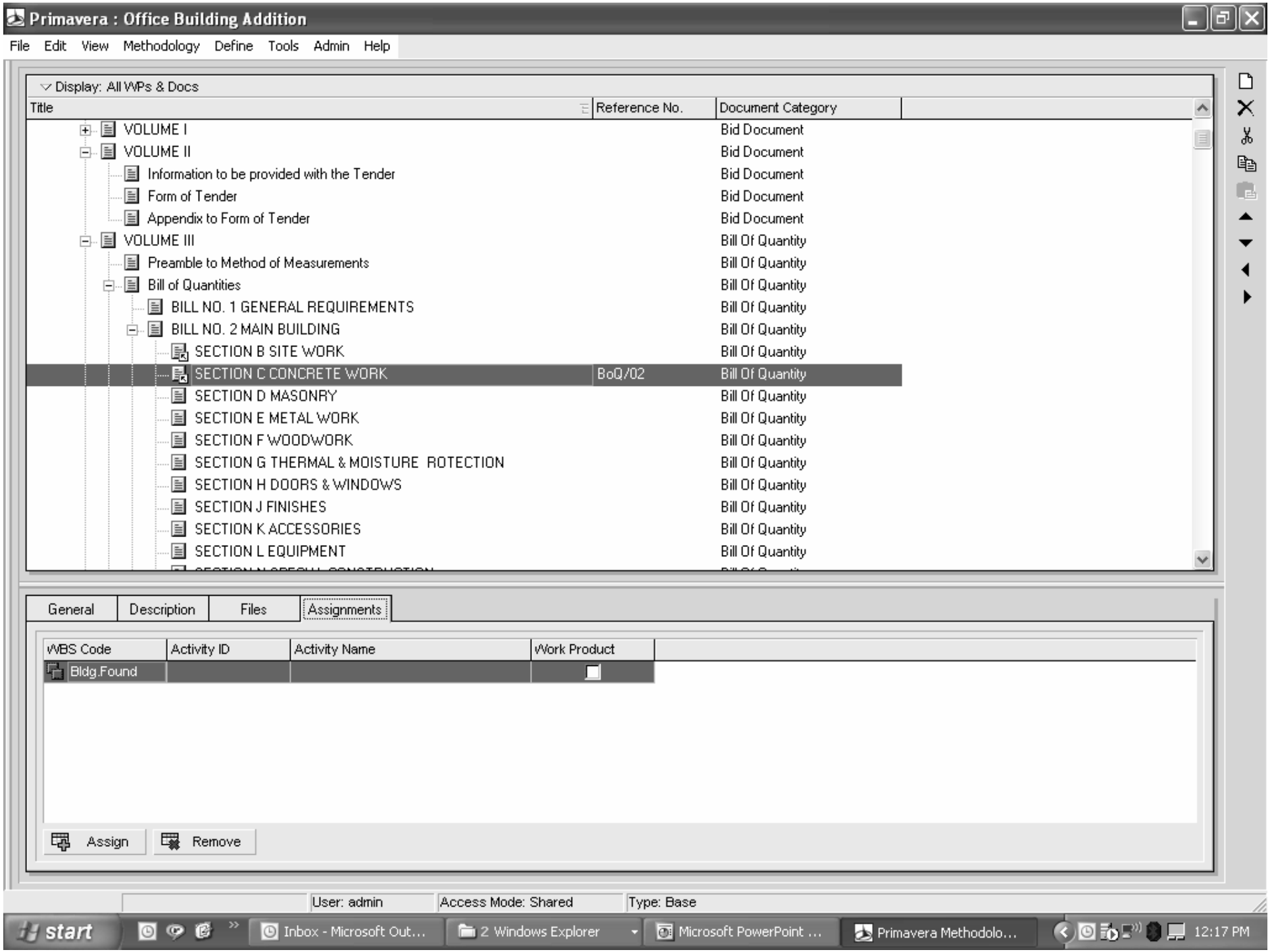
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Title
Reference No.
Document Category
VOLUME I
Bid Document
VOLUME II
Bid Document
Information to be provided with the Tender
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Form of Tender
Bid Document
Appendix to Form of Tender
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BILL NO. 1 GENERAL REQUIREMENTS
Bill Of Quantity
BILL NO. 2 MAIN BUILDING
Bill Of Quantity
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Bill Of Quantity
SECTION C CONCRETE WORK
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SECTION H DOORS & WINDOWS
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SECTION K ACCESSORIES
Bill Of Quantity
SECTION L EQUIPMENT
Bill Of Quantity
General
Description
Files
Assignments
WBS Code
Activity ID
Activity Name
Work Product
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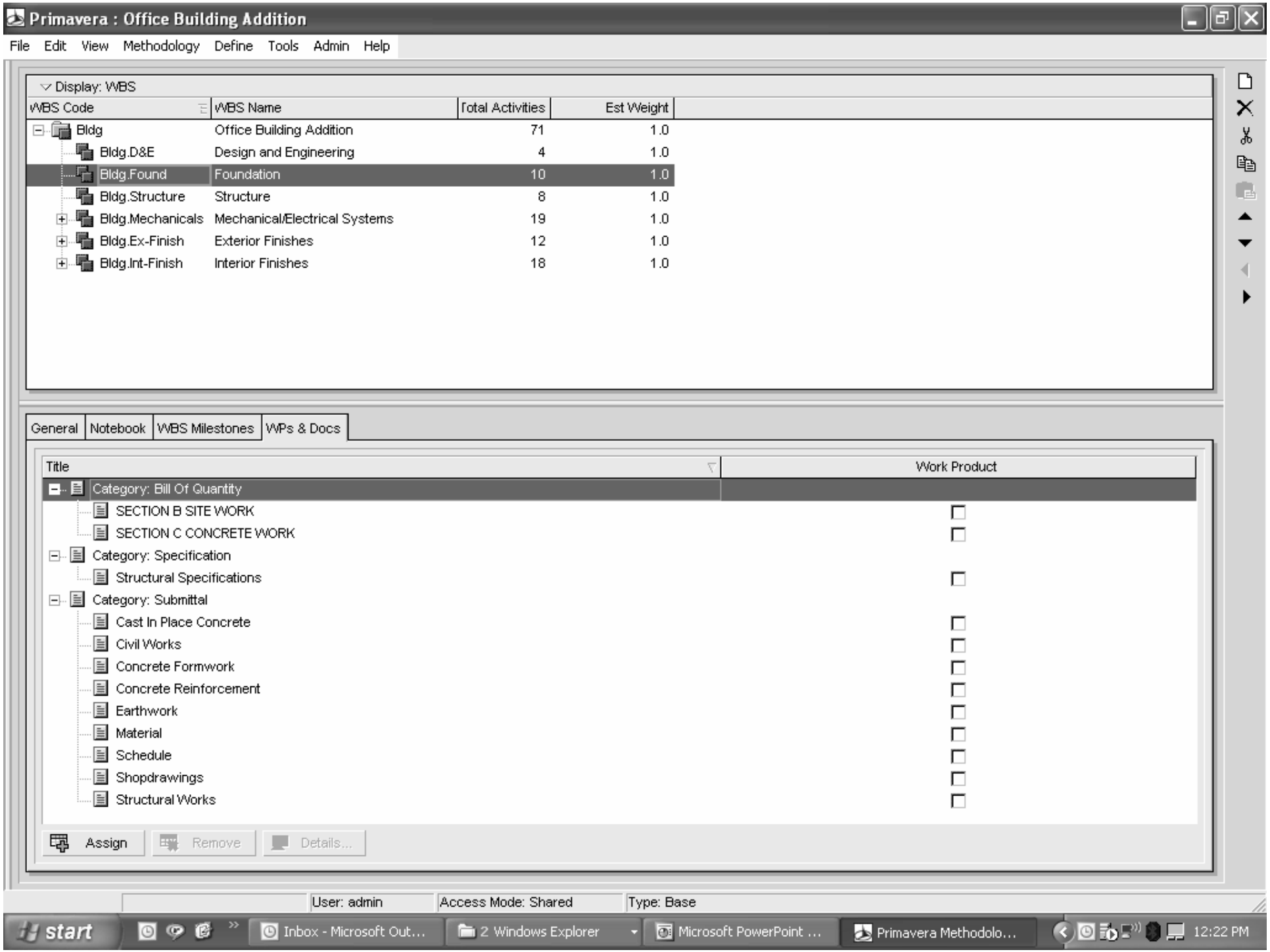
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Design and Engineering
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Bldg.Found
Foundation
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1.0
Bldg.Structure
Structure
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Mechanical/Electrical Systems
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Exterior Finishes
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1.0
Bldg.Int-Finish
Interior Finishes
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1.0
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WPs & Docs
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SECTION C CONCRETE WORK
Category: Specification
Structural Specifications
Category: Submittal
Cast In Place Concrete
Civil Works
Concrete Formwork
Concrete Reinforcement
Earthwork
Material
Schedule
Shopdrawings
Structural Works
Assign
Remove
Details...
User: admin
Access Mode: Shared
Type: Base
start
Inbox - Microsoft Out...
2 Windows Explorer
Microsoft PowerPoint ...
Primavera Methodolo...
12:22 PM

WBS Development Techniques

- Brainstorming
- Delphi technique
- Mind Mapping

Brainstorming

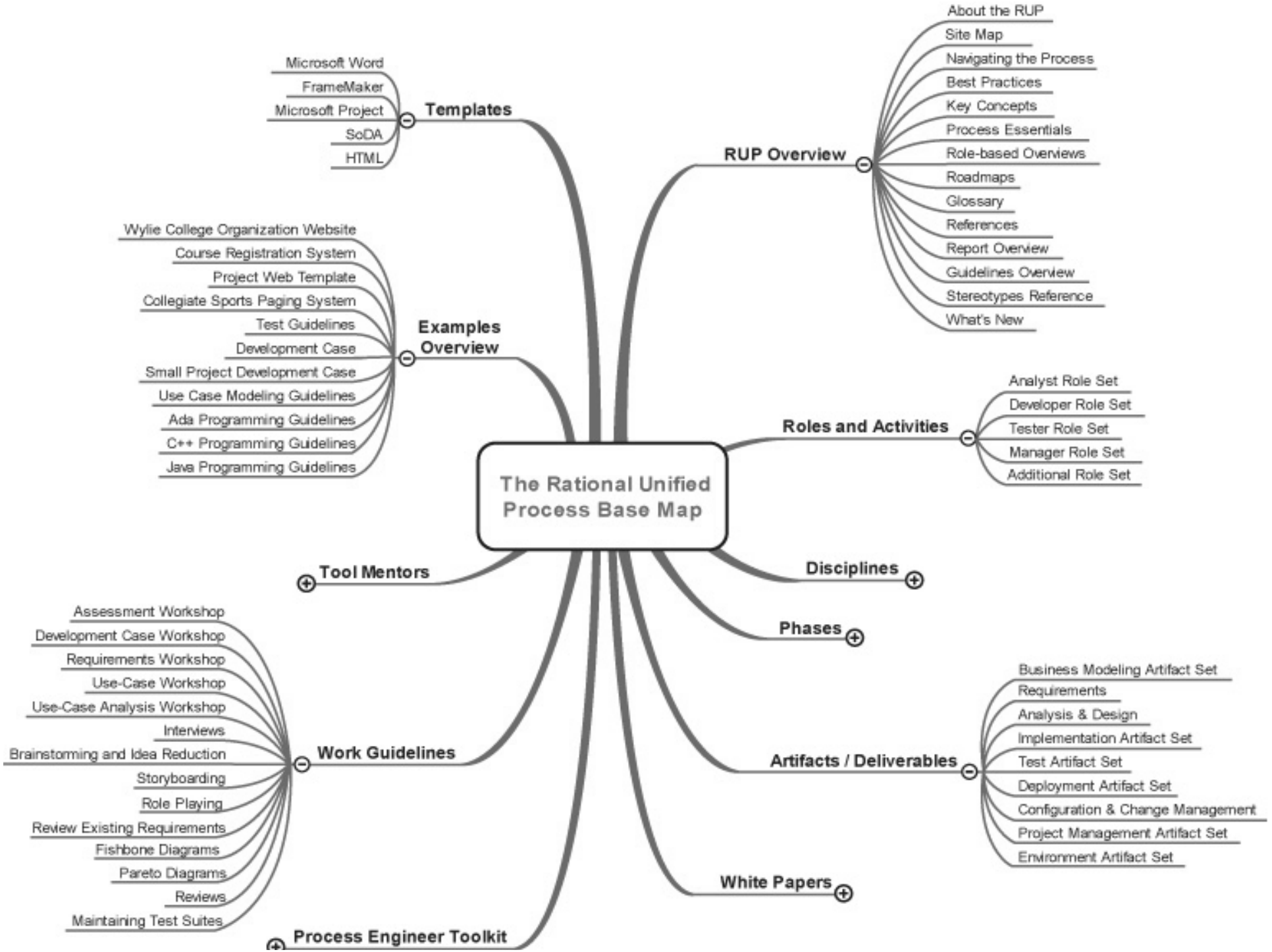
- Help people think creatively in a group setting without feeling inhibited or being criticized by others

Delphi Method

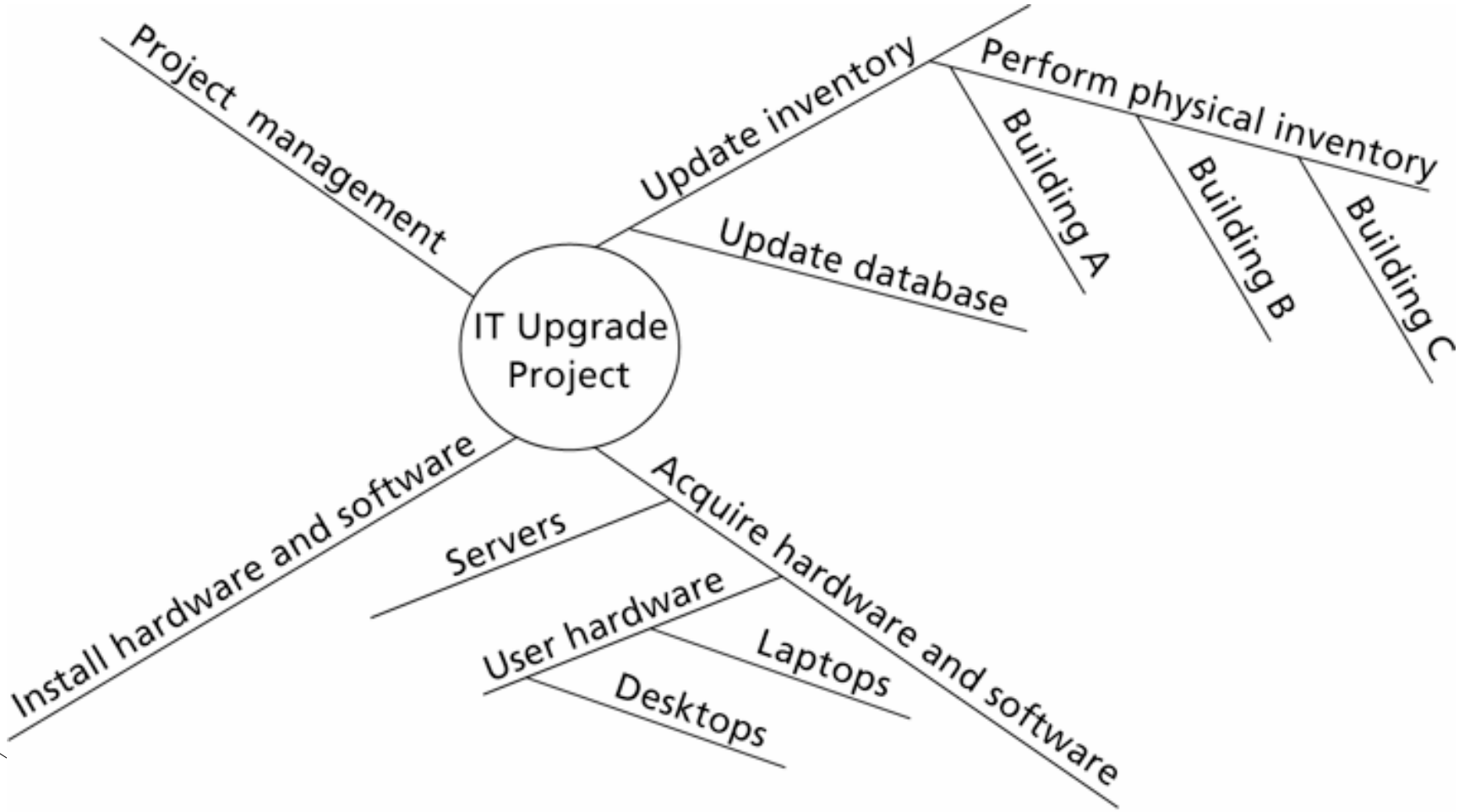
- Derives consensus using a panel of experts to arrive at a convergent solution to a specific problem
- Useful for large and critical risk impacts

Mind Mapping

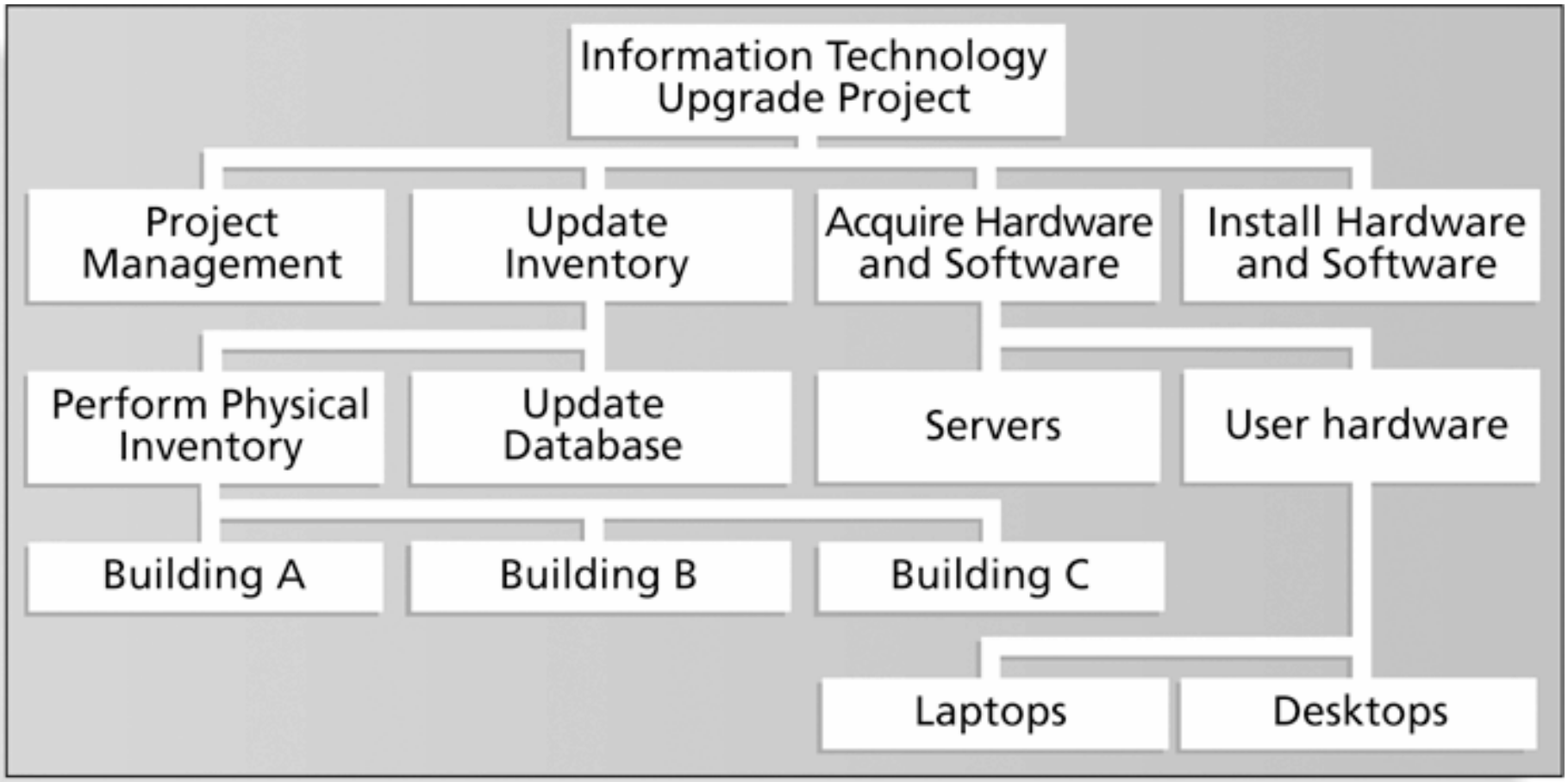
- Mind-mapping is a creative thinking that helps the analytic and creative sides of the brain.
- Mind-mapping is a visual deception of an idea, concept, or issue.
- Mind-mapping mirrors the way our minds actually work.


The Rational Unified Process Base Map
RUP Overview
About the RUP
Site Map
Navigating the Process
Best Practices
Key Concepts
Process Essentials
Role-based Overviews
Roadmaps
Glossary
References
Report Overview
Guidelines Overview
Stereotypes Reference
What's New
Templates
Microsoft Word
FrameMaker
Microsoft Project
SoDA
HTML
Examples Overview
Wylie College Organization Website
Course Registration System
Project Web Template
Collegiate Sports Paging System
Test Guidelines
Development Case
Small Project Development Case
Use Case Modeling Guidelines
Ada Programming Guidelines
C++ Programming Guidelines
Java Programming Guidelines
Roles and Activities
Analyst Role Set
Developer Role Set
Tester Role Set
Manager Role Set
Additional Role Set
Disciplines
Phases
Tool Mentors
Work Guidelines
Assessment Workshop
Development Case Workshop
Requirements Workshop
Use-Case Workshop
Use-Case Analysis Workshop
Interviews
Brainstorming and Idea Reduction
Storyboarding
Role Playing
Review Existing Requirements
Fishbone Diagrams
Pareto Diagrams
Reviews
Maintaining Test Suites
Artifacts / Deliverables
Business Modeling Artifact Set
Requirements
Analysis & Design
Implementation Artifact Set
Test Artifact Set
Deployment Artifact Set
Configuration & Change Management
Project Management Artifact Set
Environment Artifact Set
White Papers
Process Engineer Toolkit

Sample Mind-Mapping Approach



Resulting WBS in Chart Form



3. Assign Responsibility

- Assign responsibility for accomplishment of each element of the work at appropriate management level.

Requirements for Assigning Responsibility

- Performance responsibility shall be assigned for each element of the project and for the project in total
- Management responsibility shall be clearly defined
- Internal managers shall be responsible for any work to be performed externally

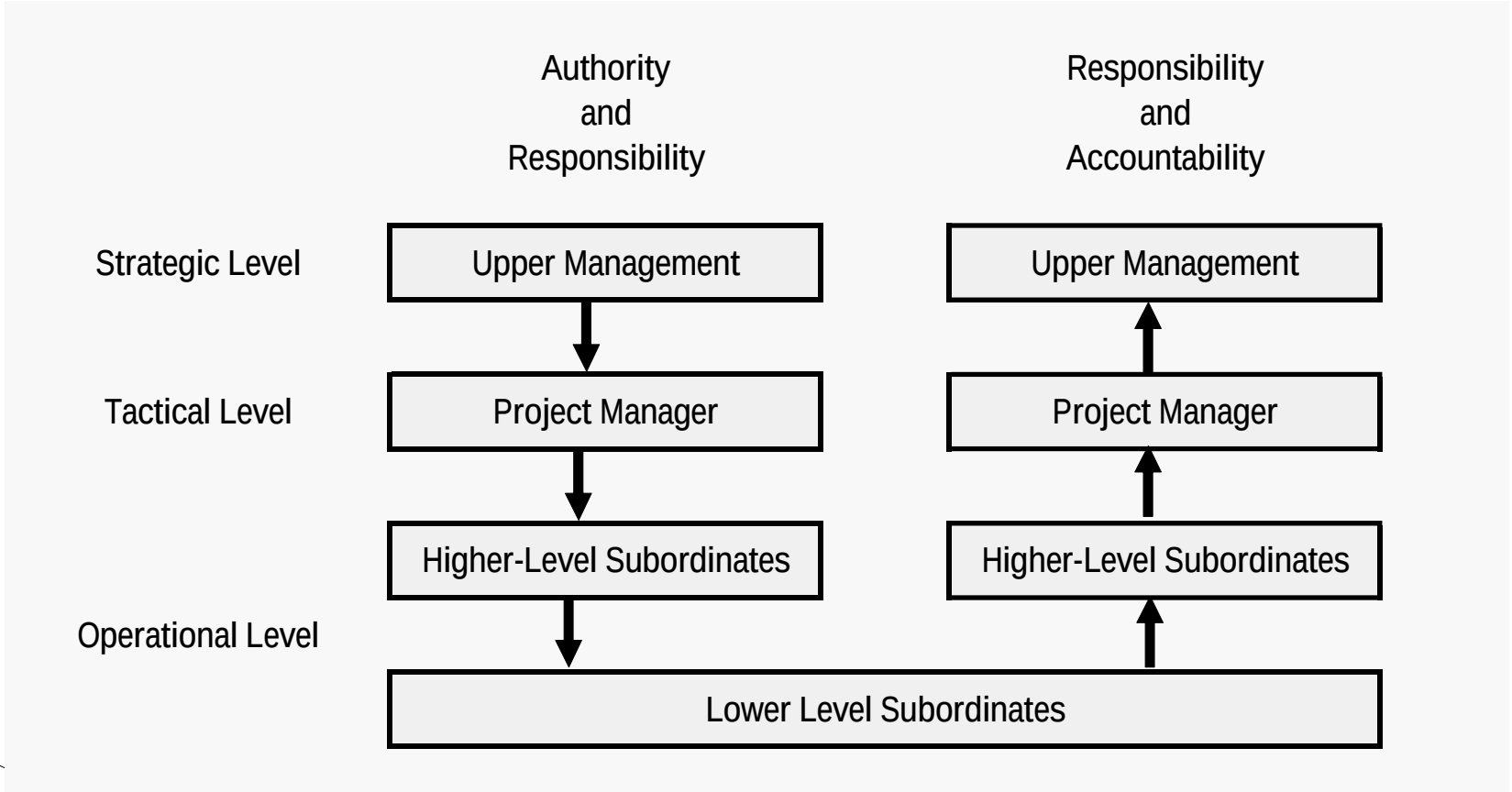
Roles and Responsibilities

- The following need to be addressed when listing the roles and responsibilities needed to complete the project.
  - **Role.** The label describing the position of a project for which a person is accountable.
  - **Authority.** The right to apply project resources, make decisions, and sign approvals.
  - **Responsibility.** The work that a project team member is expected to perform in order to complete the project's activities.
  - **Competency.** The skill and capacity required to complete project activities.

Accountability

- Means being answerable for the successful completion of specified objectives.
- Accountability = Responsibility + Authority

The Flow of Authority, Responsibility and Accountability



Key Project Players In Within The Organization

- The Project Sponsor
- The Project Manager
- The Resource Manager
- The Project Team Member

The Project Sponsor

- A single individual assigned by management to approved projects who has sufficient organizational authority to determine the scope of a project and approve the corresponding time and cost elements which will deliver the approved scope.
- The role of the sponsor is to be focal point for project decisions that are beyond the authority of the PM.

Role Of Project Sponsor

- Approve the business case for a project.
- Approve the business requirements for a project.
- Approve the negotiated scope, time, and costs and secure final approval for the project.
- Approve project scope changes and consequent changes in time and/or cost over the lifespan of the project.
- Review progress and provide strategic direction to the Project Manager.
- Set priorities and resolve conflicts escalated by the Project Manager, customer, or functional managers.

The Project Manager

- Is responsible for the coordination of the project team and, ultimately, for managing the project plan to enable the successful completion of the project on time, within budget and at the expected level of quality.

Role of Project Manager

- Identify the skills needed on the team, and negotiate with the resource managers for assignment of appropriate people.
- Coordinate tasks on the work breakdown structure (WBS).
- Negotiate the time frames in which tasks are to be performed.
- Develop and consolidate project plans.
- Track milestones, deadlines, schedules, recourse utilization, budgets, risks, changes of scope, quality of deliverables, and other project elements.
- Act as a liaison with top management and the project client.
- Issue status reports and conduct status review meetings.
- Coordinate with outside subcontractors, consultants, and vendors.
- Recommend changes to schedule, resource requirements, and budgets, when required.

The Resource Manager

- Is responsible for having available a department of subject-matter experts, engineers, software programmers, lawyers, or other professionals and service providers. They form the resource pool from which the manager of the project staffs his or her project.

Role of Resource Manager

- Hire, fire, train, discipline, and motivate the functional department's employees.
- Generate performance reviews for these employees.
- Develop and manage within departmental budgets.
- Plan the allocation of resources.
- Interpret upper-management's direction, and implement its policy.
- Solve problems as they arise.
- Assign people to the project team.
- Develop and provide a challenge to employees
- Set and maintain productivity standards.
- Accept accountability for a quality product that is to be delivered on schedule.
- Be proactive when possible and reactive when necessary.
- Validate time estimates for tasks.
- Monitor project work.
- Represent the functional group to the rest of the organization.

The Project Team Member

- The project team member is a representative of a functional department and a contributor to the project team.

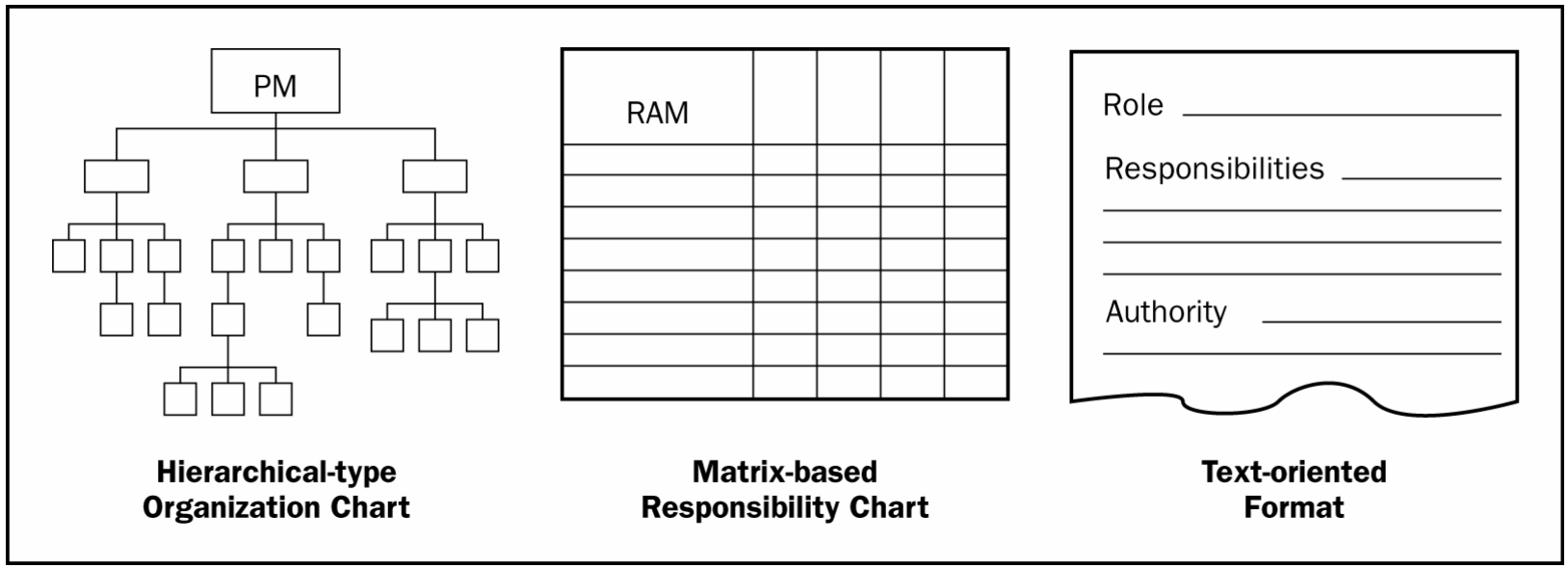
Role of Project Team Member

- Provide input regarding project objectives and scope.
- Define/design/perform assigned tasks, or assign people to do so.
- Determine time estimates for tasks that are to be performed.
- Interact with other functional areas and other team members.

Organization Charts

- Hierarchical-type charts
  - A graphic display of project team members and their reporting relationships.
  - Showing who reports to who
- Matrix-based charts
  - Illustrates the connections between work that needs to be done and project team members.
- Text-oriented formats
  - Describes roles and responsibilities of each position on the project.

Organization Charts



What is a Job Description?

- A Job Description is a document which outlines a particular role and set of responsibilities on a project. The purpose of a job description is to clarify the scope of work that a particular role is responsible for undertaking and the skills, experience and qualifications necessary to ensure that the role is undertaken effectively. It includes:
  - An overview of the respective role
  - A list of the specific responsibilities associated with the role
  - Clarification of where the role fits within the project organization structure
  - A list of the skills, experience and qualifications required
  - Measurable performance criteria
  - A statement describing the work environment
  - The salary package on offer.

RACI Chart

- One of the examples of Matrix charts is called RACI because the names of roles being documented are Responsible, Accountable, Consult and Inform.

RACI Chart

RACI Chart	Person				
Activity	Ann	Ben	Carlos	Dina	Ed
Define	A	R	I	I	I
Design	I	A	R	C	C
Develop	I	A	R	C	C
Test	A	I	I	R	I

R = Responsible A = Accountable C = Consult I = Inform

Other Possible Sets Of Actions

- 1 = Actual Responsibility
- 2 = General Supervision
- 3 = Must be Consulted
- 4 = May be Consulted
- 5 = Must be Notified
- 6 = Final Approval

Other Possible Sets Of Actions

- A = Approved The Deliverable
- R = Reviews the Deliverable (and provide feedback)
- C = Responsible for Creating the Deliverable – Could be C1 for primary and C2 for backup
- I = Provides Input
- N = Notified When Deliverable is Complete
- M = Manages the Deliverables

Responsibility Assignment Matrix (RAM)

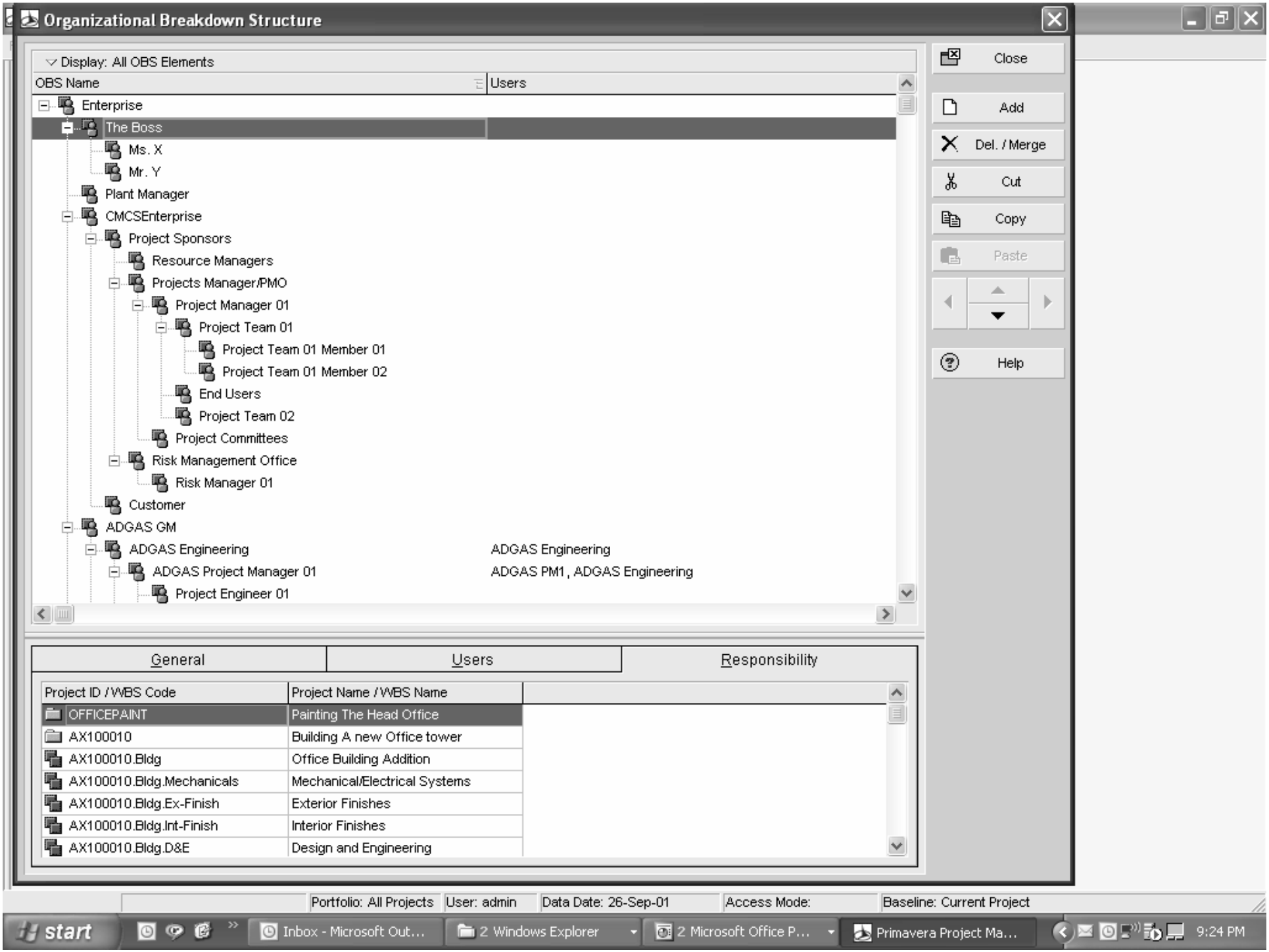
- A structure that relates the project organizational breakdown structure to the work breakdown structure to help ensure that each component of the project's scope of work is assigned to a responsible person.

Sample RAM

No.	Tasks / Activities Description	EREC	P.M	A/E	Cont.
R					
1.0	**Bonds Guarantees & Insurance Policies, Permits**				
1.1	Advance Payment Guarantees	A	R2	R1	P
1.2	Performance Guarantees	A	R2	R1	P
1.3	Insurance Policies	A	R2	R1	P
1.4	Building Permit	K	K	S	P
2.0	**Commencement & Mobilization**				
2.1	Order To Commence	A	P	S	K
2.2	Mobilization Arrangements	K	A	R	P
2.3	Contractor's Site Personnel	K	R2/A	R1	P
2.4	Consultant's Supervisory Staff	K	A	P	-
2.5	P.M. Staff	A	P	K	-
3.0	**Meetings & Conferences**				
3.1	Pre-Construction Conferences	K	P	S	K
3.2	Progress Meetings	K	P	S	K
3.3	Technical Meetings	-	K	P	K
3.4	Safety Review Meetings	-	P	S	K
3.5	Job Coordination Meetings	-	K	K	P
3.6	Planning & Scheduling Meetings	-	P	S	K
3.7	Close Out & Handing Over	K	P	S	K

Organization Breakdown Structure (OBS)

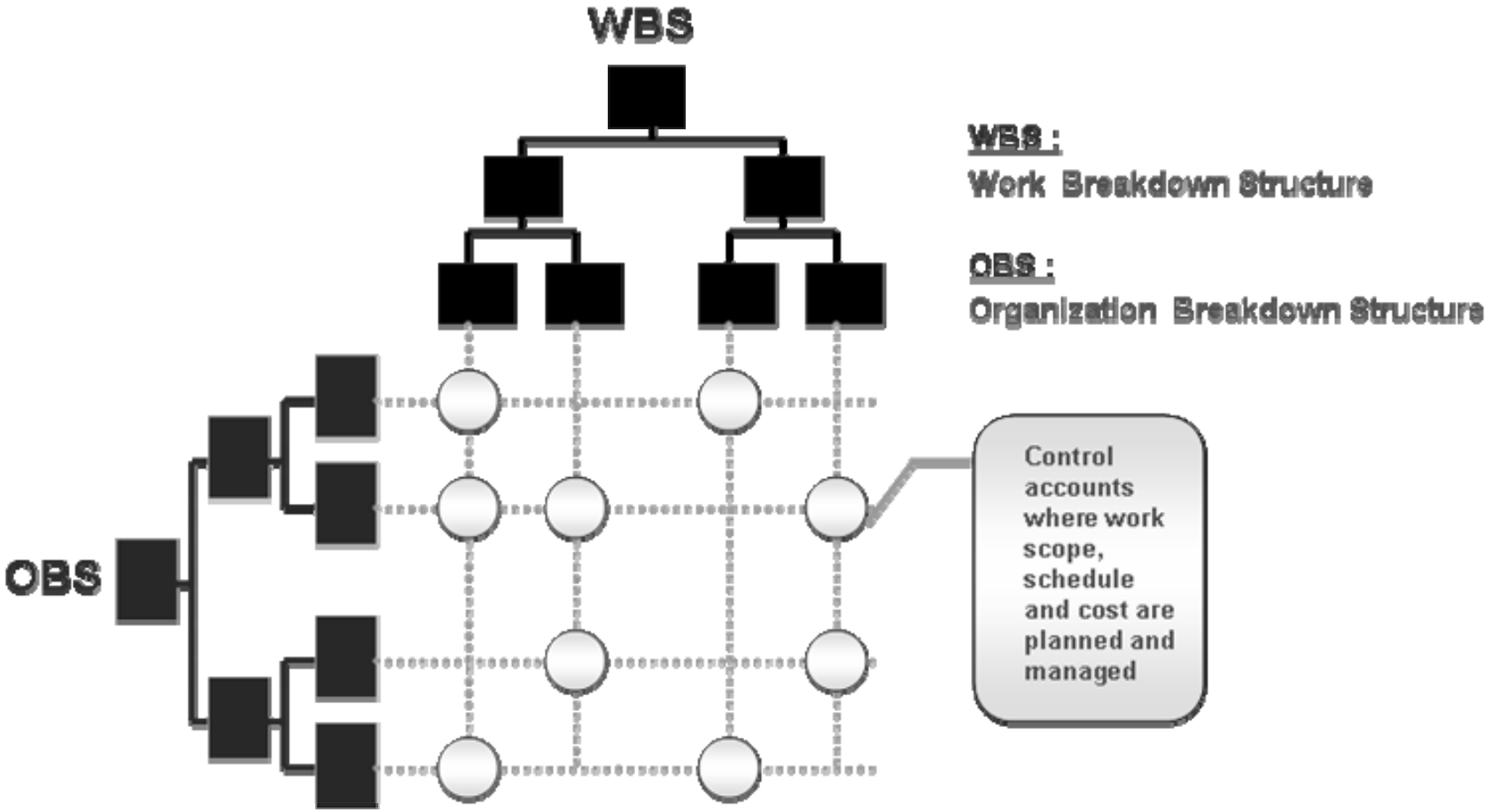
- The Organization Breakdown Structure is used to identify all the roles and responsibilities in a project. The OBS breaks down a project into descending levels of responsibilities, naming all the individuals required to supervise and manage the deliverables named in the project scope of work.


Organizational Breakdown Structure
Display: All OBS Elements
OBS Name
Users
Enterprise
The Boss
Ms. X
Mr. Y
Plant Manager
CMCSEnterprise
Project Sponsors
Resource Managers
Projects Manager/PMO
Project Manager 01
Project Team 01
Project Team 01 Member 01
Project Team 01 Member 02
End Users
Project Team 02
Project Committees
Risk Management Office
Risk Manager 01
Customer
ADGAS GM
ADGAS Engineering
ADGAS Engineering
ADGAS Project Manager 01
ADGAS PM1 , ADGAS Engineering
Project Engineer 01
Close
Add
Del. / Merge
Cut
Copy
Paste
Help
General
Users
Responsibility
Project ID / WBS Code
Project Name / WBS Name
OFFICEPAINT
Painting The Head Office
AX100010
Building A new Office tower
AX100010.Bldg
Office Building Addition
AX100010.Bldg.Mechanicals
Mechanical/Electrical Systems
AX100010.Bldg.Ex-Finish
Exterior Finishes
AX100010.Bldg.Int-Finish
Interior Finishes
AX100010.Bldg.D&E
Design and Engineering
Portfolio: All Projects
User: admin
Data Date: 26-Sep-01
Access Mode:
Baseline: Current Project
start
Inbox - Microsoft Out...
2 Windows Explorer
2 Microsoft Office P...
Primavera Project Ma...
9:24 PM

Control Account

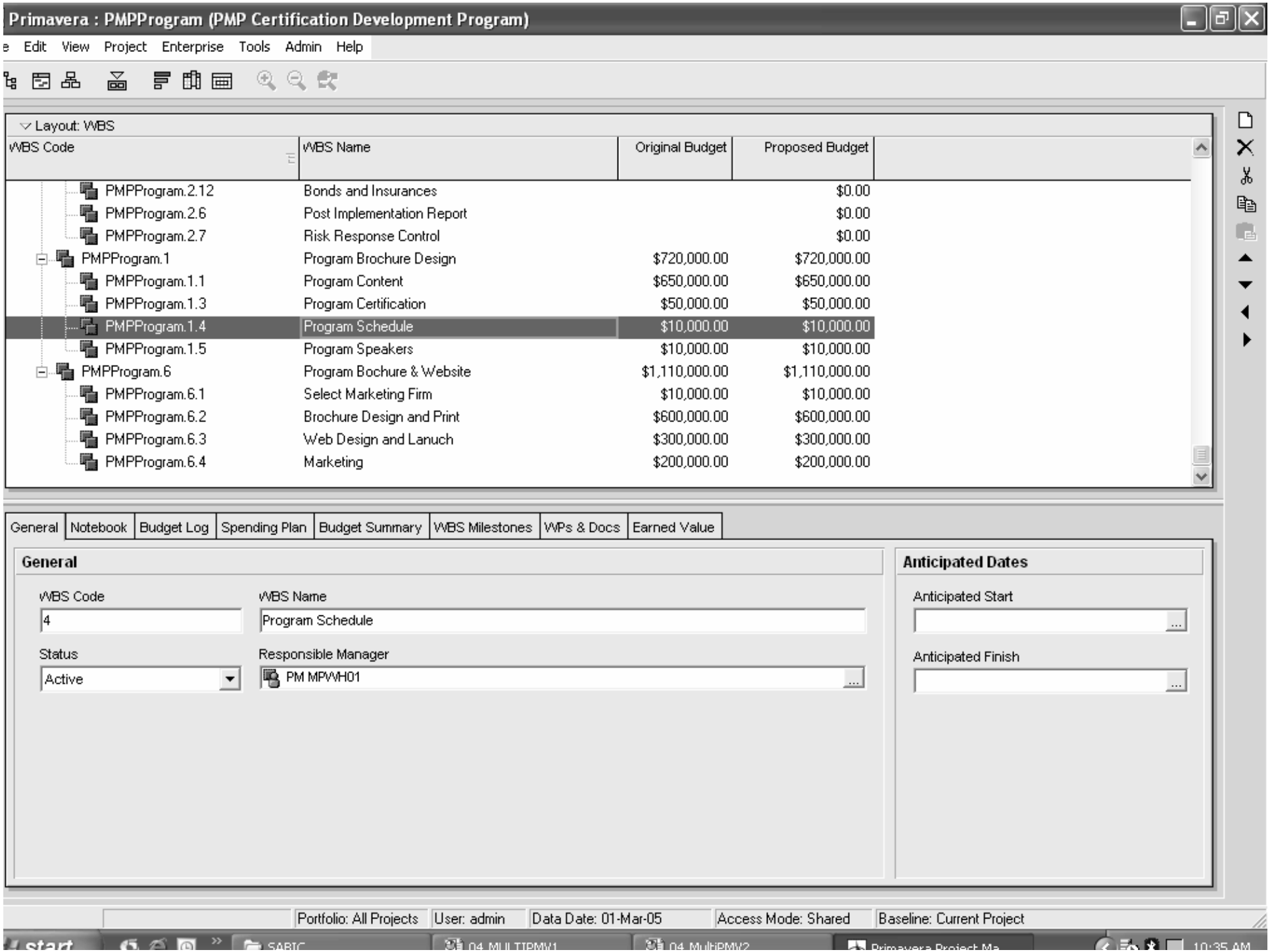
- A management control point where the integration of scope, budget, actual cost, and schedule takes place, and where the measurement of performance will occur.
- Control accounts are placed at selected management points of the work breakdown structure. Each control account may include one or more work packages, but each work package may be associated with only one control account.
- Each control account is associated with a specific single organizational component in the organizational breakdown structure (OBS).

Control Account Matrix



Control Account Manager (CAM)

- Integration of the WBS and OBS establishes the control account where the performance measurement necessary for project management is performed. This intersection results in designation of a focal point for management control, the control account manager (CAM).


Primavera : PMPProgram (PMP Certification Development Program)
Edit View Project Enterprise Tools Admin Help
Layout: WBS
WBS Code
WBS Name
Original Budget
Proposed Budget
PMPProgram.2.12 Bonds and Insurances $0.00
PMPProgram.2.6 Post Implementation Report $0.00
PMPProgram.2.7 Risk Response Control $0.00
PMPProgram.1 Program Brochure Design $720,000.00 $720,000.00
PMPProgram.1.1 Program Content $650,000.00 $650,000.00
PMPProgram.1.3 Program Certification $50,000.00 $50,000.00
PMPProgram.1.4 Program Schedule $10,000.00 $10,000.00
PMPProgram.1.5 Program Speakers $10,000.00 $10,000.00
PMPProgram.6 Program Bochure & Website $1,110,000.00 $1,110,000.00
PMPProgram.6.1 Select Marketing Firm $10,000.00 $10,000.00
PMPProgram.6.2 Brochure Design and Print $600,000.00 $600,000.00
PMPProgram.6.3 Web Design and Lanuch $300,000.00 $300,000.00
PMPProgram.6.4 Marketing $200,000.00 $200,000.00
General
Notebook
Budget Log
Spending Plan
Budget Summary
WBS Milestones
WPs & Docs
Earned Value
General
WBS Code
4
WBS Name
Program Schedule
Status
Active
Responsible Manager
PM MPWH01
Anticipated Dates
Anticipated Start
Anticipated Finish
Portfolio: All Projects
User: admin
Data Date: 01-Mar-05
Access Mode: Shared
Baseline: Current Project

4. Schedule The Work

- Create a schedule for all the work which identifies activities, durations, milestones and interdependencies.
- A project schedule is the agreed upon set of tasks and due dates used to guide and monitor the project to completion.

What The Schedule Will Outline?

- The major activities to be accomplished in the project.
- The detailed tasks associated with those activities.
- Dependencies and relationships between tasks and activities.
- The project schedule is a comprehensive calendar depicting:
  - Time (duration) estimates for all tasks and activities
  - Start and finish dates for the tasks and activities
  - Names of resources assigned responsibility to complete the tasks and activities
  - Current status of each task and activity
- The project schedule is structured to reflect the WBS and includes successor/predecessor relationships representing the dependencies between tasks and activities.

Project Constraints

- Factors that limit the project team's options.
  - Budget Constraints
  - Target Date Constraints
  - Resource Availability Constraint
  - Duration Constraint
  - Task Predecessor Constraint

Project Assumptions

- Assumptions are external circumstances or events that must occur for the project to be successful, and they involve some risk.
- Assumptions are factors that, for planning purposes, will be considered true, real or certain.

Activity list

- A comprehensive list including all schedule activities planned to be performed on the project.

Characteristics Of An Activity

- Work is performed and described in terms of a verb, objective and noun- there is action performed
- A single person is responsible for an activity- accountability
- It has defined start and finish dates
- Usually, there is a tangible output or product at completion
- It fits logically under an existing WBS element
- It is of a size and duration that is sufficient for control
- The labor and costs necessary to perform the activity can be estimated
- Actual progress data can be collected for the activity

Milestone

- A significant point or event in the project.
  - Mandatory which are required by Contract
  - Optional which are based upon project requirements or historical information
- **Start Milestone.** Typically used to mark the beginning of a phase or to communicate project deliverables.
- **Finish Milestone.** Typically used to mark the end of a phase or to communicate project deliverables.

Milestones Are Selected Based On:

- Importance for monitoring project progress
- Ability to control the course of future work
- Availability of key personnel, facilities, equipment, or other important resources
- The need to flag important external and internal commitments
- Customer requirements

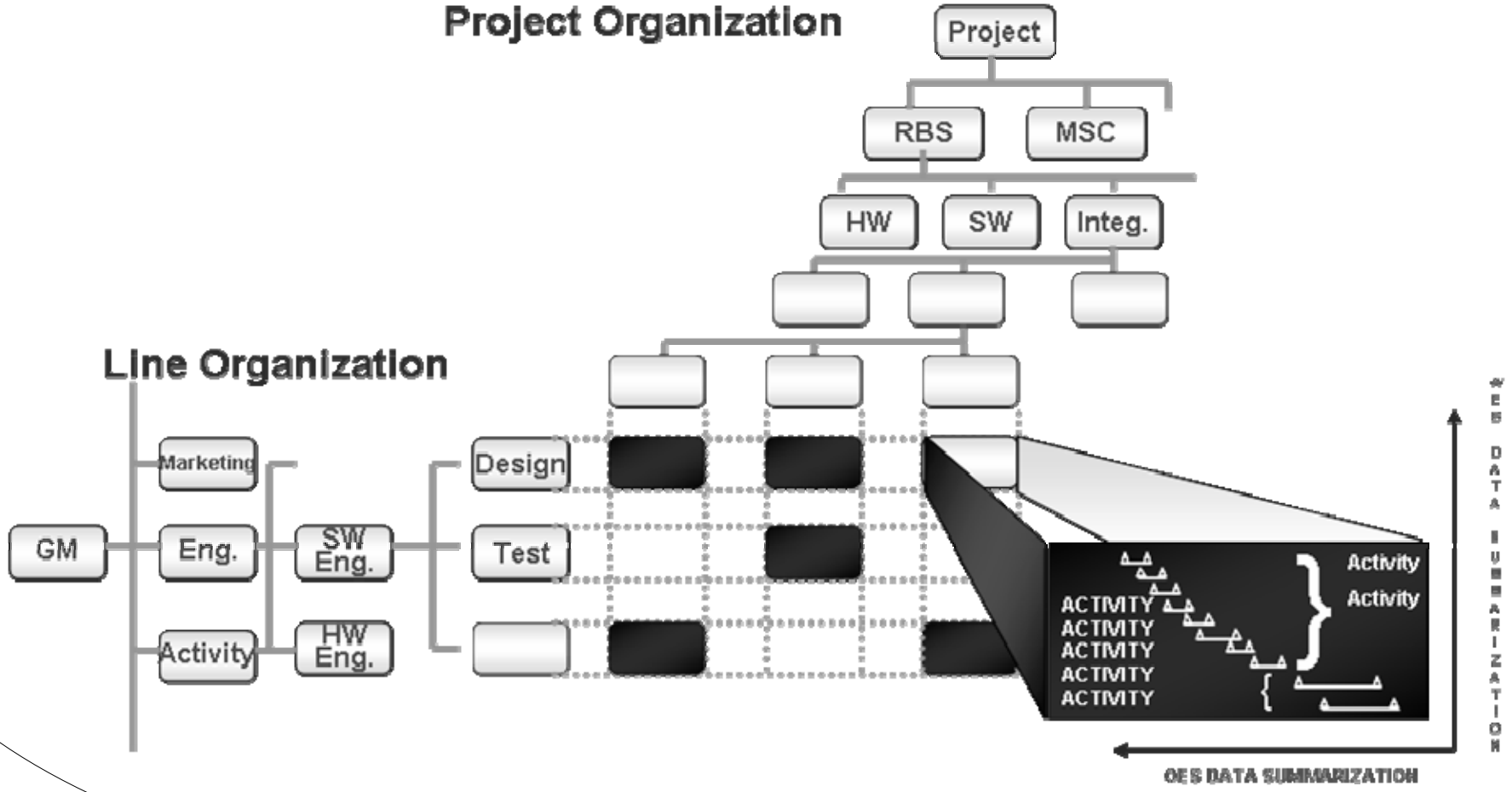
Hammock

- An aggregate or summary activity

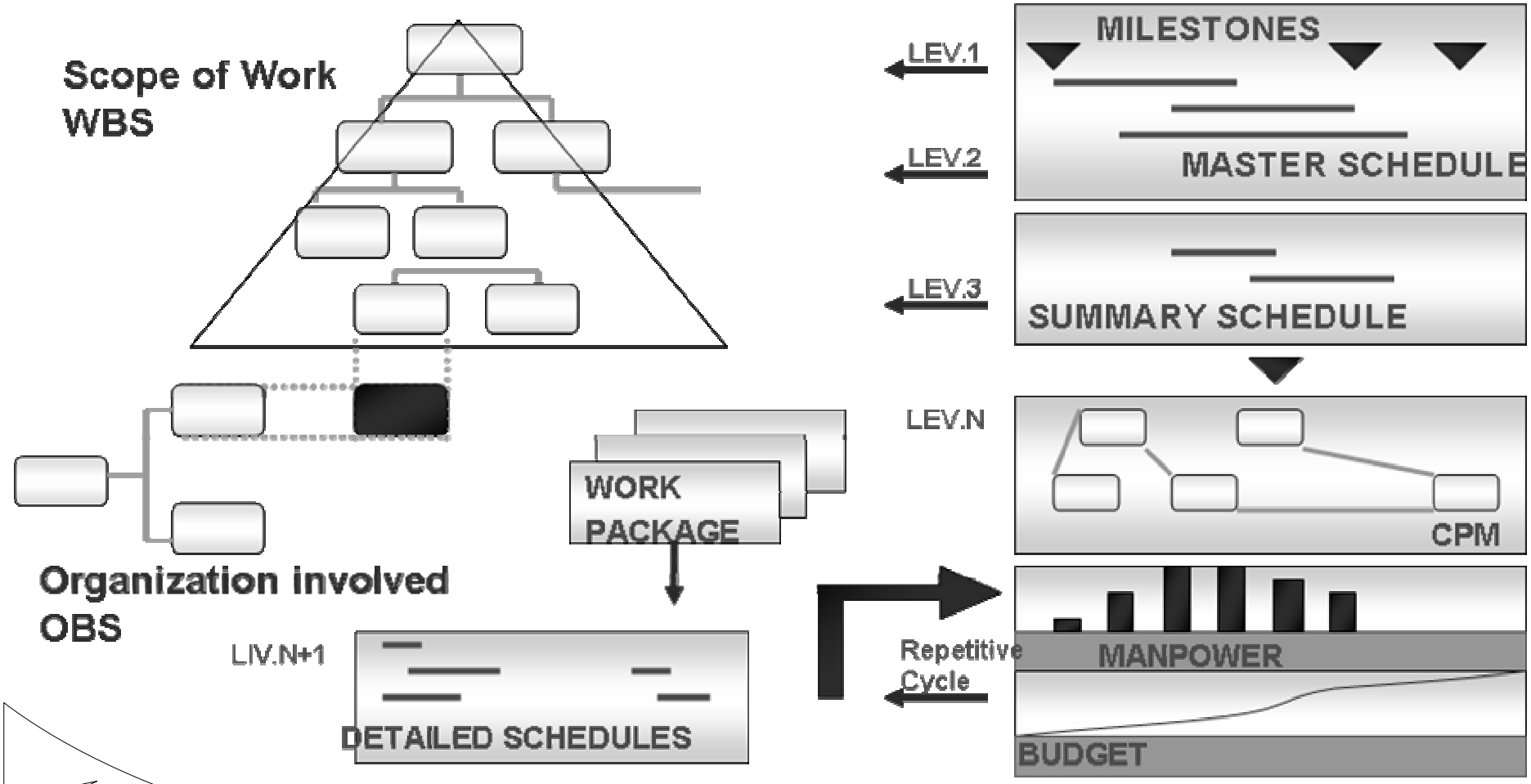
Work Package

- A deliverable or project work component at the lowest level of each branch of the work breakdown structure.
- The work package includes the schedule activities and schedule milestones required to complete the work package deliverable or project work component.

Work Package



WBS and Activity Link



What Is Enough Detail?

- Activities Should Be:
  - Assignable
  - Clearly Defined
  - Duration Can Be Estimated
  - Cost Can Be Estimated
  - Progress Can Be Tracked

Practical Tips

- Only Detail Tasks if You Have Enough Information
- More Detail for Earlier Phases
- Leave Later Phases at a Lower Level of Detail
- Set Milestones For Developing Further Detail

Progressive Elaboration

- Continuously improving and detailing a plan as more detailed and specific information and more accurate estimates become available as the project progresses, and thereby producing more accurate and complete plans that result from the successive iterations of the planning process.

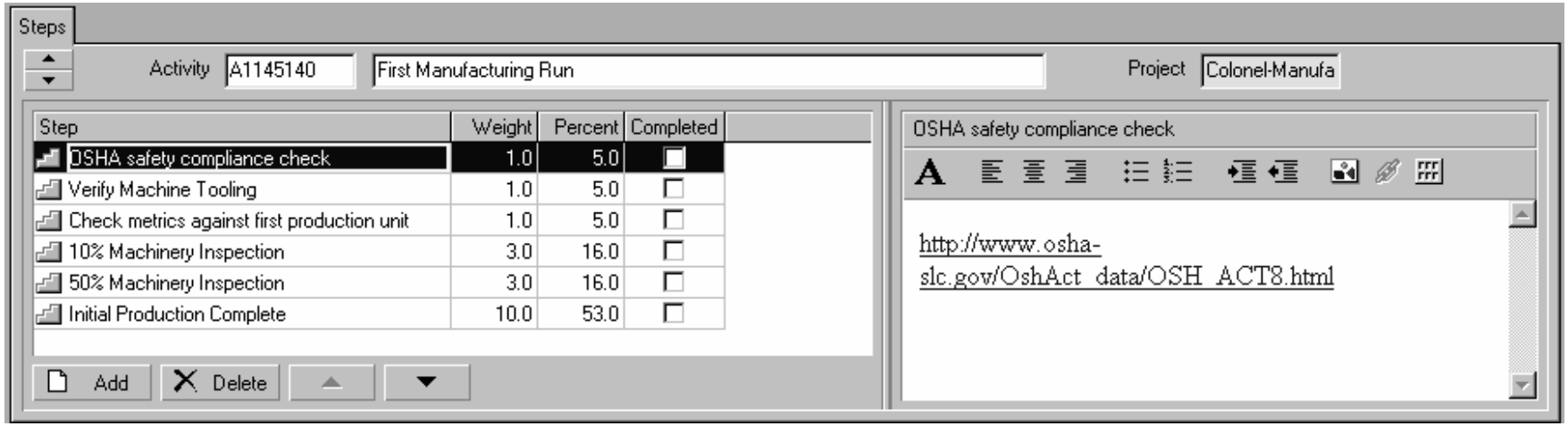
Rolling Wave Planning

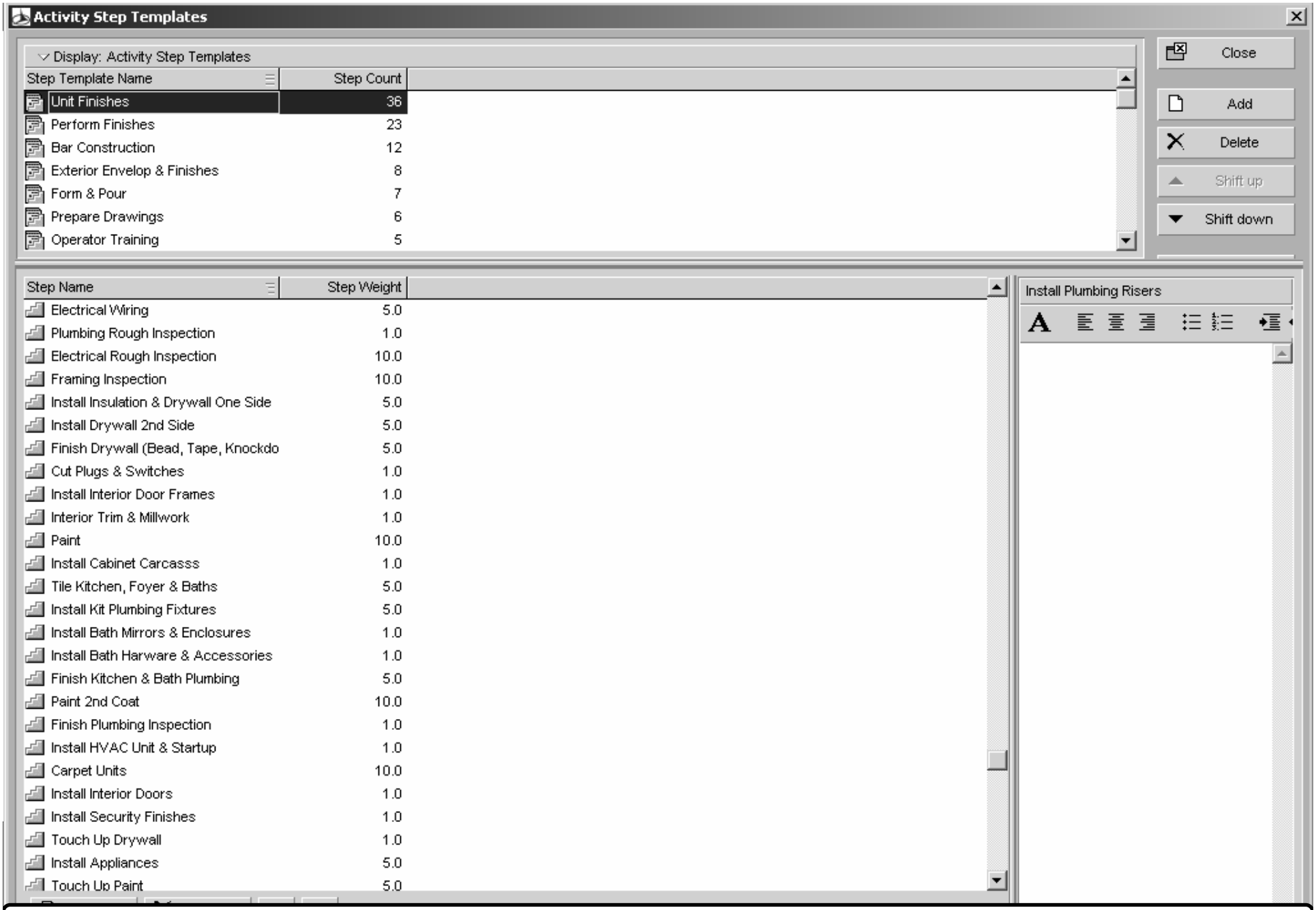
- Is a form of progressive elaboration planning where the work to be accomplished in the near term is planned in detail at a low level of the WBS, while work far in the future is planned for WBS components that are at a relatively high level of the WBS.

Activity Steps

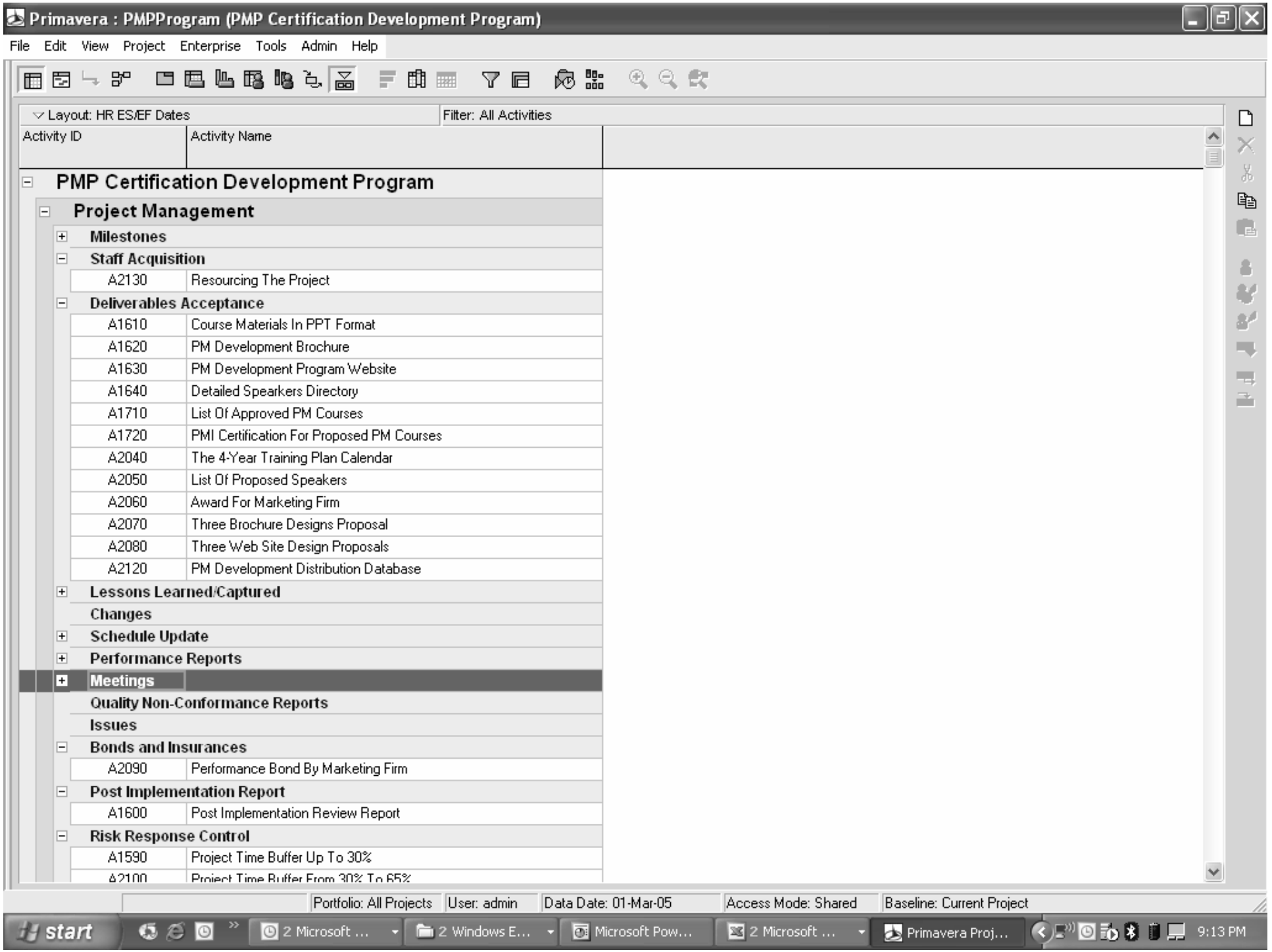
- For selected activities, the activity could be divided into steps.
- Each step will have a weight value representing the importance of this step for completing an activity.
- Steps are not necessarily to be completed in the same order.

Activity Steps





Step templates


Primavera : PMPProgram (PMP Certification Development Program)
File Edit View Project Enterprise Tools Admin Help
Layout: HR ES/EF Dates
Filter: All Activities
Activity ID
Activity Name
PMP Certification Development Program
Project Management
Milestones
Staff Acquisition
A2130 Resourcing The Project
Deliverables Acceptance
A1610 Course Materials In PPT Format
A1620 PM Development Brochure
A1630 PM Development Program Website
A1640 Detailed Spearkers Directory
A1710 List Of Approved PM Courses
A1720 PMI Certification For Proposed PM Courses
A2040 The 4-Year Training Plan Calendar
A2050 List Of Proposed Speakers
A2060 Award For Marketing Firm
A2070 Three Brochure Designs Proposal
A2080 Three Web Site Design Proposals
A2120 PM Development Distribution Database
Lessons Learned/Captured
Changes
Schedule Update
Performance Reports
Meetings
Quality Non-Conformance Reports
Issues
Bonds and Insurances
A2090 Performance Bond By Marketing Firm
Post Implementation Report
A1600 Post Implementation Review Report
Risk Response Control
A1590 Project Time Buffer Up To 30%
A2100 Project Time Buffer From 30% To 65%
Portfolio: All Projects
User: admin
Data Date: 01-Mar-05
Access Mode: Shared
Baseline: Current Project
start
2 Microsoft ...
2 Windows E...
Microsoft Pow...
2 Microsoft ...
Primavera Proj...
9:13 PM

Planning Diagram Techniques

- Arrow Diagram Method (ADM)
- Precedence Diagram Method (PDM)
- Conditional Diagramming Methods
  - GERT and System Dynamics models
  - Allows for non-sequential activities such as loops or conditional branches

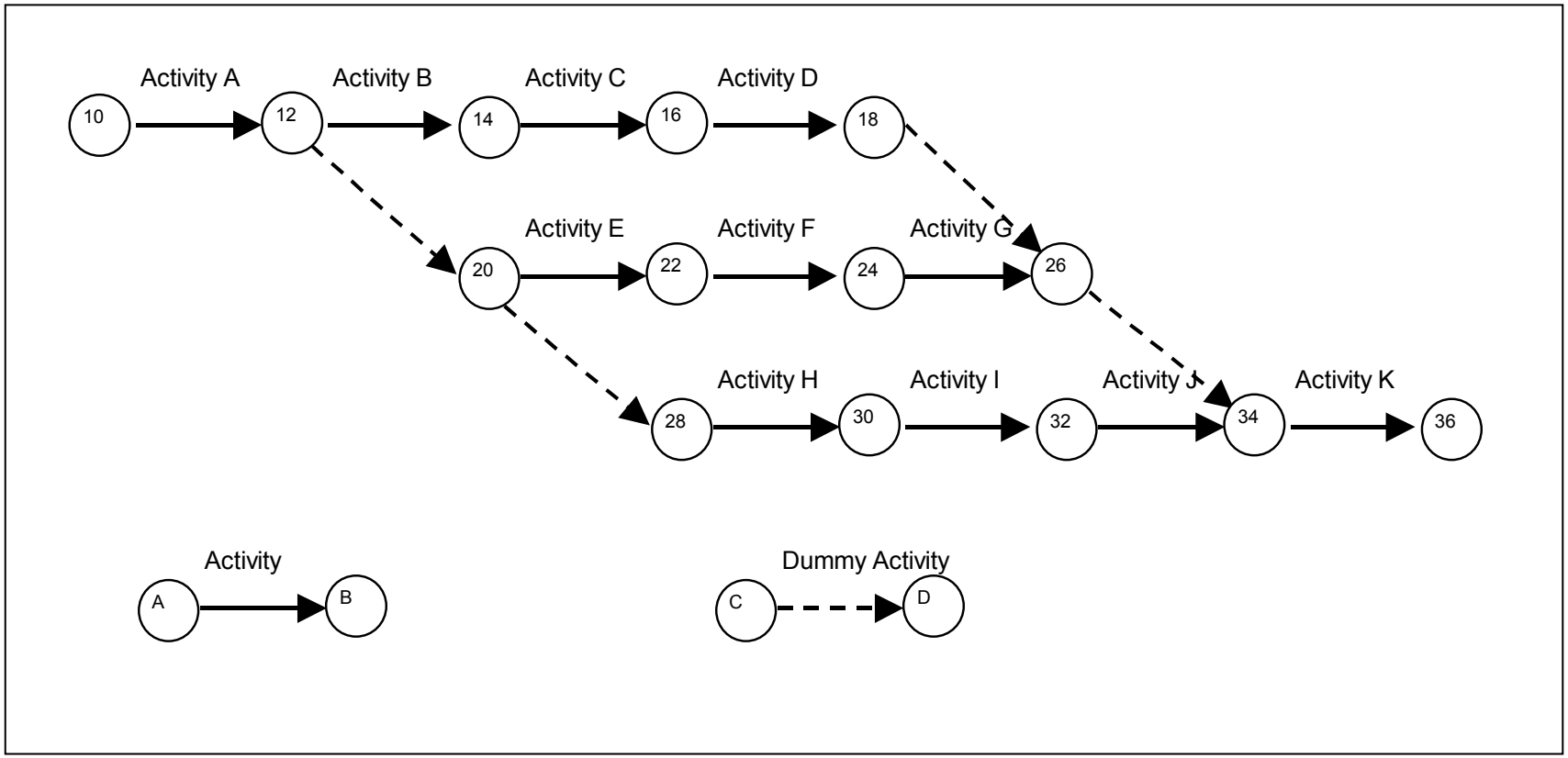
Arrow Diagram Method

- The arrows are used to represent tasks.
- The boxes represent task dependencies.
- This method uses:
  - Only finish-to-start relationships between tasks
  - May use dummies

Dummy Activity

- An activity that consumes no time or resources and shows only that a dependency exists between two activities.

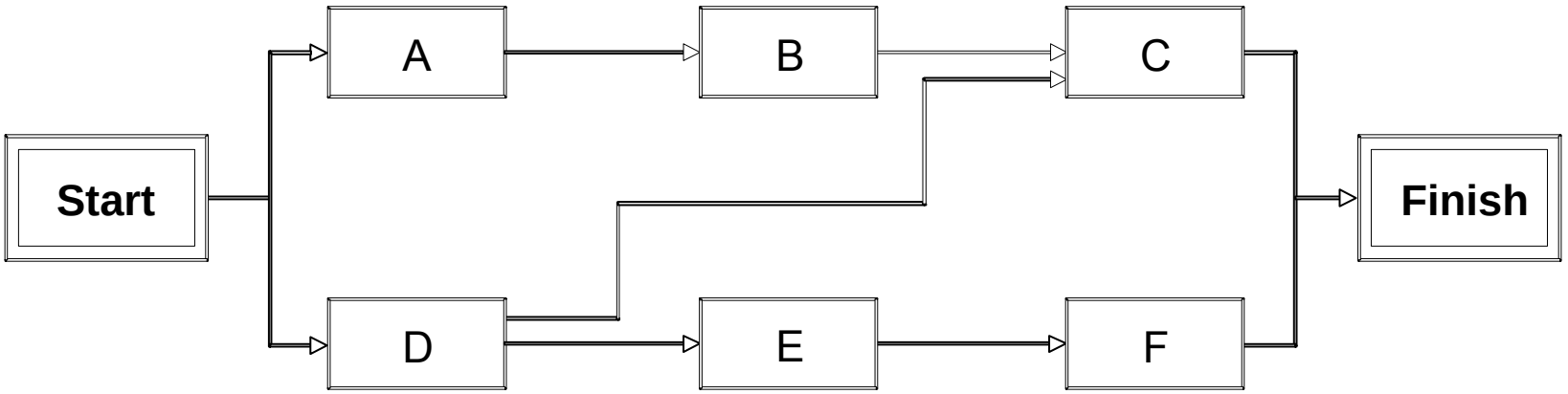
Arrow Diagram Method



Precedence Diagramming Method

- Nodes (or boxes) are used to represent tasks and arrows show task dependencies.
- The method adds leads and lags to relationship and:
  - Has four type of relationships (FS, SS, FF and SF)

Precedence Diagramming Method

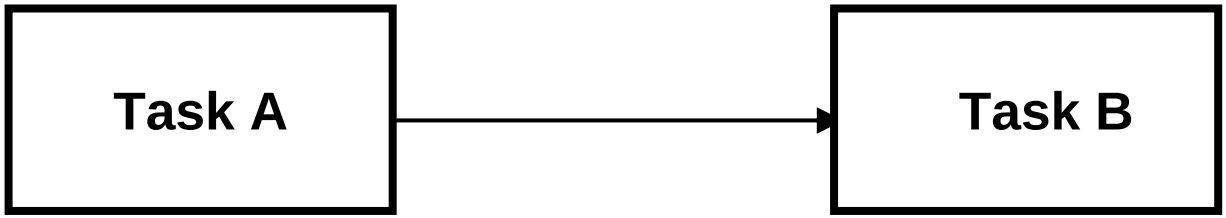


Types of Dependencies

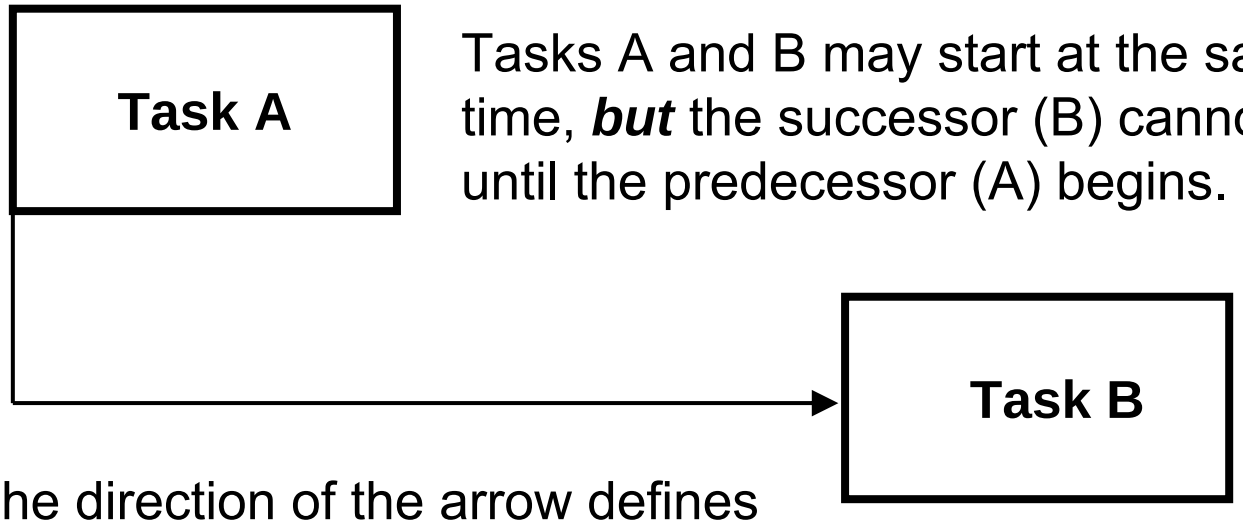
- **Mandatory (Hard Logic):** Inherent in the nature of the work being done (e.g., you must design before you can construct).
- **Discretionary (Preferred, Preferential or Soft Logic):** Based on experience, desire or preferences.
- **External:** Based on the needs or desire of a party outside the project (e.g., government or suppliers).

Precedence Relationships
Finish to Start (FS)

The “from” activity Task A must finish before the “to” activity Task B can start



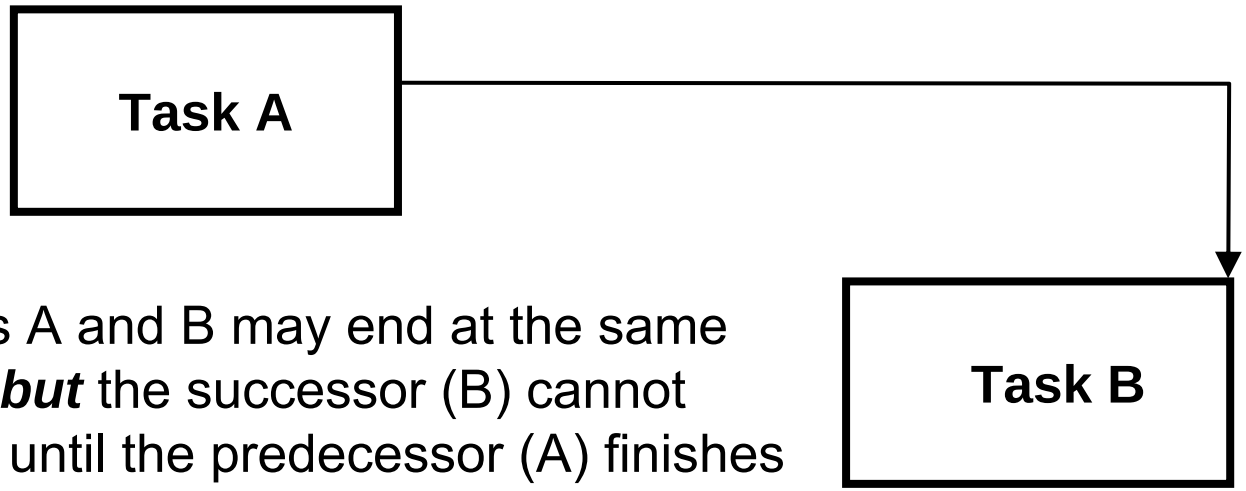
Precedence Relationships
Start to Start (SS)



Tasks A and B may start at the same time, ***but*** the successor (B) cannot start until the predecessor (A) begins.

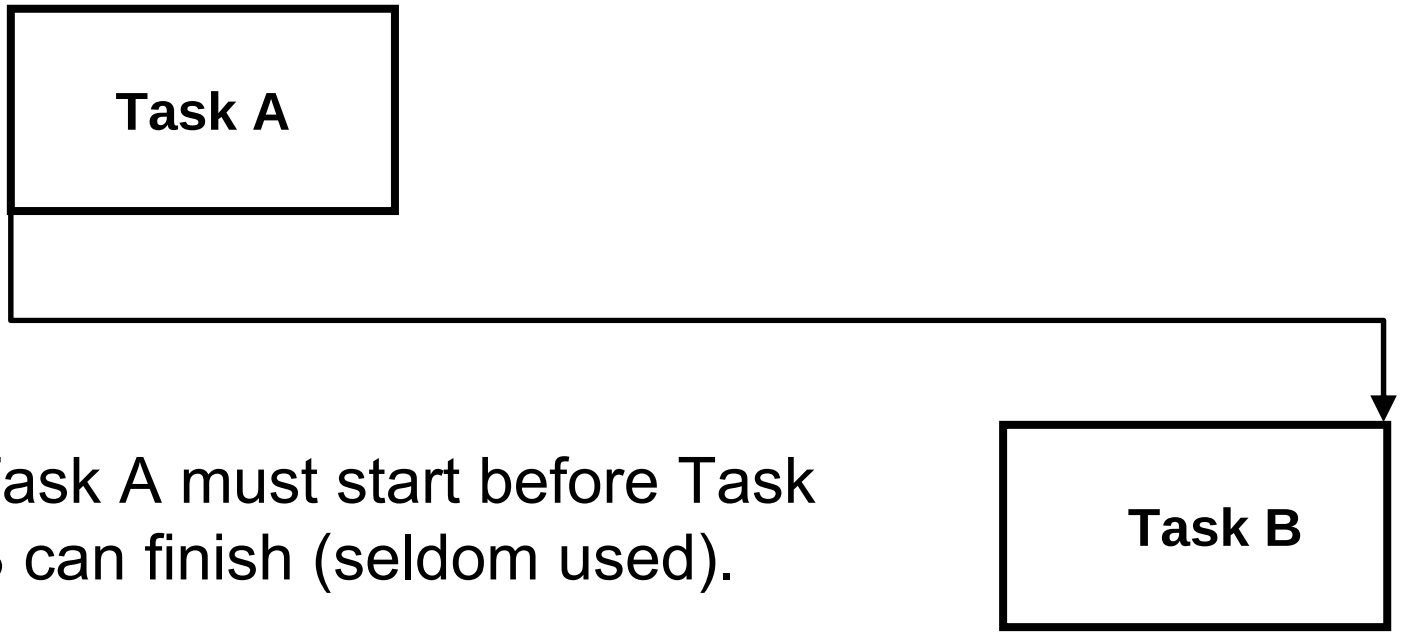
The direction of the arrow defines which task is the predecessor and which is the successor.

Precedence Relationships
Finish to Finish (FF)



Tasks A and B may end at the same time, ***but*** the successor (B) cannot finish until the predecessor (A) finishes

Precedence Relationships
Start to Finish (SF)



Task A must start before Task B can finish (seldom used).

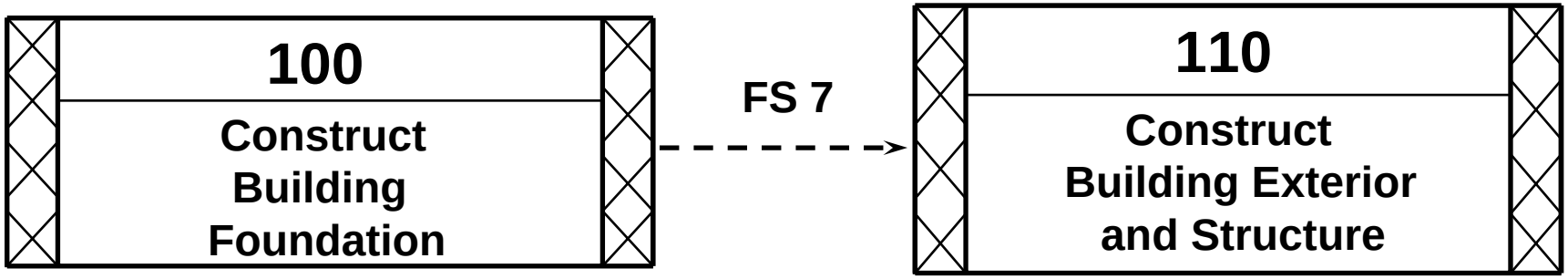
Lag

- A modification of a logical relationship that directs a delay in the successor activity. For example, in a finish-to-start dependency with a ten-day lag, the successor activity cannot start until ten days after the predecessor activity has finished.

Lead

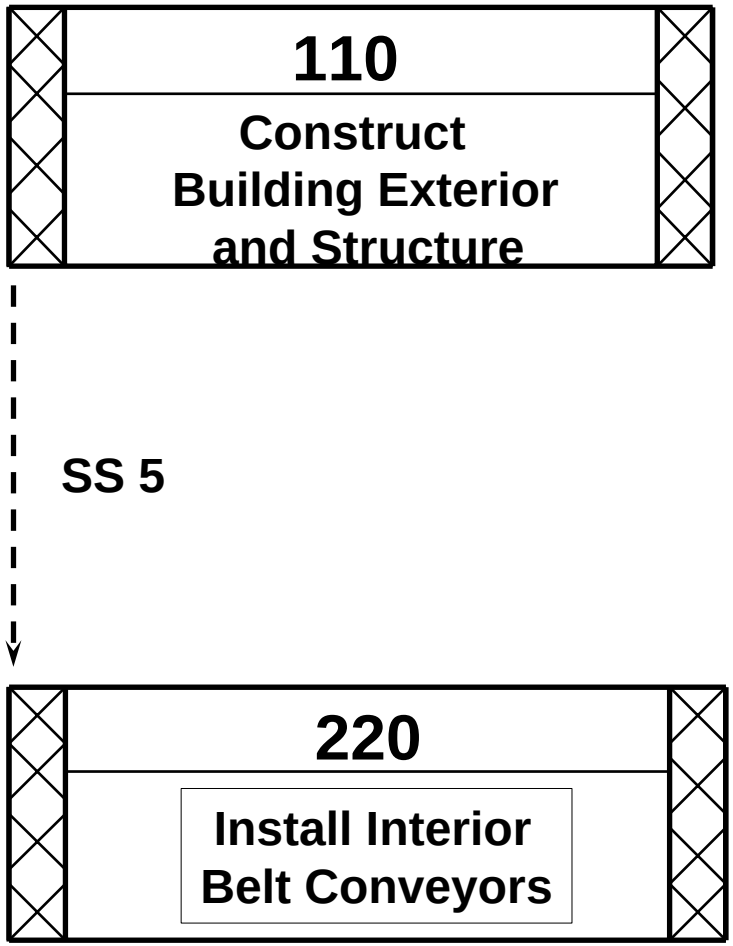
- A modification of a logical relationship that allows an acceleration of the successor activity. For example, in a finish-to-start dependency with a ten-day lead, the successor activity can start ten days before the predecessor activity has finished.
- A negative lead is equivalent to a positive lag.

Finish-To-Start With Lag



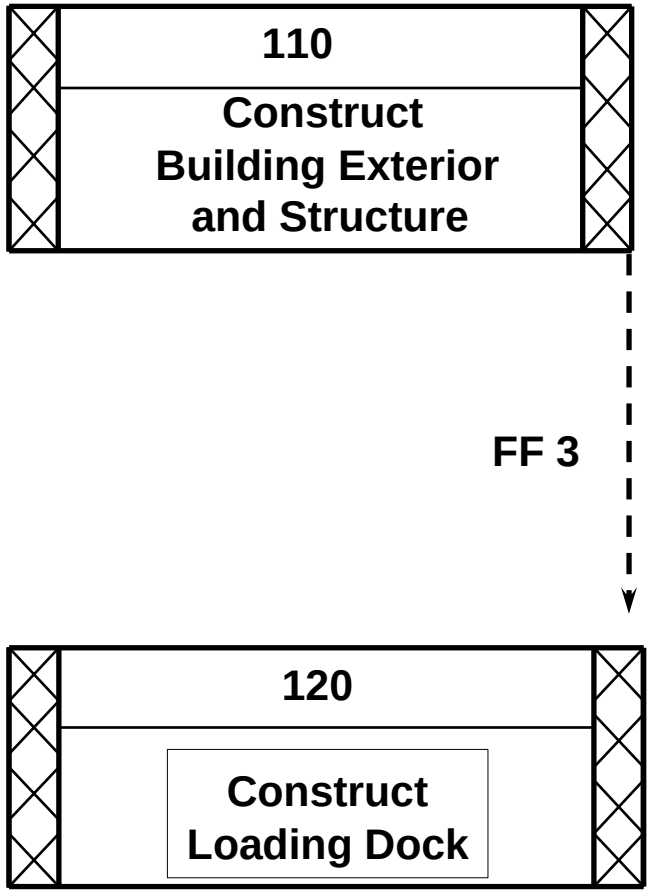
Construct Building Foundation must be finished seven days before Construct Building Exterior and Structure can start.

Start-To-Start With Lag



Installation of Interior Belt Conveyors can start five days or more after Construct Building Exterior and Structure starts.

Finish-To-Finish With Lag

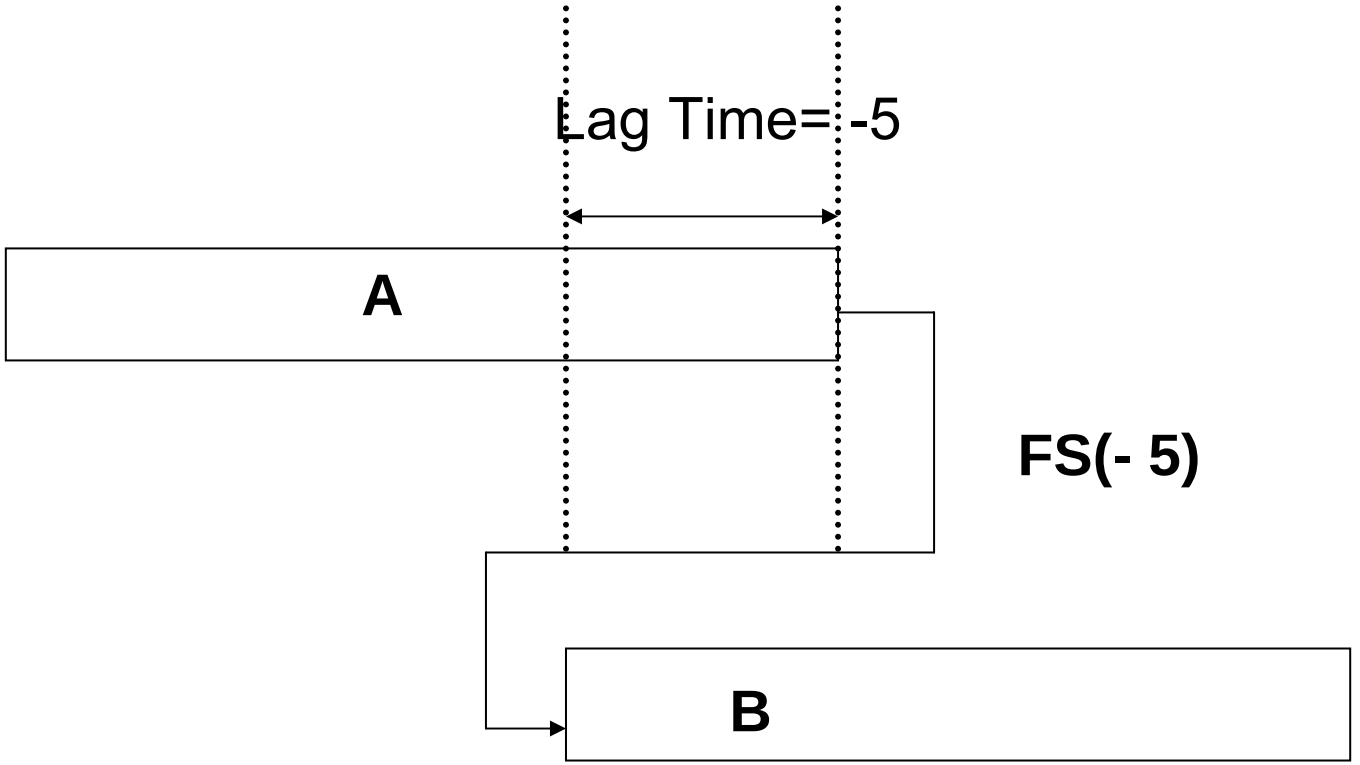


Construct Loading Dock can finish three days or more after Construct Building Exterior and Structure finishes.

Quiz

- Model the following situation describing the relationship between tasks A & B:
- Task A duration is 20 days. Last Five Days of Task A involve testing of the product resulting from Task A. However, Task B, Involves Marketing Reviewing Product from Task A for Market Strategy, Which Does Not Require Testing At All.

Answer



Logic Errors and Problems

- Incorrect Logic
- Redundant Logic
- Loops
- Open Ends/Dangling

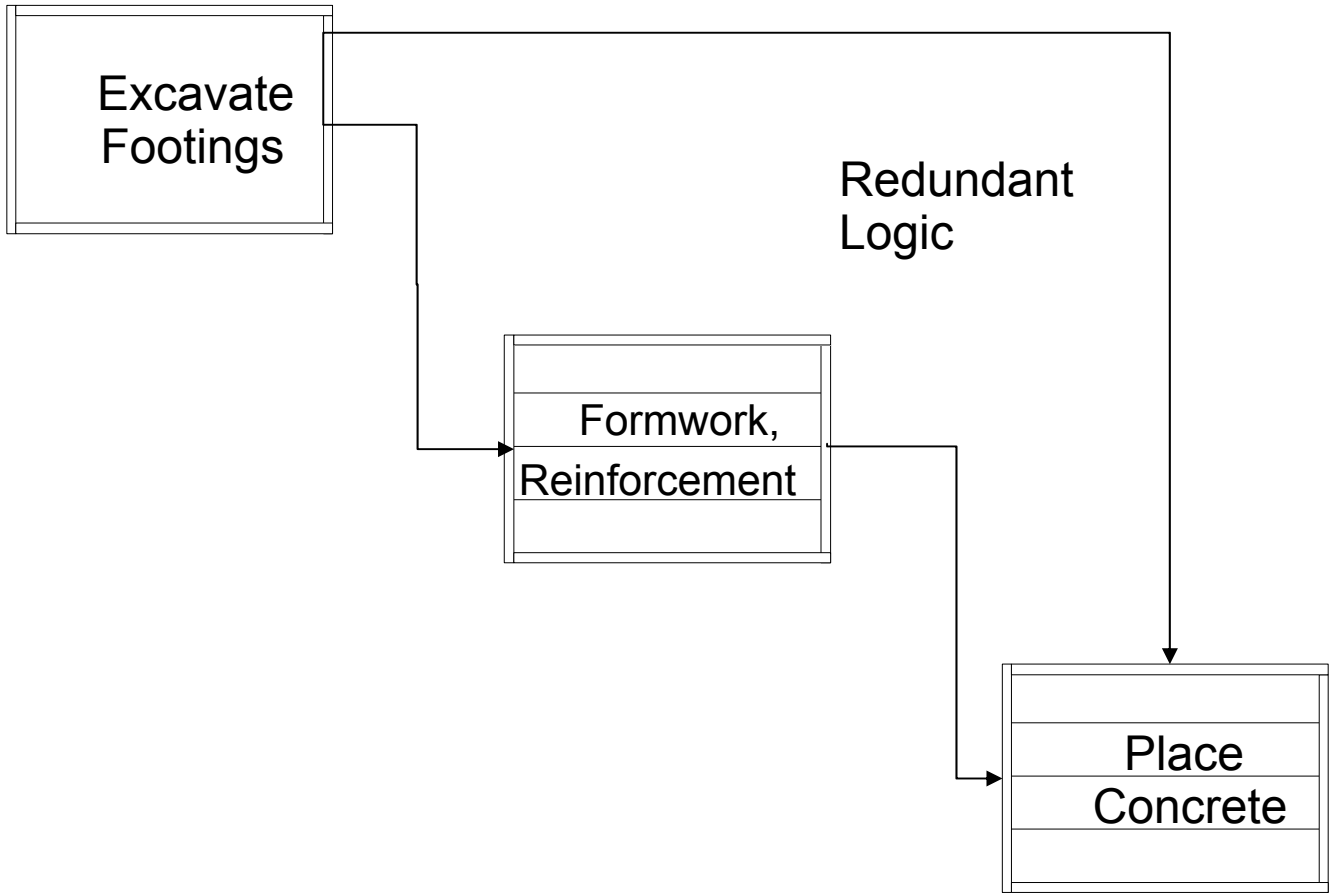
Incorrect Logic

- The activity logic included in the network schedule must be correct. If the logic is not correct, the network schedule will not accurately represent the way construction will actually be carried out.
- For example, the selection of an interior architect paint color by the architect should not restrain the application of the roof in the network because these two activities are not logically related.
- Incorrect activity logic reduces the effectiveness of the network schedule as a planning and management tool.

Redundant Logic

- Redundant logic is not incorrect but should be avoided when constructing activity networks. Redundant logic tends to unnecessarily complicate an activity network. Redundant logic makes modifying and analyzing an activity network more difficult.

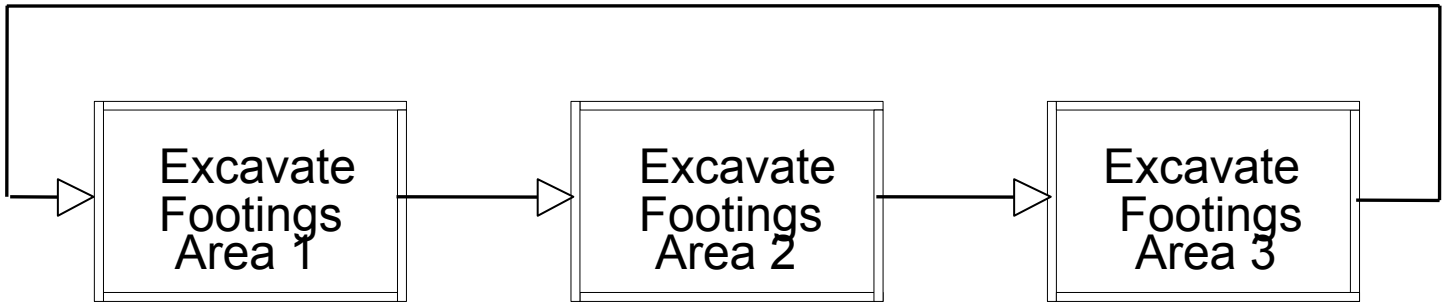
Redundant Logic



Logic Loops

- As noted previously, activity networks used in construction normally have a unidirectional flow from the start to completion of the project.
- Logic loops violate this basic premise and result in an impossible situation where a predecessor activity cannot start until a successor activity is completed.
- Loops not only result in impossible network logic but also prevent the schedule from being calculated using the forward and background pass technique.

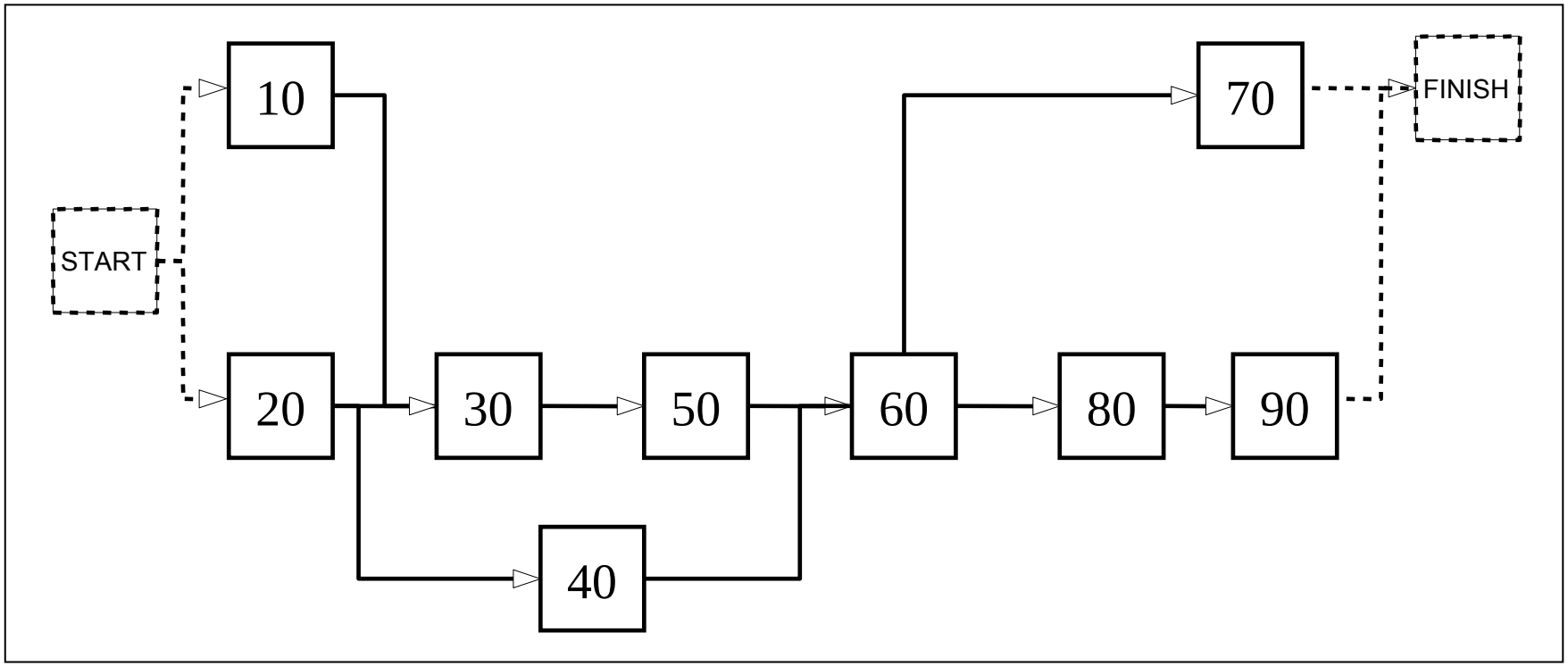
Loops



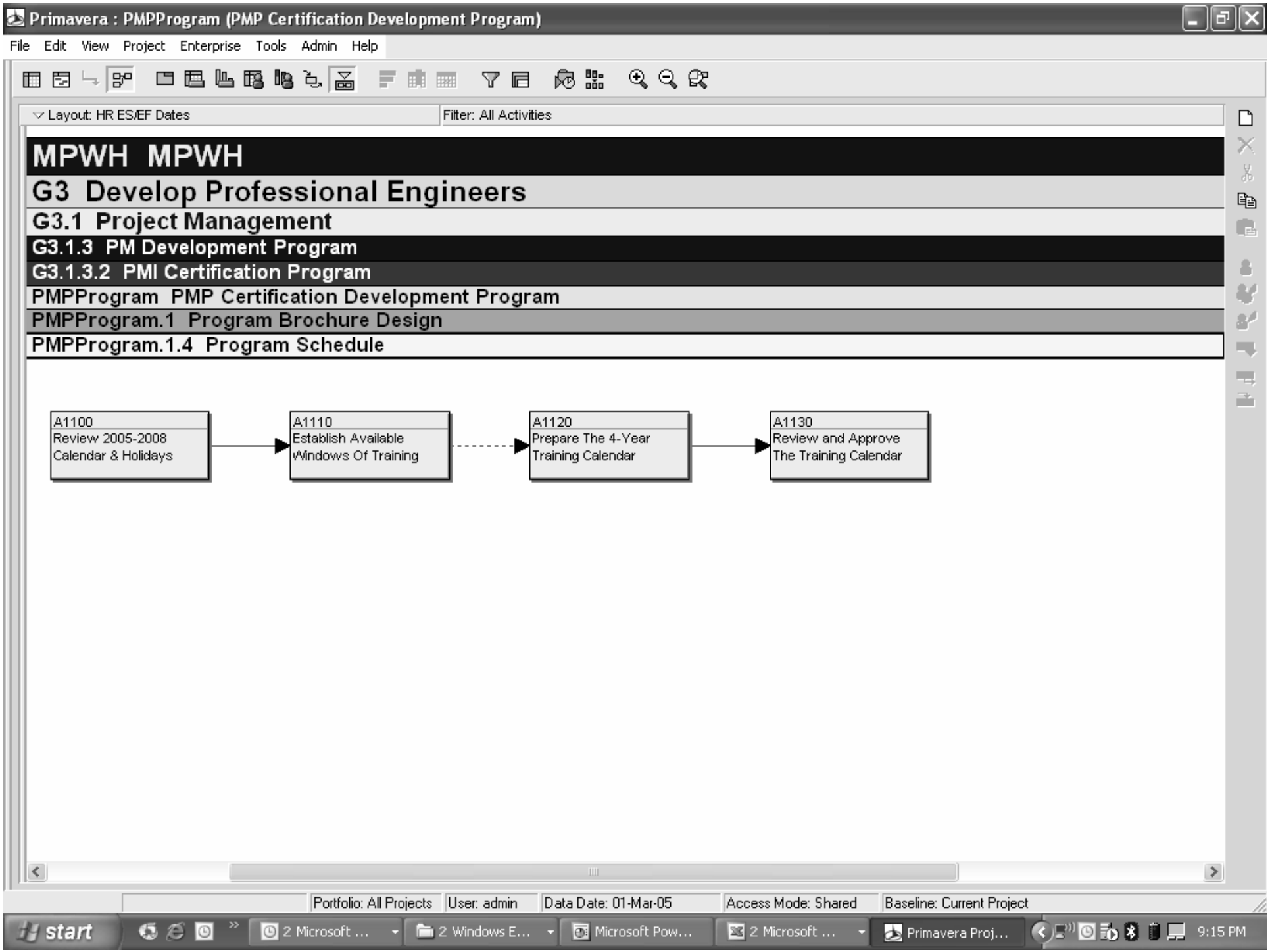
Open Ends/ Dangling

- It is recommended that project plans have single start and end points. This will help in ensuring that logic is complete as well as it makes presentation neater.

Open Ends



NOTE: We recommend that each project have only two open ends, the first milestone activity and the last milestone activity.


Primavera : PMPProgram (PMP Certification Development Program)
File Edit View Project Enterprise Tools Admin Help
Layout: HR ES/EF Dates
Filter: All Activities
MPWH MPWH
G3 Develop Professional Engineers
G3.1 Project Management
G3.1.3 PM Development Program
G3.1.3.2 PMI Certification Program
PMPProgram PMP Certification Development Program
PMPProgram.1 Program Brochure Design
PMPProgram.1.4 Program Schedule
A1100
Review 2005-2008
Calendar & Holidays
A1110
Establish Available
Windows Of Training
A1120
Prepare The 4-Year
Training Calendar
A1130
Review and Approve
The Training Calendar
Portfolio: All Projects
User: admin
Data Date: 01-Mar-05
Access Mode: Shared
Baseline: Current Project
start
2 Microsoft ...
2 Windows E...
Microsoft Pow...
2 Microsoft ...
Primavera Proj...
9:15 PM

PERT

- An acronym of Program, Evaluation and Review Technique denoting a form of network analysis in which the duration of processes required to complete a complex task or project is used to calculate the range of possible completion times and to aid informed decisions on the scheduling of these processes.

PERT

- What is the PERT formula?
  - DUR = (P+4M+O)/6
- The formula for standard deviation?
  - SD = (P-O)/6
- The formula for variance?
  - VAR = SD^2

P= Pessimistic
M = Most Likely
O = Optimistic
SD = Standard Deviation

GERT Diagram

- GERT = Graphical Evaluation Review Technique
- A network diagramming method that allows loops between nodes.

End Of Section

Planning and Scheduling Projects: Getting Ready For The PSP Exam

DAY TWO

Activity Resource Estimating

- Estimating the type and quantities of resources required to perform each schedule activity.

Resource Types

- Labor/People Resources
  - Technical
  - Non-Technical
- Equipment Resources
- Material Resources

Definition Of Resource

- Labor (people)
  - Measured in units of time
  - Generally, reused between activities and projects
  - Recorded in terms of price/unit e.g., $50.00/hour
- Non-labor (equipment)
  - Measured in units of time
  - Generally, reused between activities and projects
  - Recorded in terms of price/unit e.g., 1 training room per day
- Material
  - Measured in units other than time
  - Generally, consumed by the activity to which it is assigned
  - Recorded in terms of price/unit .e.g., $4.50/square foot

Resource Availability

- Information on which resources are potentially available is used for estimating resource types.

Alternative Analysis

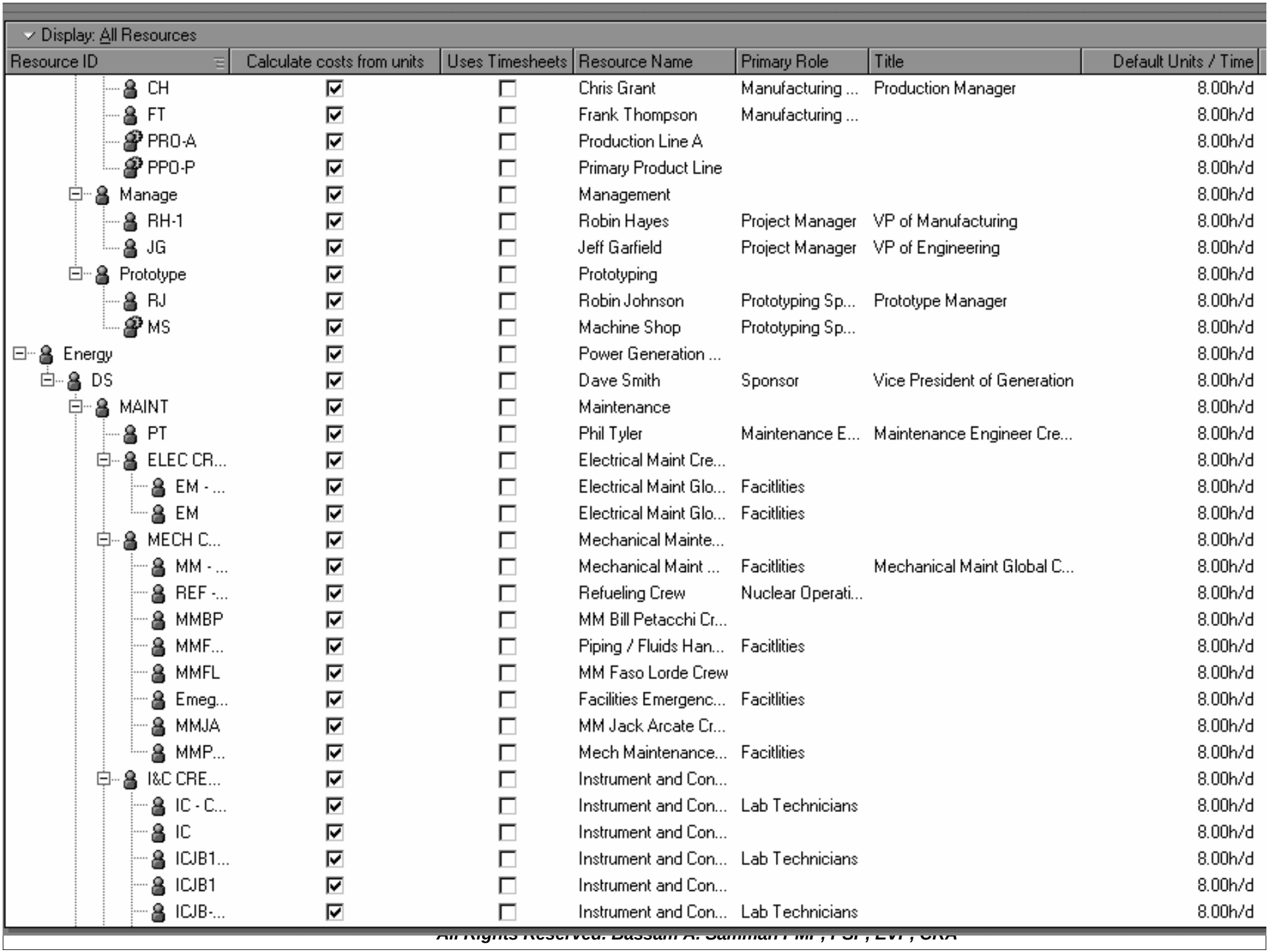
- Many schedule activities have alternative methods of accomplishment. They include using various levels of resource capability or skills, different size or type of machine, different tools, outsourcing, etc.,

Published Estimating Data

- Several companies routinely publish updated production rates and unit costs of resources for an extensive array of labor rates, material and equipment for different countries.
- Examples: RS Means, Dodge, etc.

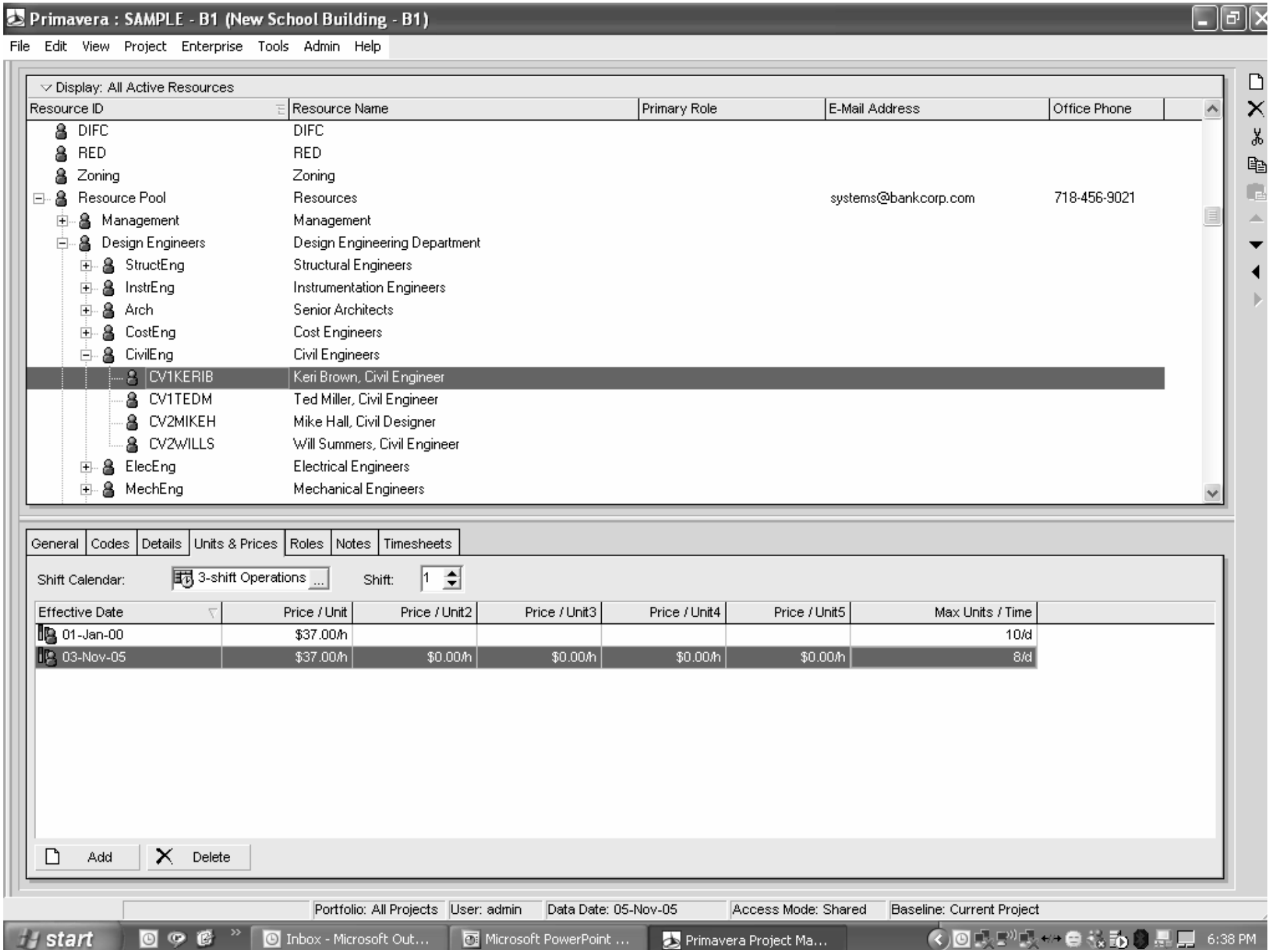
Resource Breakdown Structure

- Is a hierarchical structure of the identified resources by resource category and type.



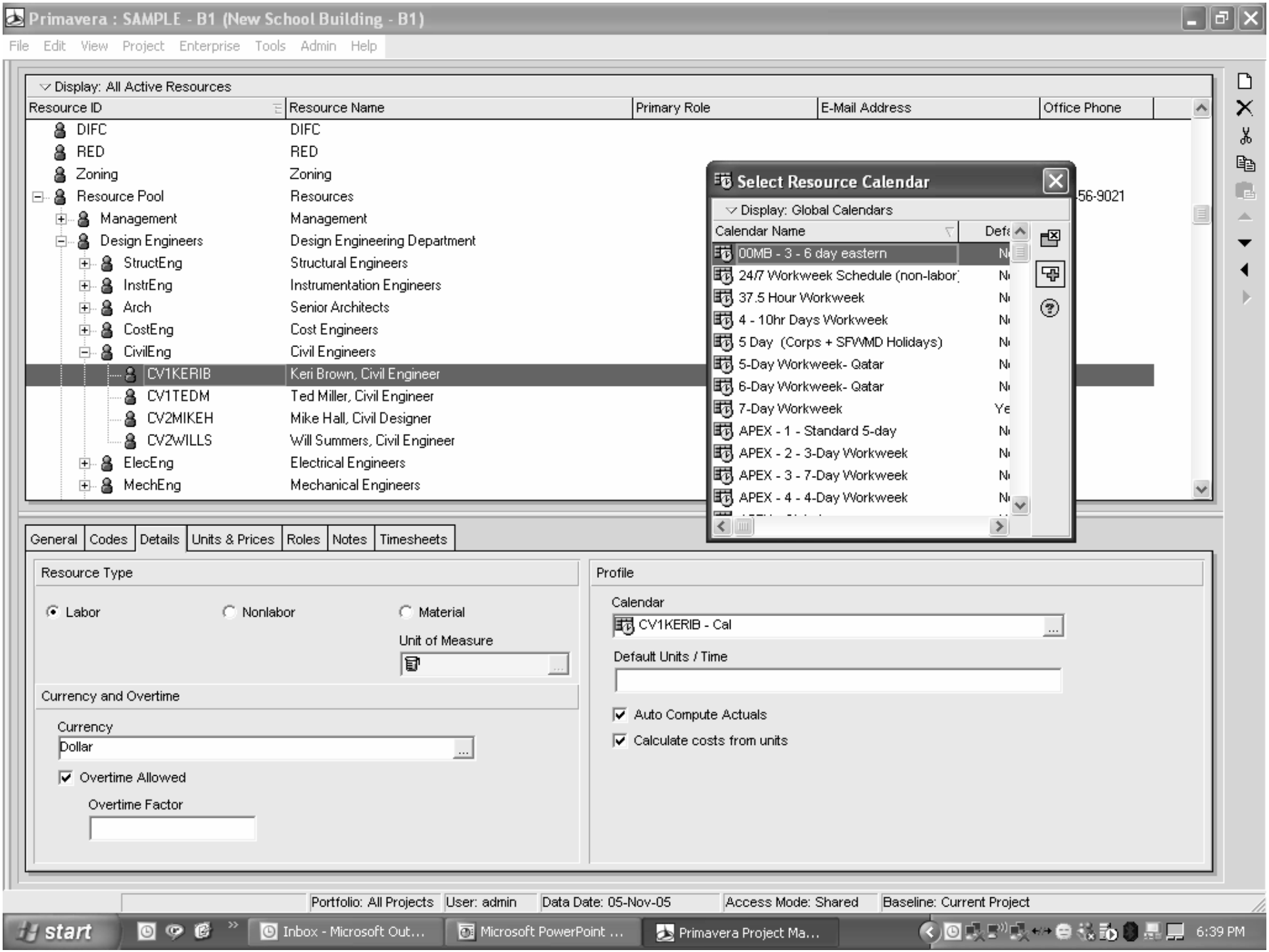
Display: All Resources

Resource ID	Calculate costs from units	Uses Timesheets	Resource Name	Primary Role	Title	Default Units / Time
CH	☑	☐	Chris Grant	Manufacturing ...	Production Manager	8.00h/d
FT	☑	☐	Frank Thompson	Manufacturing ...		8.00h/d
PRO-A	☑	☐	Production Line A			8.00h/d
PPO-P	☑	☐	Primary Product Line			8.00h/d
Manage	☑	☐	Management			8.00h/d
RH-1	☑	☐	Robin Hayes	Project Manager	VP of Manufacturing	8.00h/d
JG	☑	☐	Jeff Garfield	Project Manager	VP of Engineering	8.00h/d
Prototype	☑	☐	Prototyping			8.00h/d
RJ	☑	☐	Robin Johnson	Prototyping Sp...	Prototype Manager	8.00h/d
MS	☑	☐	Machine Shop	Prototyping Sp...		8.00h/d
Energy	☑	☐	Power Generation ...			8.00h/d
DS	☑	☐	Dave Smith	Sponsor	Vice President of Generation	8.00h/d
MAINT	☑	☐	Maintenance			8.00h/d
PT	☑	☐	Phil Tyler	Maintenance E...	Maintenance Engineer Cre...	8.00h/d
ELEC CR...	☑	☐	Electrical Maint Cre...			8.00h/d
EM - ...	☑	☐	Electrical Maint Glo...	Facitlities		8.00h/d
EM	☑	☐	Electrical Maint Glo...	Facitlities		8.00h/d
MECH C...	☑	☐	Mechanical Mainte...			8.00h/d
MM - ...	☑	☐	Mechanical Maint ...	Facitlities	Mechanical Maint Global C...	8.00h/d
REF -...	☑	☐	Refueling Crew	Nuclear Operati...		8.00h/d
MMBP	☑	☐	MM Bill Petacchi Cr...			8.00h/d
MMF...	☑	☐	Piping / Fluids Han...	Facitlities		8.00h/d
MMFL	☑	☐	MM Faso Lorde Crew			8.00h/d
Emeg...	☑	☐	Facilities Emergenc...	Facitlities		8.00h/d
MMJA	☑	☐	MM Jack Arcate Cr...			8.00h/d
MMP...	☑	☐	Mech Maintenance...	Facitlities		8.00h/d
I&C CRE...	☑	☐	Instrument and Con...			8.00h/d
IC - C...	☑	☐	Instrument and Con...	Lab Technicians		8.00h/d
IC	☑	☐	Instrument and Con...			8.00h/d
ICJB1...	☑	☐	Instrument and Con...	Lab Technicians		8.00h/d
ICJB1	☑	☐	Instrument and Con...			8.00h/d
ICJB-...	☑	☐	Instrument and Con...	Lab Technicians		8.00h/d


Primavera : SAMPLE - B1 (New School Building - B1)
File Edit View Project Enterprise Tools Admin Help
Display: All Active Resources
Resource ID
Resource Name
Primary Role
E-Mail Address
Office Phone
DIFC DIFC
RED RED
Zoning Zoning
Resource Pool Resources systems@bankcorp.com 718-456-9021
Management Management
Design Engineers Design Engineering Department
StructEng Structural Engineers
InstrEng Instrumentation Engineers
Arch Senior Architects
CostEng Cost Engineers
CivilEng Civil Engineers
CV1KERIB Keri Brown, Civil Engineer
CV1TEDM Ted Miller, Civil Engineer
CV2MIKEH Mike Hall, Civil Designer
CV2WILLS Will Summers, Civil Engineer
ElecEng Electrical Engineers
MechEng Mechanical Engineers
General Codes Details Units & Prices Roles Notes Timesheets
Shift Calendar: 3-shift Operations ...
Shift: 1
Effective Date
Price / Unit
Price / Unit2
Price / Unit3
Price / Unit4
Price / Unit5
Max Units / Time
01-Jan-00 $37.00/h 10/d
03-Nov-05 $37.00/h $0.00/h $0.00/h $0.00/h $0.00/h 8/d
Add
Delete
Portfolio: All Projects
User: admin
Data Date: 05-Nov-05
Access Mode: Shared
Baseline: Current Project
start
Inbox - Microsoft Out...
Microsoft PowerPoint ...
Primavera Project Ma...
6:38 PM

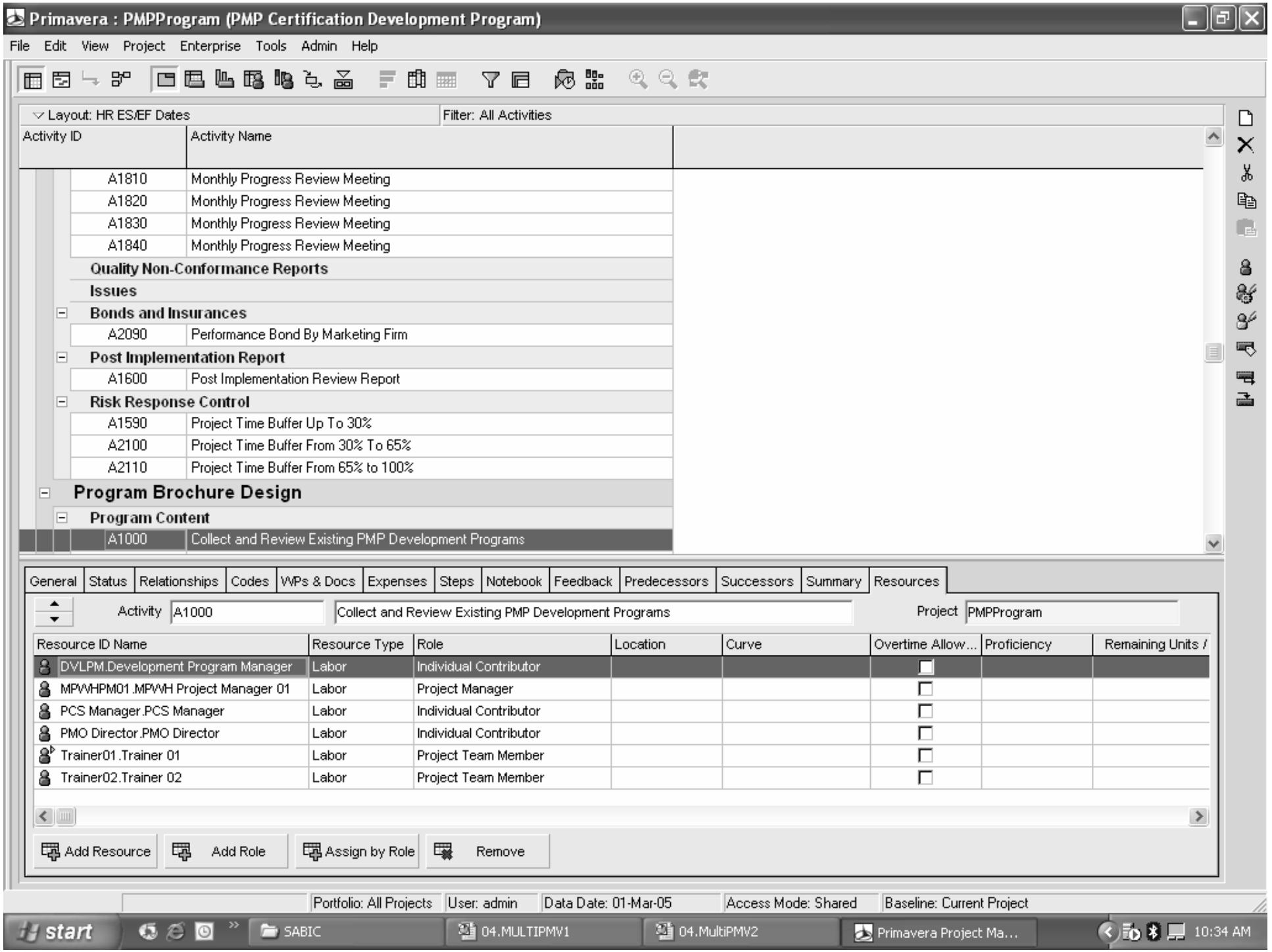
Resource Calendar

- Documenting working and non-working days for which a resource will be active or idle.


Primavera : SAMPLE - B1 (New School Building - B1)
File Edit View Project Enterprise Tools Admin Help
Display: All Active Resources
Resource ID
Resource Name
Primary Role
E-Mail Address
Office Phone
DIFC
DIFC
RED
RED
Zoning
Zoning
Resource Pool
Resources
Management
Management
Design Engineers
Design Engineering Department
StructEng
Structural Engineers
InstrEng
Instrumentation Engineers
Arch
Senior Architects
CostEng
Cost Engineers
CivilEng
Civil Engineers
CV1KERIB
Keri Brown, Civil Engineer
CV1TEDM
Ted Miller, Civil Engineer
CV2MIKEH
Mike Hall, Civil Designer
CV2WILLS
Will Summers, Civil Engineer
ElecEng
Electrical Engineers
MechEng
Mechanical Engineers
56-9021
Select Resource Calendar
Display: Global Calendars
Calendar Name
00MB - 3 - 6 day eastern
24/7 Workweek Schedule (non-labor)
37.5 Hour Workweek
4 - 10hr Days Workweek
5 Day (Corps + SFWMD Holidays)
5-Day Workweek- Qatar
6-Day Workweek- Qatar
7-Day Workweek
APEX - 1 - Standard 5-day
APEX - 2 - 3-Day Workweek
APEX - 3 - 7-Day Workweek
APEX - 4 - 4-Day Workweek
General
Codes
Details
Units & Prices
Roles
Notes
Timesheets
Resource Type
Labor
Nonlabor
Material
Unit of Measure
Currency and Overtime
Currency
Dollar
Overtime Allowed
Overtime Factor
Profile
Calendar
CV1KERIB - Cal
Default Units / Time
Auto Compute Actuals
Calculate costs from units
Portfolio: All Projects
User: admin
Data Date: 05-Nov-05
Access Mode: Shared
Baseline: Current Project
start
Inbox - Microsoft Out...
Microsoft PowerPoint ...
Primavera Project Ma...
6:39 PM

Published Estimating Data

- Several companies routinely publish updated production rates and unit costs of resources for an extensive array of labor rates, material and equipment for different countries.
- Examples: RS Means, Dodge, etc.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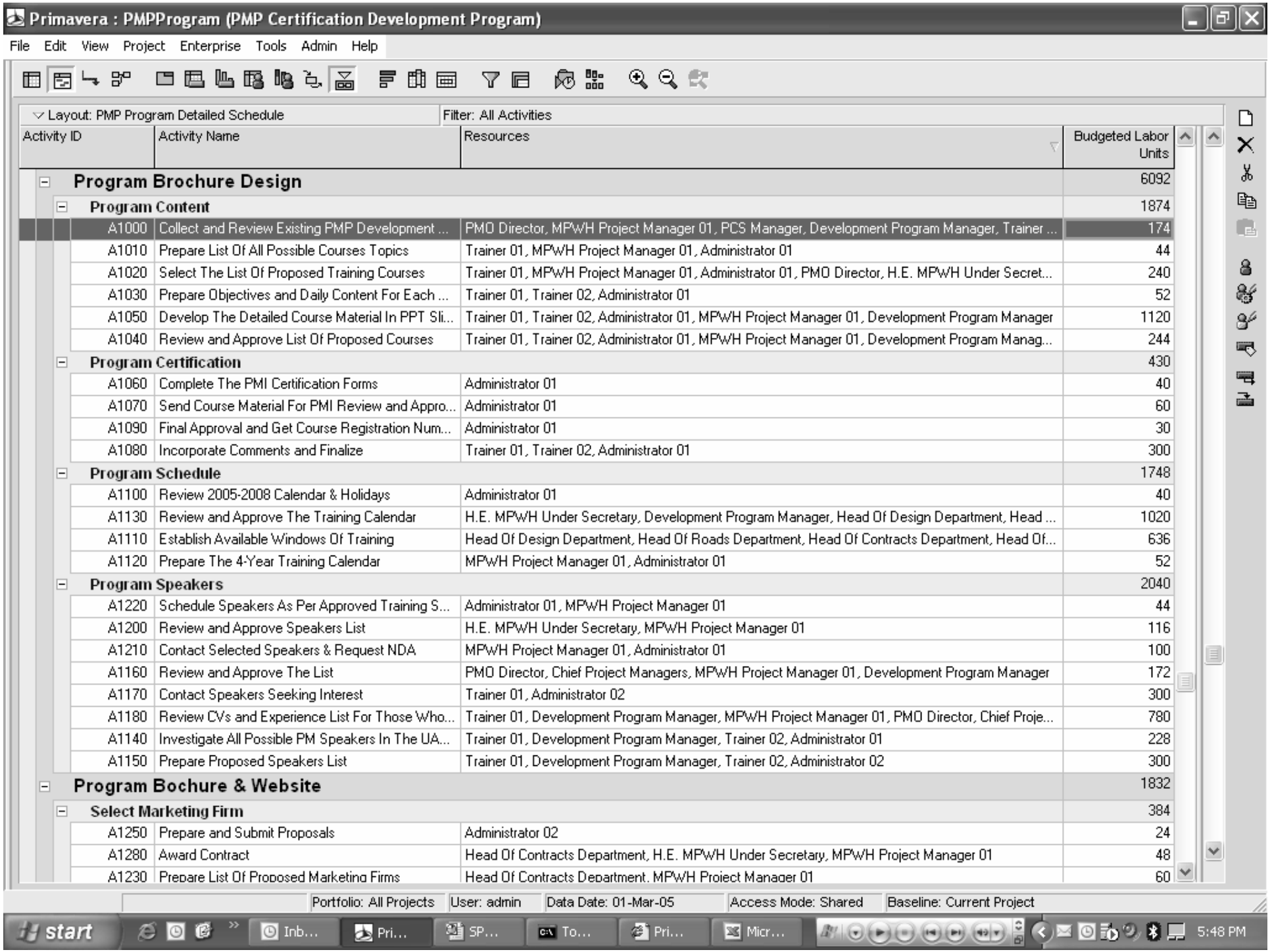
File Edit View Project Enterprise Tools Admin Help
Layout: HR ES/EF Dates
Filter: All Activities
Activity ID
Activity Name
A1810 Monthly Progress Review Meeting
A1820 Monthly Progress Review Meeting
A1830 Monthly Progress Review Meeting
A1840 Monthly Progress Review Meeting
Quality Non-Conformance Reports
Issues
Bonds and Insurances
A2090 Performance Bond By Marketing Firm
Post Implementation Report
A1600 Post Implementation Review Report
Risk Response Control
A1590 Project Time Buffer Up To 30%
A2100 Project Time Buffer From 30% To 65%
A2110 Project Time Buffer From 65% to 100%
Program Brochure Design
Program Content
A1000 Collect and Review Existing PMP Development Programs
General Status Relationships Codes WPs & Docs Expenses Steps Notebook Feedback Predecessors Successors Summary Resources
Activity A1000
Collect and Review Existing PMP Development Programs
Project PMPProgram
Resource ID Name
Resource Type
Role
Location
Curve
Overtime Allow...
Proficiency
Remaining Units /
DVLPM.Development Program Manager Labor Individual Contributor
MPWHPM01.MPWH Project Manager 01 Labor Project Manager
PCS Manager.PCS Manager Labor Individual Contributor
PMO Director.PMO Director Labor Individual Contributor
Trainer01.Trainer 01 Labor Project Team Member
Trainer02.Trainer 02 Labor Project Team Member
Add Resource
Add Role
Assign by Role
Remove
Portfolio: All Projects
User: admin
Data Date: 01-Mar-05
Access Mode: Shared
Baseline: Current Project
start
SABIC
04.MULTIPMV1
04.MultiPMV2
Primavera Project Ma...
10:34 AM


Primavera : PMPProgram (PMP Certification Development Program)
File Edit View Project Enterprise Tools Admin Help
Layout: PMP Program Detailed Schedule
Filter: All Activities
Activity ID
Activity Name
Resources
Budgeted Labor Units
Program Brochure Design 6092
Program Content 1874
A1000 Collect and Review Existing PMP Development ... PMO Director, MPWH Project Manager 01, PCS Manager, Development Program Manager, Trainer ... 174
A1010 Prepare List Of All Possible Courses Topics Trainer 01, MPWH Project Manager 01, Administrator 01 44
A1020 Select The List Of Proposed Training Courses Trainer 01, MPWH Project Manager 01, Administrator 01, PMO Director, H.E. MPWH Under Secret... 240
A1030 Prepare Objectives and Daily Content For Each ... Trainer 01, Trainer 02, Administrator 01 52
A1050 Develop The Detailed Course Material In PPT Sli... Trainer 01, Trainer 02, Administrator 01, MPWH Project Manager 01, Development Program Manager 1120
A1040 Review and Approve List Of Proposed Courses Trainer 01, Trainer 02, Administrator 01, MPWH Project Manager 01, Development Program Manag... 244
Program Certification 430
A1060 Complete The PMI Certification Forms Administrator 01 40
A1070 Send Course Material For PMI Review and Appro... Administrator 01 60
A1090 Final Approval and Get Course Registration Num... Administrator 01 30
A1080 Incorporate Comments and Finalize Trainer 01, Trainer 02, Administrator 01 300
Program Schedule 1748
A1100 Review 2005-2008 Calendar & Holidays Administrator 01 40
A1130 Review and Approve The Training Calendar H.E. MPWH Under Secretary, Development Program Manager, Head Of Design Department, Head ... 1020
A1110 Establish Available Windows Of Training Head Of Design Department, Head Of Roads Department, Head Of Contracts Department, Head Of... 636
A1120 Prepare The 4-Year Training Calendar MPWH Project Manager 01, Administrator 01 52
Program Speakers 2040
A1220 Schedule Speakers As Per Approved Training S... Administrator 01, MPWH Project Manager 01 44
A1200 Review and Approve Speakers List H.E. MPWH Under Secretary, MPWH Project Manager 01 116
A1210 Contact Selected Speakers & Request NDA MPWH Project Manager 01, Administrator 01 100
A1160 Review and Approve The List PMO Director, Chief Project Managers, MPWH Project Manager 01, Development Program Manager 172
A1170 Contact Speakers Seeking Interest Trainer 01, Administrator 02 300
A1180 Review CVs and Experience List For Those Who... Trainer 01, Development Program Manager, MPWH Project Manager 01, PMO Director, Chief Proje... 780
A1140 Investigate All Possible PM Speakers In The UA... Trainer 01, Development Program Manager, Trainer 02, Administrator 01 228
A1150 Prepare Proposed Speakers List Trainer 01, Development Program Manager, Trainer 02, Administrator 02 300
Program Bochure & Website 1832
Select Marketing Firm 384
A1250 Prepare and Submit Proposals Administrator 02 24
A1280 Award Contract Head Of Contracts Department, H.E. MPWH Under Secretary, MPWH Project Manager 01 48
A1230 Prepare List Of Proposed Marketing Firms Head Of Contracts Department, MPWH Project Manager 01 60
Portfolio: All Projects
User: admin
Data Date: 01-Mar-05
Access Mode: Shared
Baseline: Current Project
start
5:48 PM

Activity Duration Estimating

- Define a time duration for each activity based on estimated work and historical productivity rates.

Underestimating Activities

- Being optimistic and desire to please
- Underestimate nonproductive periods
- Incomplete recall of previous experience
- Unfamiliar with the complete project scope
- No experience in specific activities

Estimating Activity Durations

- The duration of an activity is a function of the amount of work that must be accomplished and the rate at which that work can be accomplished. Simply stated, the duration of an activity is the quantity of work divided by the production rate. The basic formula for estimating activity durations is as follows:

$$\text{Activity Duration} = \frac{\text{Work Quantity}}{\text{Production Rate}}$$

Work Quantity

- The work quantity is the amount of work that must be accomplished which is normally defined by the construction documents.
- The quantity of work is expressed in some measurable quantity that could be the amount of materials or equipment that need to be installed.
- The quantity of work includes all work that is necessary to complete the scope of work defined by the activity.

Production Rate

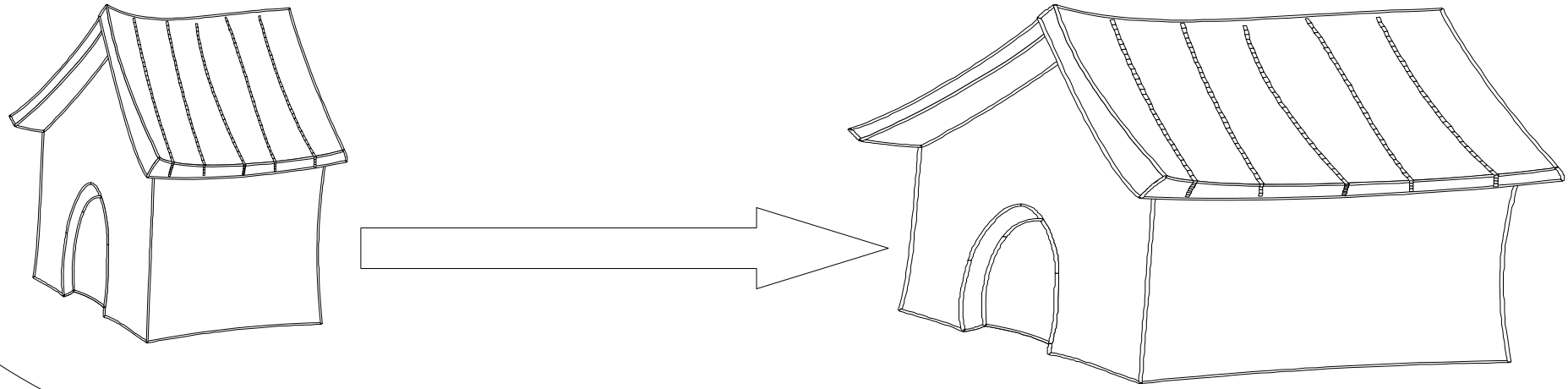
- The production rate should be the planned average daily production rate based on the available resources and the environment within which the work will be performed.
- It also includes the idle and nonproductive time associated with the movement and setup of equipment, break times, expected equipment downtime for maintenance and repair, and other expected downtime.

Factors Affecting Productivity

- Nature Of the Work
- Labor And Equipment Productivity
- Management Skill
- Material And Equipment Availability
- Seasonal Conditions
- Work Restrictions
- Quality Of Work
- Concurrent Activities

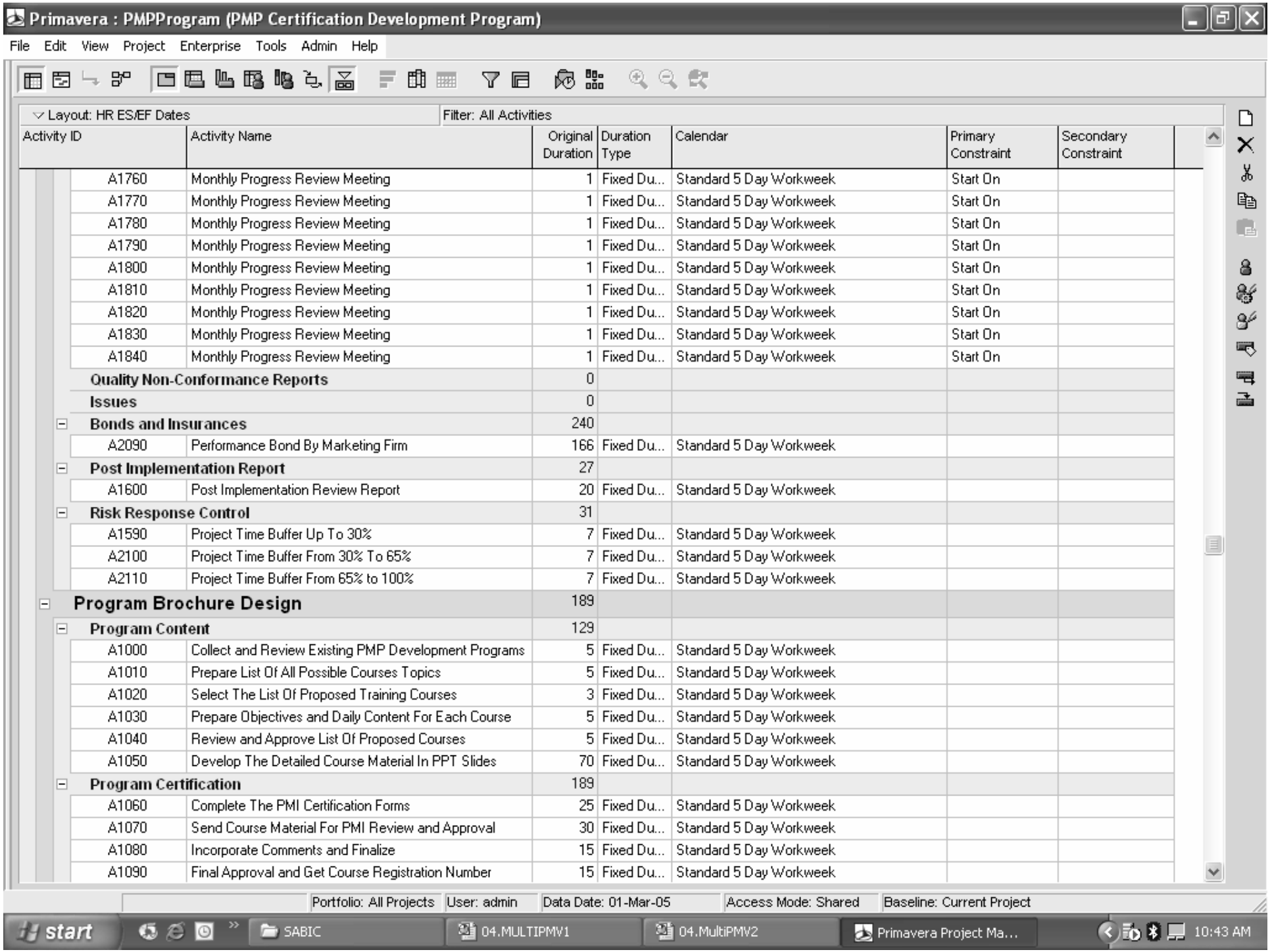
Analogous Estimating

- Using the actual duration of a previous similar schedule activity as the basis for estimating the duration of a future activity.



Parametric Estimating

- Estimating the basis for activity durations can be quantitatively determined by multiplying the quantity of the work to be performed by the productivity rate.


Primavera : PMPProgram (PMP Certification Development Program)
File Edit View Project Enterprise Tools Admin Help
Layout: HR ES/EF Dates
Filter: All Activities
Activity ID | Activity Name | Original Duration | Duration Type | Calendar | Primary Constraint | Secondary Constraint
A1760 | Monthly Progress Review Meeting | 1 | Fixed Du... | Standard 5 Day Workweek | Start On
A1770 | Monthly Progress Review Meeting | 1 | Fixed Du... | Standard 5 Day Workweek | Start On
A1780 | Monthly Progress Review Meeting | 1 | Fixed Du... | Standard 5 Day Workweek | Start On
A1790 | Monthly Progress Review Meeting | 1 | Fixed Du... | Standard 5 Day Workweek | Start On
A1800 | Monthly Progress Review Meeting | 1 | Fixed Du... | Standard 5 Day Workweek | Start On
A1810 | Monthly Progress Review Meeting | 1 | Fixed Du... | Standard 5 Day Workweek | Start On
A1820 | Monthly Progress Review Meeting | 1 | Fixed Du... | Standard 5 Day Workweek | Start On
A1830 | Monthly Progress Review Meeting | 1 | Fixed Du... | Standard 5 Day Workweek | Start On
A1840 | Monthly Progress Review Meeting | 1 | Fixed Du... | Standard 5 Day Workweek | Start On
Quality Non-Conformance Reports | 0
Issues | 0
Bonds and Insurances | 240
A2090 | Performance Bond By Marketing Firm | 166 | Fixed Du... | Standard 5 Day Workweek
Post Implementation Report | 27
A1600 | Post Implementation Review Report | 20 | Fixed Du... | Standard 5 Day Workweek
Risk Response Control | 31
A1590 | Project Time Buffer Up To 30% | 7 | Fixed Du... | Standard 5 Day Workweek
A2100 | Project Time Buffer From 30% To 65% | 7 | Fixed Du... | Standard 5 Day Workweek
A2110 | Project Time Buffer From 65% to 100% | 7 | Fixed Du... | Standard 5 Day Workweek
Program Brochure Design | 189
Program Content | 129
A1000 | Collect and Review Existing PMP Development Programs | 5 | Fixed Du... | Standard 5 Day Workweek
A1010 | Prepare List Of All Possible Courses Topics | 5 | Fixed Du... | Standard 5 Day Workweek
A1020 | Select The List Of Proposed Training Courses | 3 | Fixed Du... | Standard 5 Day Workweek
A1030 | Prepare Objectives and Daily Content For Each Course | 5 | Fixed Du... | Standard 5 Day Workweek
A1040 | Review and Approve List Of Proposed Courses | 5 | Fixed Du... | Standard 5 Day Workweek
A1050 | Develop The Detailed Course Material In PPT Slides | 70 | Fixed Du... | Standard 5 Day Workweek
Program Certification | 189
A1060 | Complete The PMI Certification Forms | 25 | Fixed Du... | Standard 5 Day Workweek
A1070 | Send Course Material For PMI Review and Approval | 30 | Fixed Du... | Standard 5 Day Workweek
A1080 | Incorporate Comments and Finalize | 15 | Fixed Du... | Standard 5 Day Workweek
A1090 | Final Approval and Get Course Registration Number | 15 | Fixed Du... | Standard 5 Day Workweek
Portfolio: All Projects
User: admin
Data Date: 01-Mar-05
Access Mode: Shared
Baseline: Current Project
start
SABIC
04.MULTIPMV1
04.MultiPMV2
Primavera Project Ma...
10:43 AM

Schedule Development

- Analyzing activity sequences, durations, resource requirements, and schedule constraints to create the project schedule.

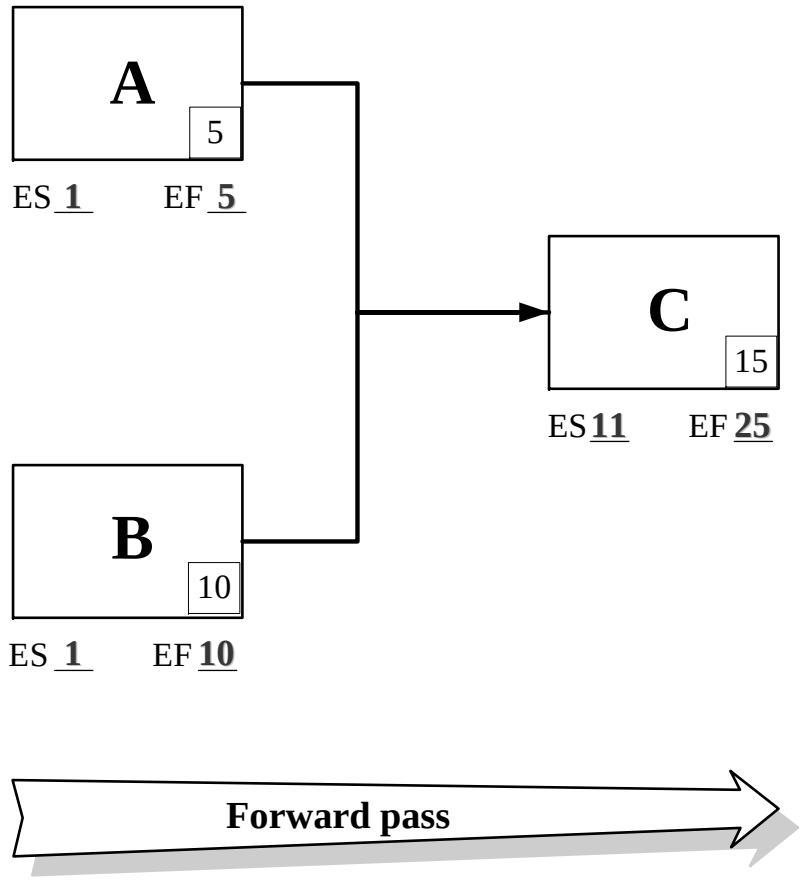
CPM Schedule Calculation

- Forward Pass
- Backward Pass
- Float
- Critical Path

Forward Pass Definitions

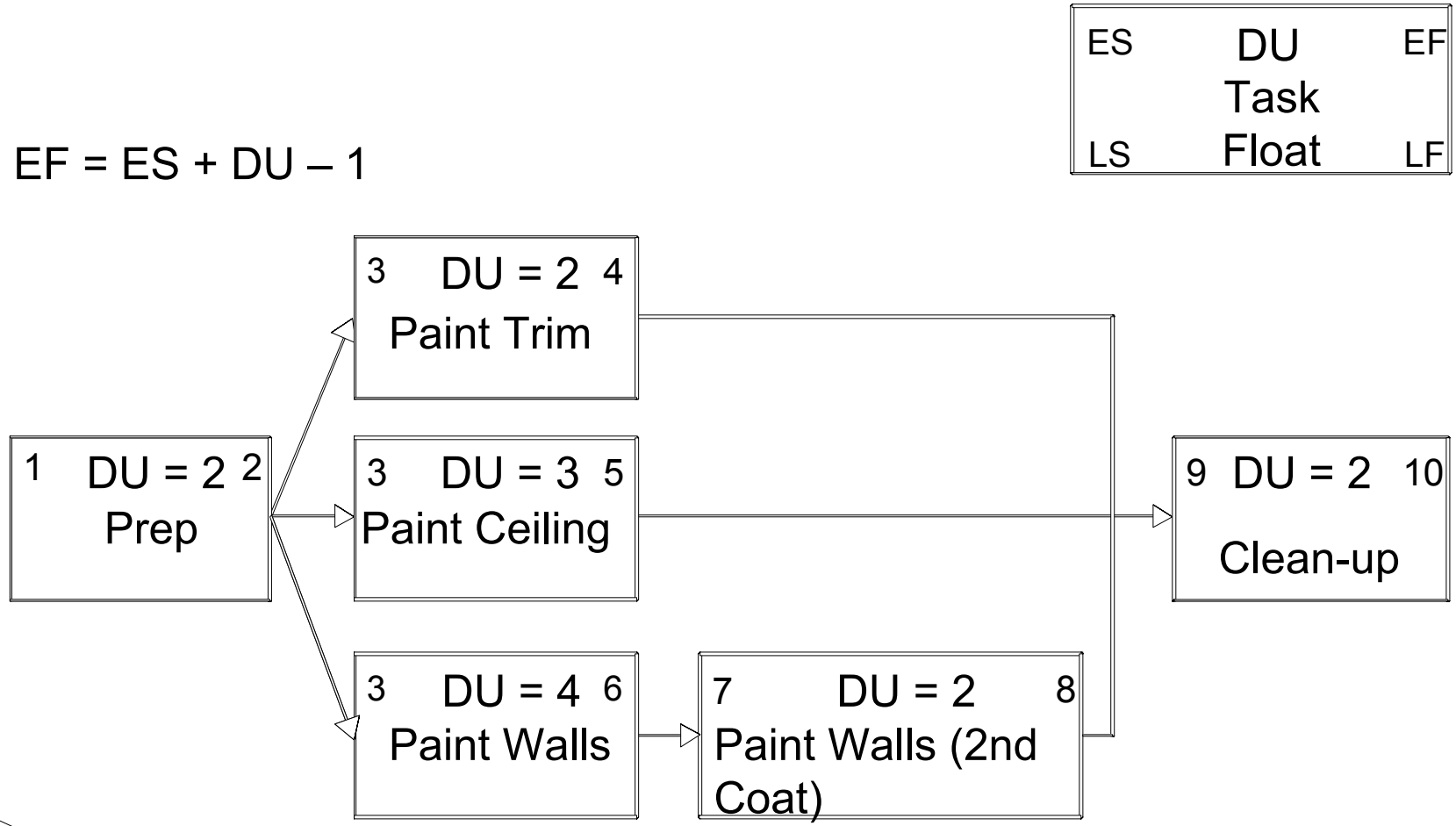
- **Early Start Date (ES)**
  - Earliest possible point in time an activity can start, based on the network logic and any schedule constraints
- **Duration (DU)**
  - Number of work periods, excluding holidays or other nonworking periods, required to complete the activity; expressed as workdays or workweeks
- **Early Finish Date (EF)**
  - Earliest possible time the activity can finish
- **Forward Pass**
  - Starting at the beginning (left) of the network develop early start and early finish dates for each task, progressing to end (right-most box) of the network

Forward Pass



Forward Pass Calculation

EF = ES + DU – 1



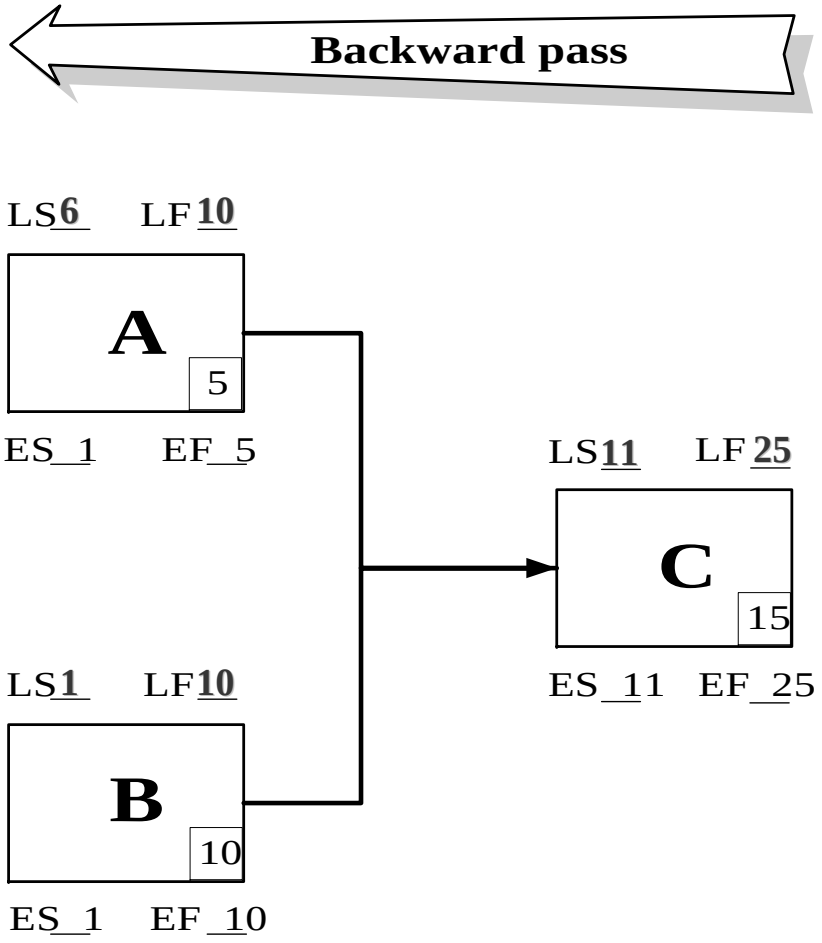
Task Identification
Forward Pass

Name	Duration	ES	EF
Prep	2	1	2
Paint Trim	2	3	4
Paint Ceiling	3	3	5
Paint Walls	4	3	6
Paint Walls (2nd Coat)	2	7	8
Clean-up	2	9	10

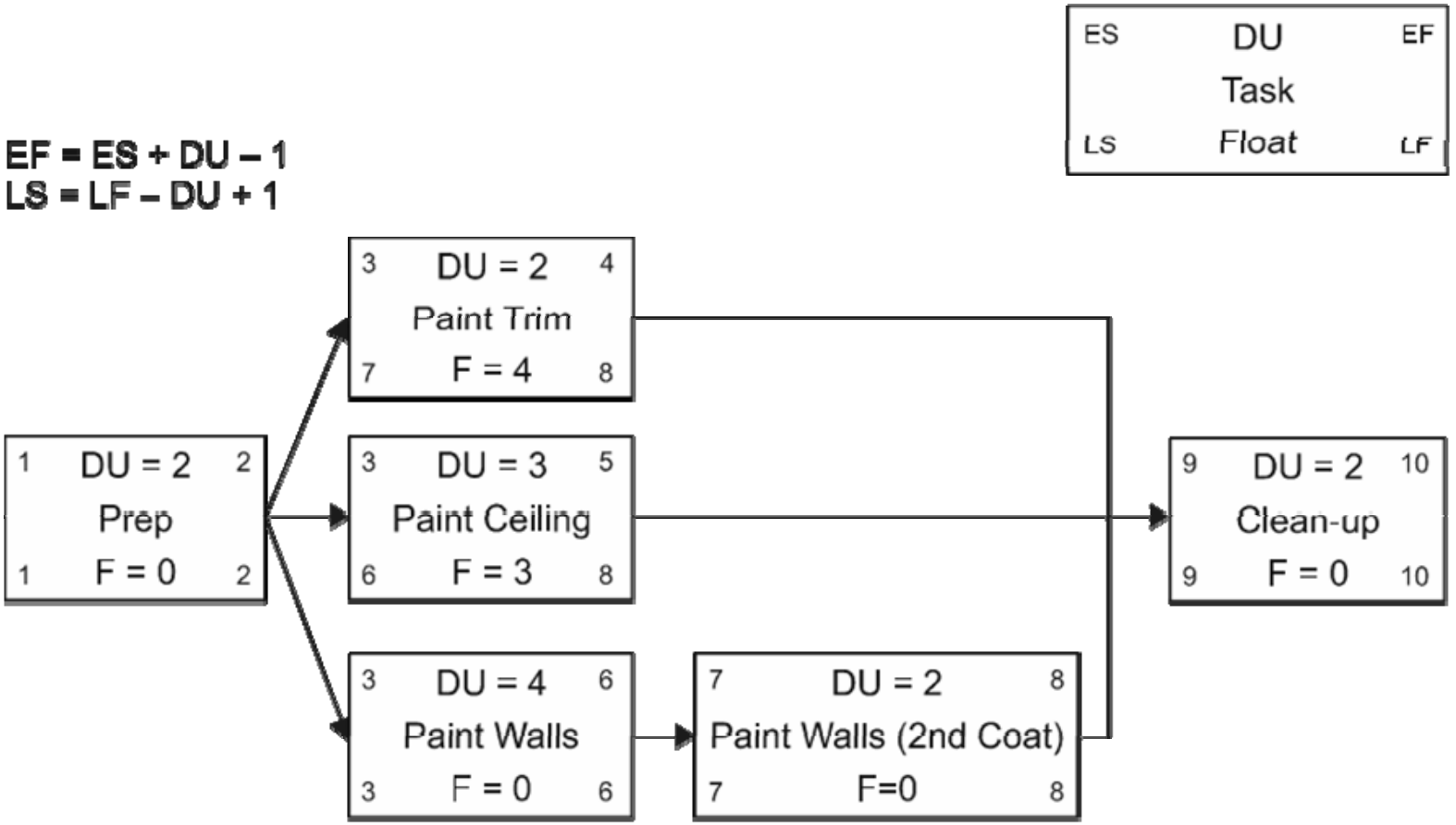
Backward Pass Definitions

- Late Start Date (LS)
  - Latest point in time that an activity may begin without delaying that activity's successor
  - If the activity is on the critical path, the project end date will be affected
- Late Finish (LF)
  - Latest point in time a task may be completed without delaying that activity's successor
  - If the activity is on the critical path, the project end date will be affected
- Backward Pass
  - Calculate late start and late finish dates by starting at project completion, using finish times and working backwards

Backward Pass



Backward Pass Calculation



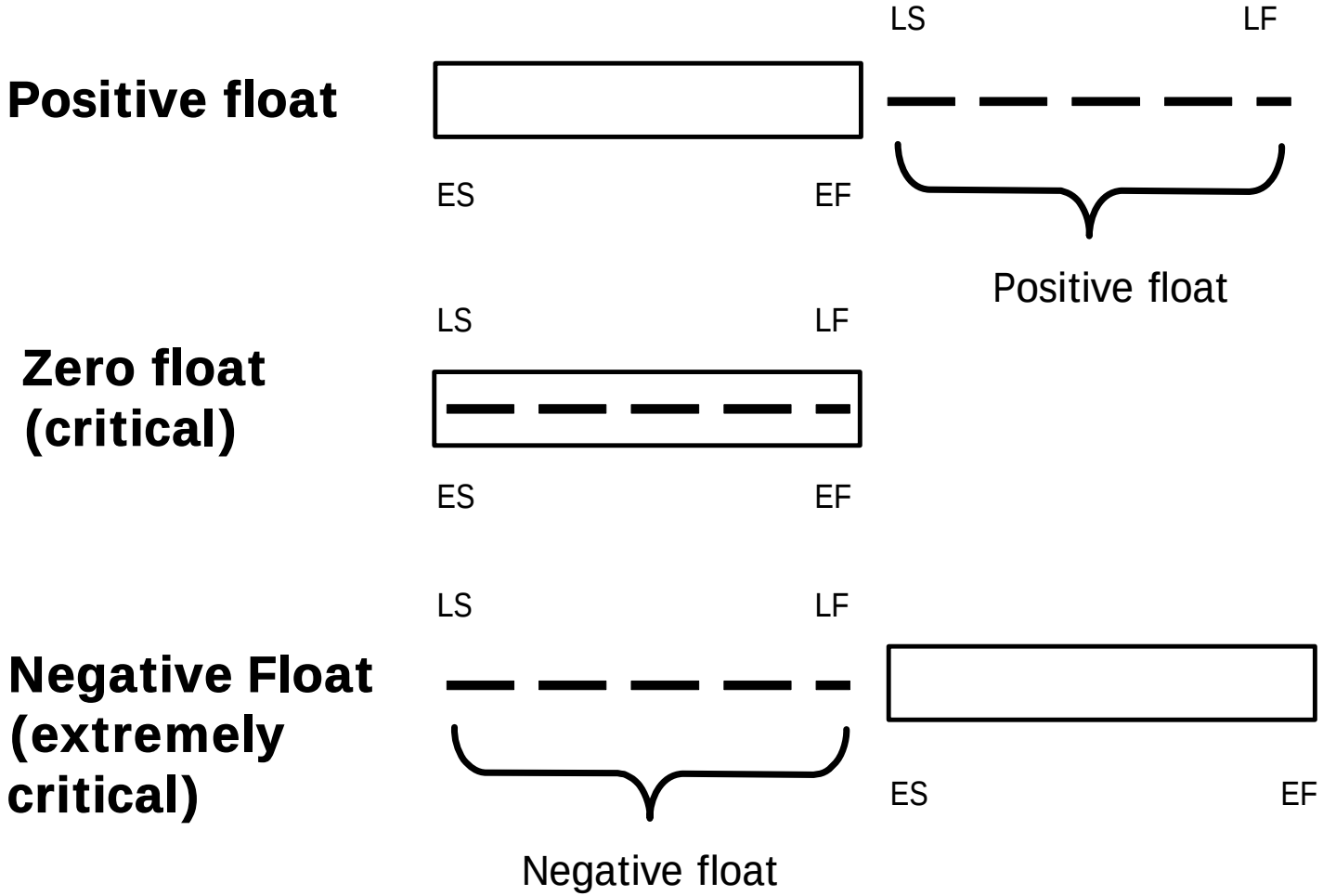
Free Slack and Total Slack

- *Free slack (Float):* The amount of time a task can be delayed without delaying the early start date of its successor
- *Total slack (Float):* The amount of time a task can be delayed without affecting a project's required due date.

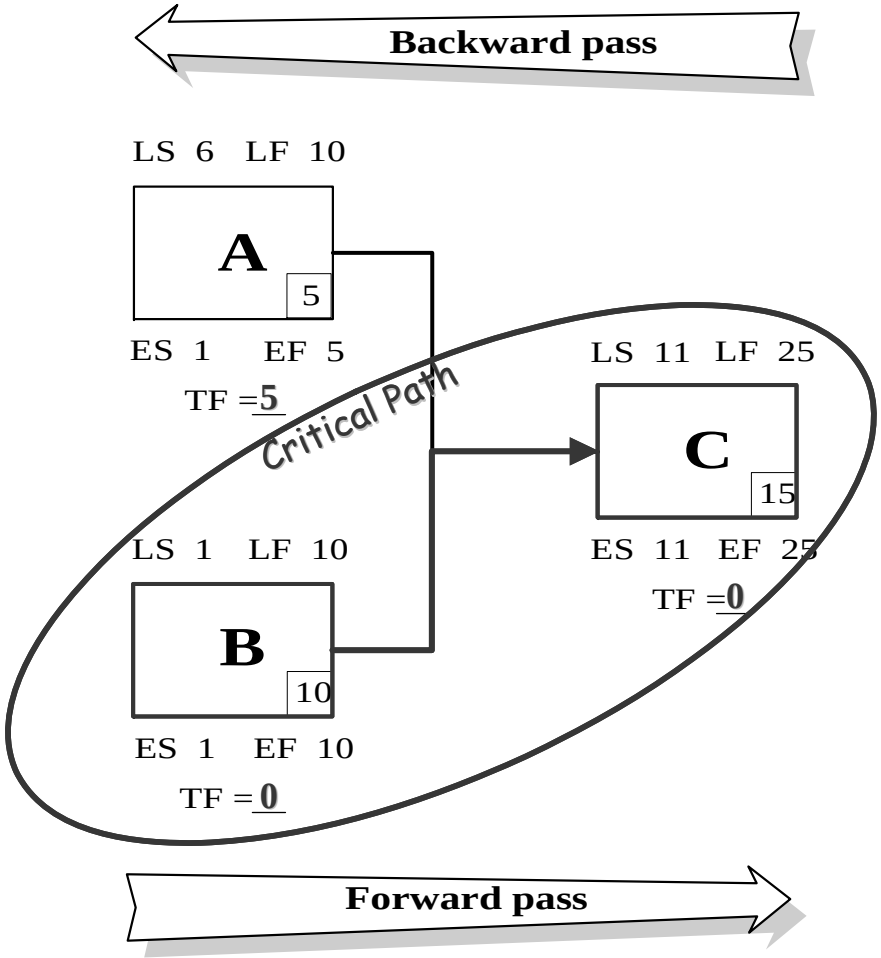
Total Float

- The amount of time an activity can slip from its early start without delaying the project
- The difference between an activity's late dates and early dates
- Activities with zero total float are critical.
- Late Dates - Early Dates = Total Float

Total Float



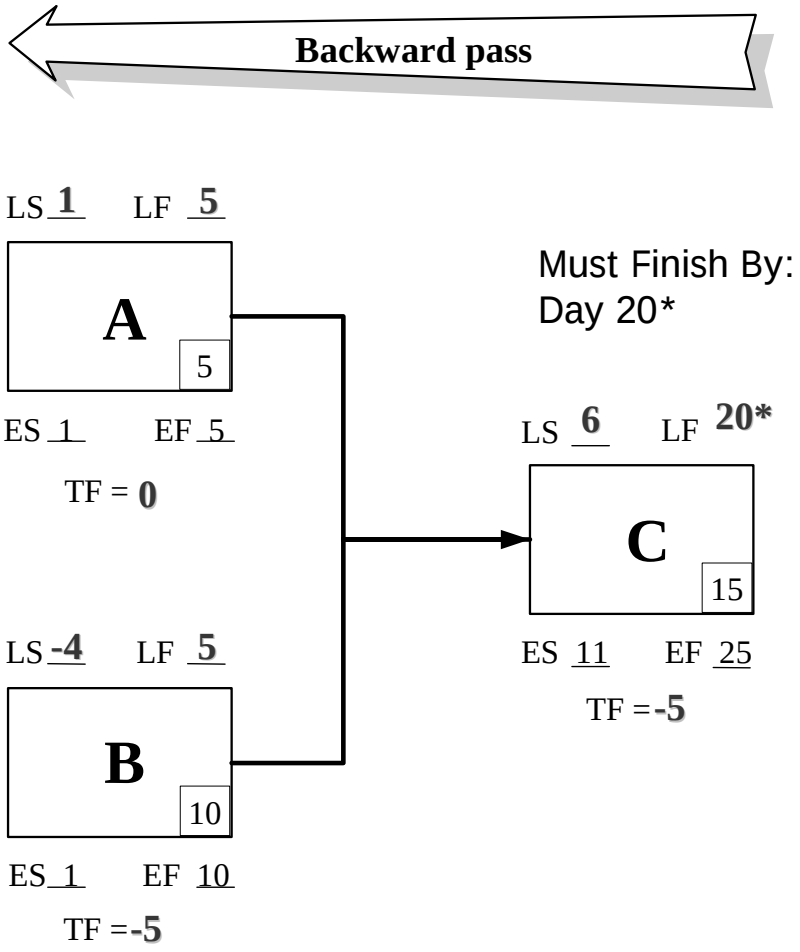
Critical Path



Backward Pass with Required Finish

- A required finish is used when there is a date the project must finish by.
- Used only during the backward pass.
- Specifies when the project must finish regardless of the network's duration and logic.
- Late Finish – Duration + 1 = Late Start

Backward Pass with Required Finish



Task Identification
Forward and Backward Passes

Name	Duration	ES	EF	LS	LF	Float
Prep	2	1	2	1	2	0
Paint Trim	2	3	4	7	8	4
Paint Ceiling	3	3	5	6	8	3
Paint Walls	4	3	6	3	6	0
Paint Walls (2nd Coat)	2	7	8	7	8	0
Clean-up	2	9	10	9	10	0

The Critical Path

- The critical path is the longest duration path through a network diagram and determines the shortest time to complete the project.

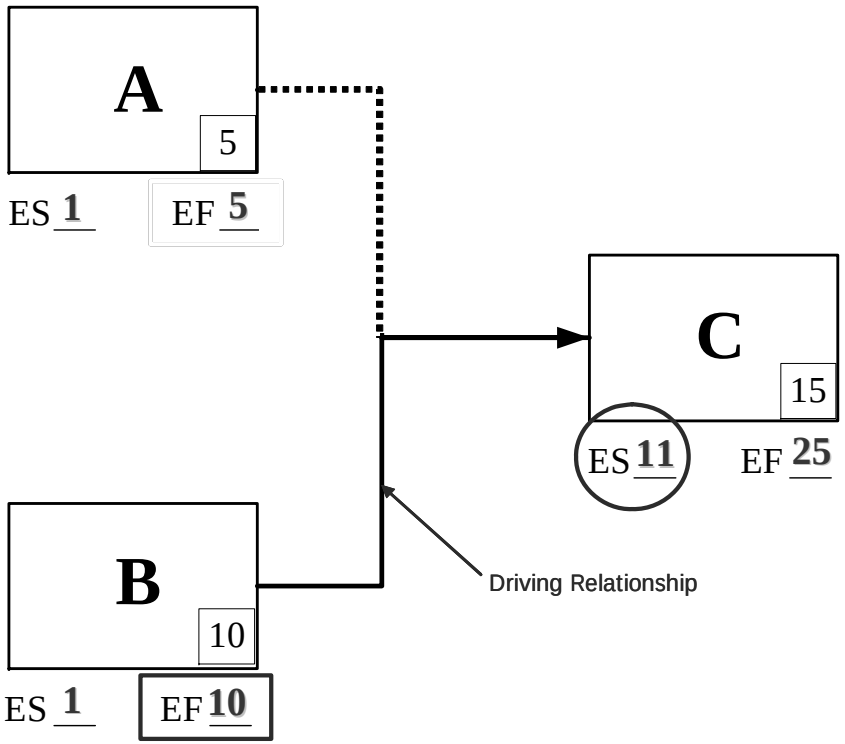
Near-Critical Activity

- A schedule activity that has low total float. The concept of near-critical is equally applicable to a schedule activity or schedule network path. The limit below which total float is considered near critical is subject to expert judgment and varies from project to project.

Driving Relationship

- Relationship from a predecessor that determines an activity's early start.
- How This Is Represented:
  - A solid relationship line = driving
  - A dashed relationship line = non-driving

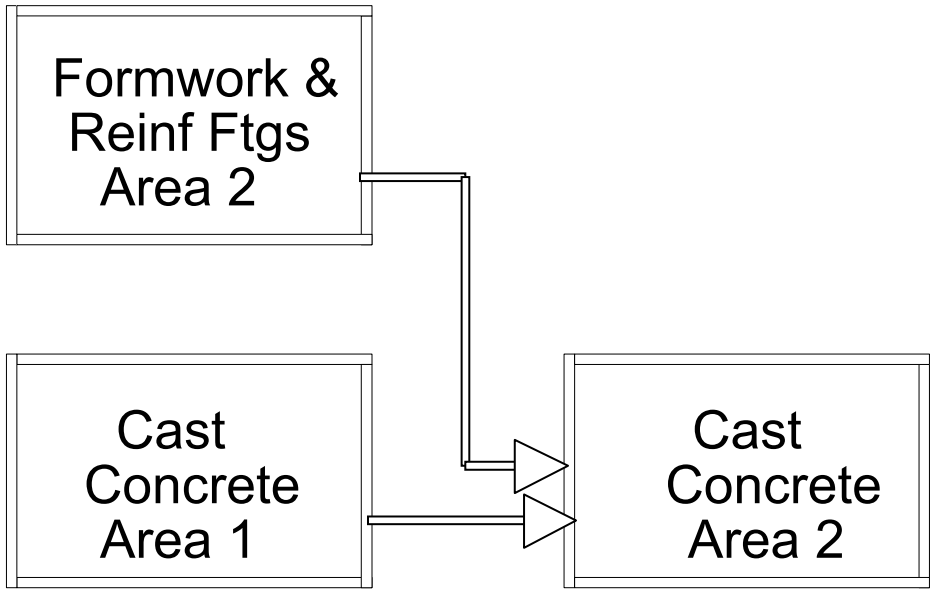
Driving Relationship



Path Convergence

- In mathematical analysis, the tendency of parallel paths of approximately equal duration to delay the completion of the milestone where they meet.

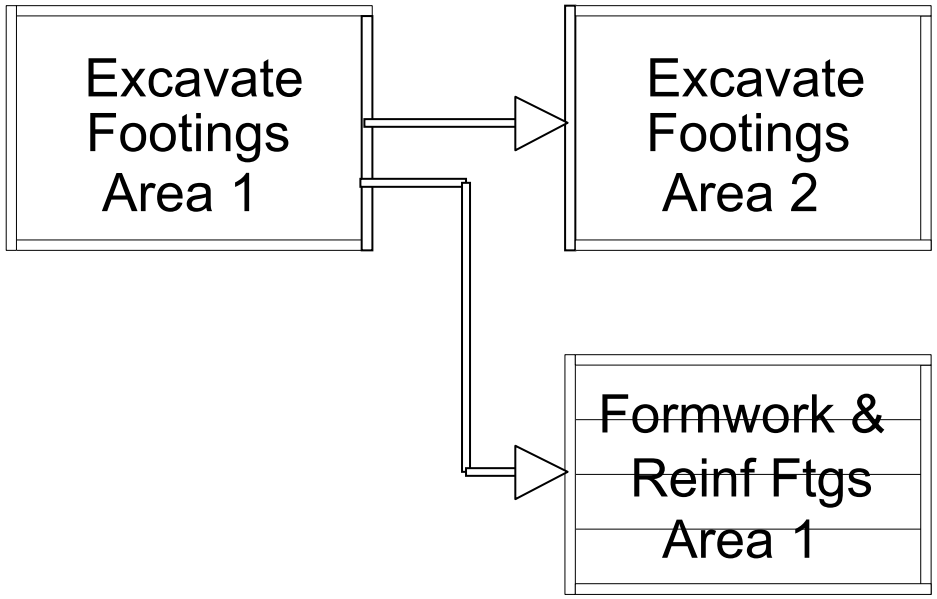
Path Convergence



Path Divergence

- Extending or generating parallel schedule network paths from the same node in a project schedule network diagram. Path divergence is characterized by a schedule activity with more than one successor activity.

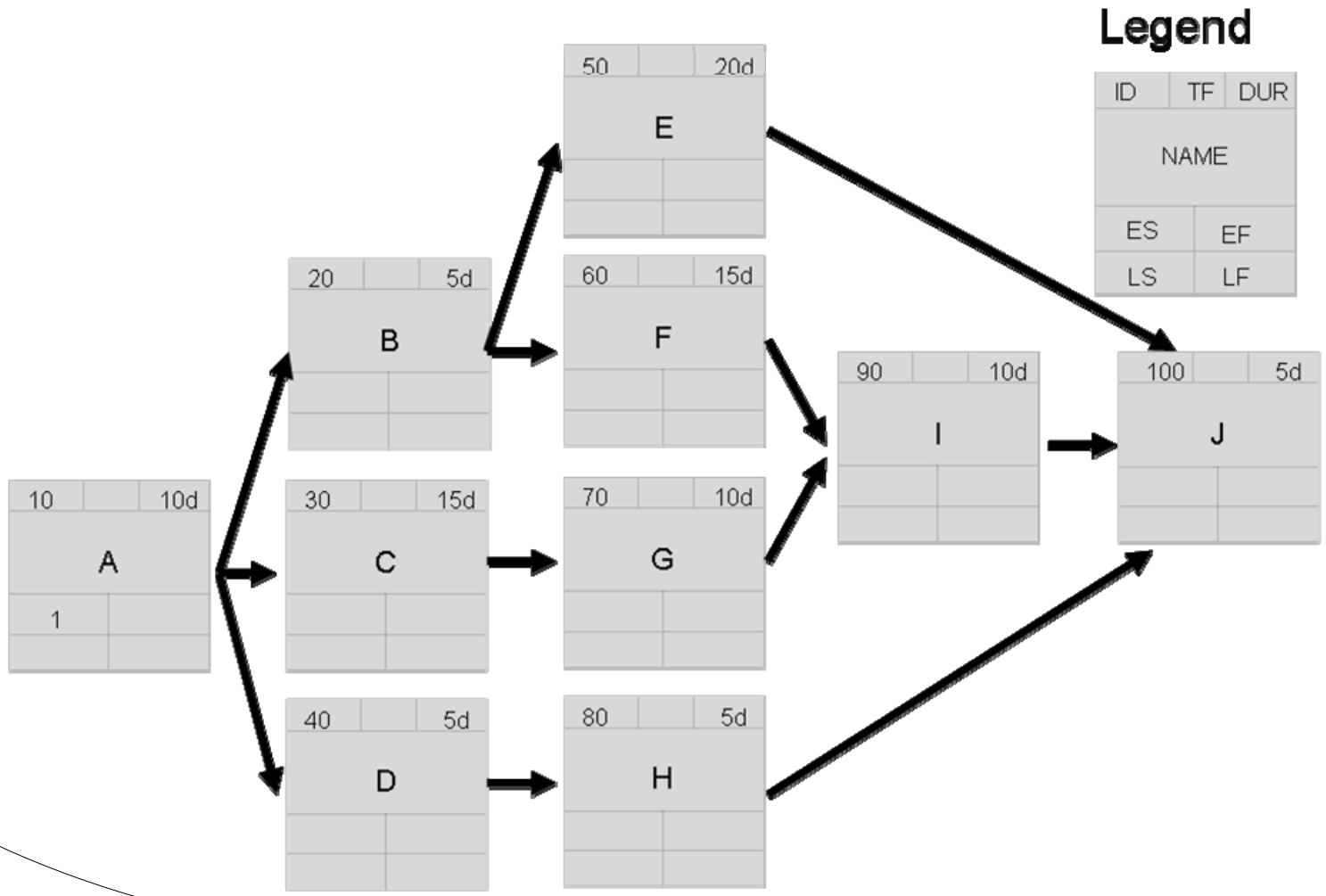
Path Divergence



Exercise

- Calculate “Early Schedule”
- Calculate “Late Schedule”
- Calculate Total Float
- Calculate Critical Path

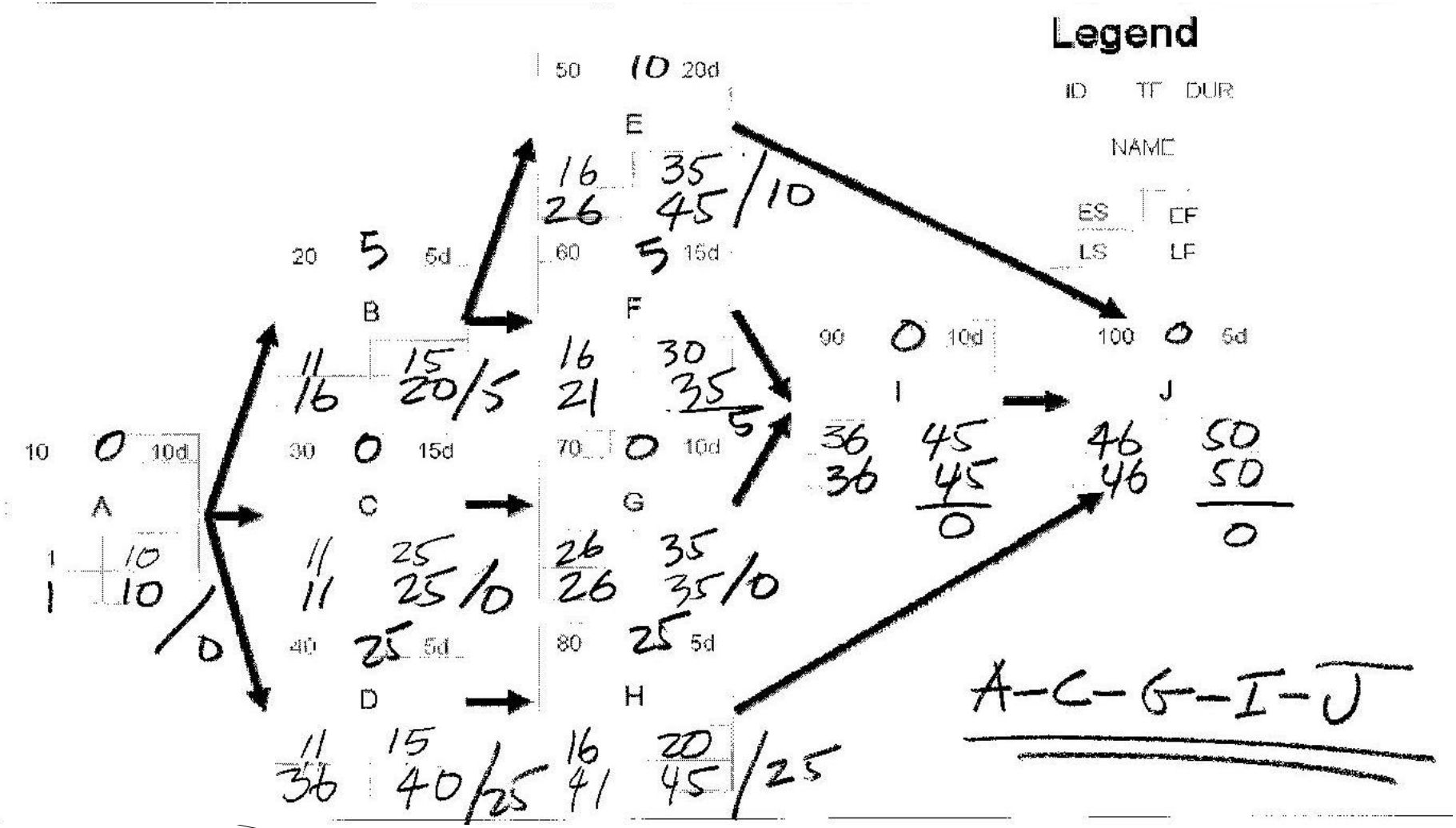
PDM Network



The Project Schedule

Activity	DU	ES	EF	LS	LF	TF
A	10	1				
B	5					
C	15					
D	5					
E	20					
F	15					
G	10					
H	5					
I	10					
J	5					

Answer



The Project Schedule

Activity	DU	ES	EF	LS	LF	TF
A	***10***	***1***	***10***	***1***	***10***	***0***
B	5	11	15	16	20	5
C	***15***	***11***	***25***	***11***	***25***	***0***
D	5	11	15	36	40	25
E	20	16	35	26	45	10
F	15	16	30	21	35	5
G	***10***	***26***	***35***	***26***	***35***	***0***
H	5	16	20	41	45	25
I	***10***	***36***	***45***	***36***	***45***	***0***
J	***5***	***46***	***50***	***46***	***50***	***0***

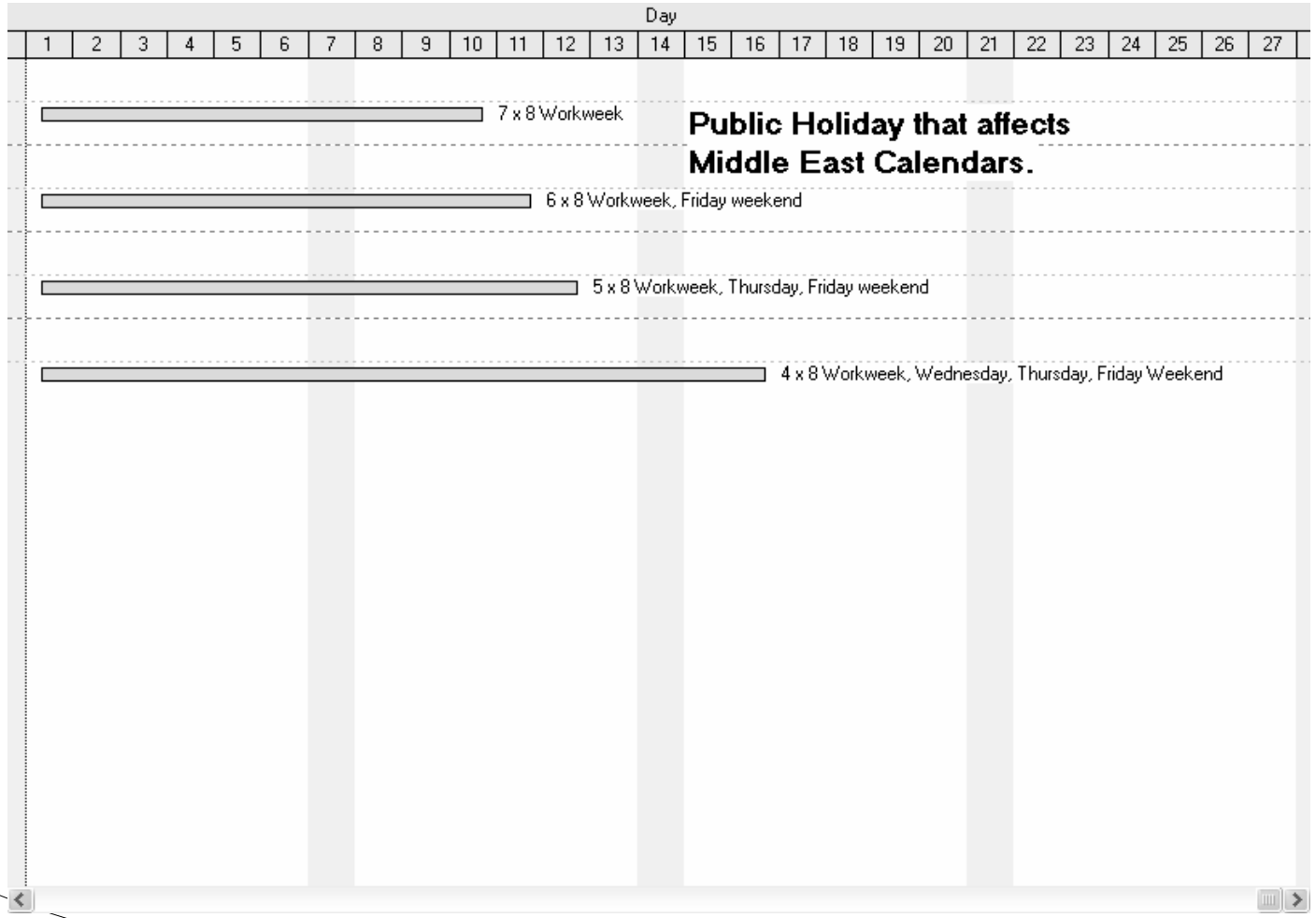
Factors that Affect Schedule Calculations

- Calendars
- Constraints
  - Start Date Constraints
  - Finish Date Constraints
  - Float Constraints

Activity Calendars

- Holidays
  - Public Holiday Days
  - Events
- Weekends
  - 5 Day Week
  - 6 Day Week
  - International Weeks

Activity Calendars



Date Constraints

- Date Constraints used to constrain the scheduling of activities during the forward (early date constraints) and backward (late date constraints) passes based on calendar dates.
- Date constraints take precedence over schedule when performing schedule calculations.

Why It Is Needed?

- Imposed date restrictions used to reflect project requirements that cannot be built into the logic.
- Schedule more accurately reflects the real world aspects of the project
- Provides additional control to the project
- Use to impose a restriction on the entire project or an individual activity

Activity Constraints

- Start Date Constraints
  - Start No Earlier
  - Start No Later
  - Start On
- Finish Date Constraints
  - Finish No Earlier
  - Finish No Later
  - Finish On
- Float Constraints
  - Zero Free Float
  - Zero Total Float

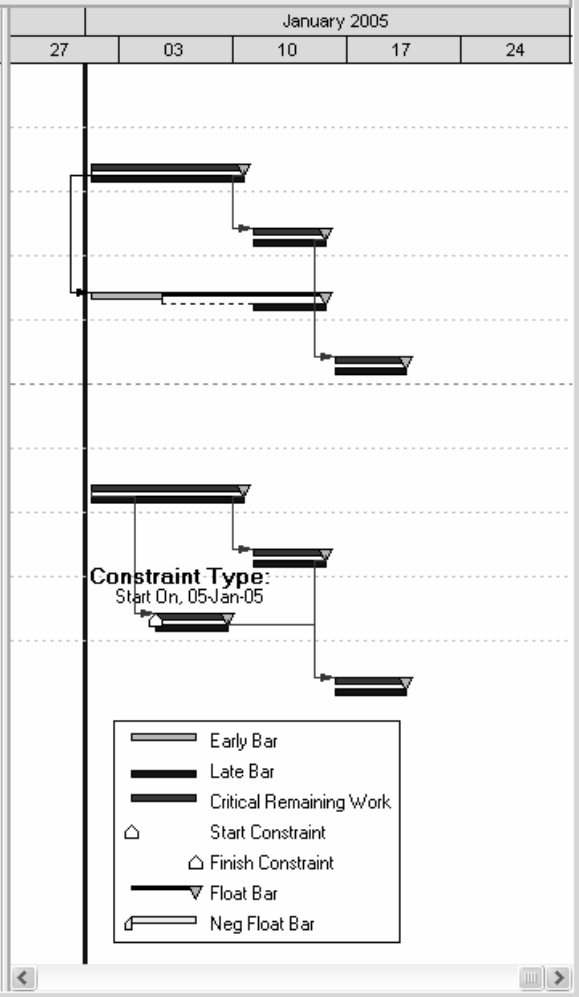
Start On

- Forces the activity to start on the constraint date
  - Shifts both early start and late start dates
  - Delays an early start or accelerates a late start
  - Used to specify dates submitted by contractors or vendors

Start On

Layout: constraints | Filter: All Activities

Act ID	Activity Name	Orig Dur	Rem Dur	%	Early Start	Early Finish	Late Start	Late Finish	Total Float
Before Applying Constraint		20d	20d	0%	01-Jan-05	20-Jan-05	01-Jan-05	20-Jan-05	0d
00010	Activity 1	10d	10d	0%	01-Jan-05	10-Jan-05	01-Jan-05	10-Jan-05	0d
00020	Activity 2	5d	5d	0%	11-Jan-05	15-Jan-05	11-Jan-05	15-Jan-05	0d
00030	Activity 3	5d	5d	0%	01-Jan-05	05-Jan-05	11-Jan-05	15-Jan-05	10d
00040	Activity 4	5d	5d	0%	16-Jan-05	20-Jan-05	16-Jan-05	20-Jan-05	0d
After Applying Constraint		20d	20d	0%	01-Jan-05	20-Jan-05	01-Jan-05	20-Jan-05	0d
00010	Activity 1	10d	10d	0%	01-Jan-05	10-Jan-05	01-Jan-05	10-Jan-05	0d
00020	Activity 2	5d	5d	0%	11-Jan-05	15-Jan-05	11-Jan-05	15-Jan-05	0d
00030	Activity 3	5d	5d	0%	05-Jan-05*	09-Jan-05	05-Jan-05	09-Jan-05	0d
00040	Activity 4	5d	5d	0%	16-Jan-05	20-Jan-05	16-Jan-05	20-Jan-05	0d



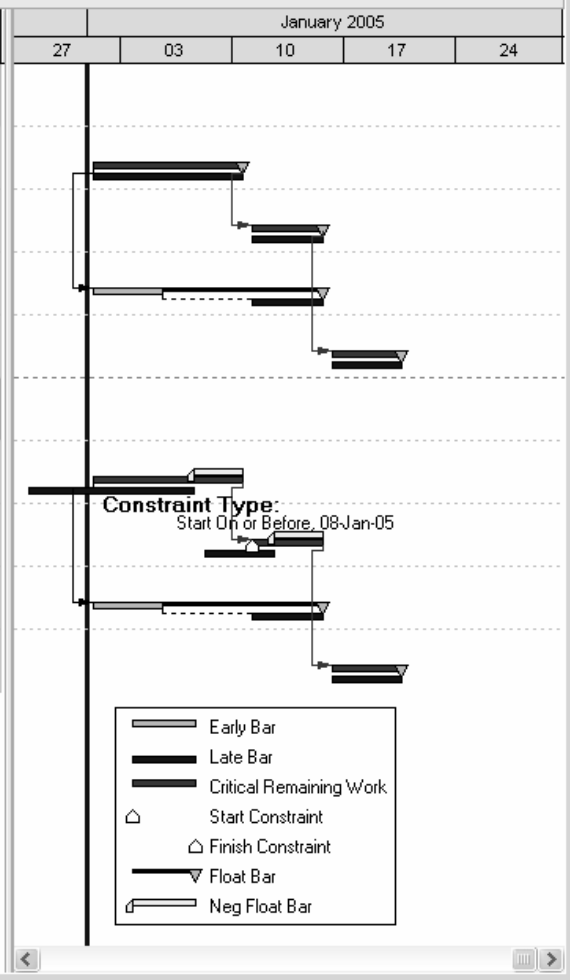
Start On or Before

- Forces the activity to start no later than the constraint date
  - Shifts the late start to the constraint date
  - Affects the late dates of its predecessors
  - Used to place a deadline on the start of an activity

Start On or Before

Layout: constraints | Filter: All Activities

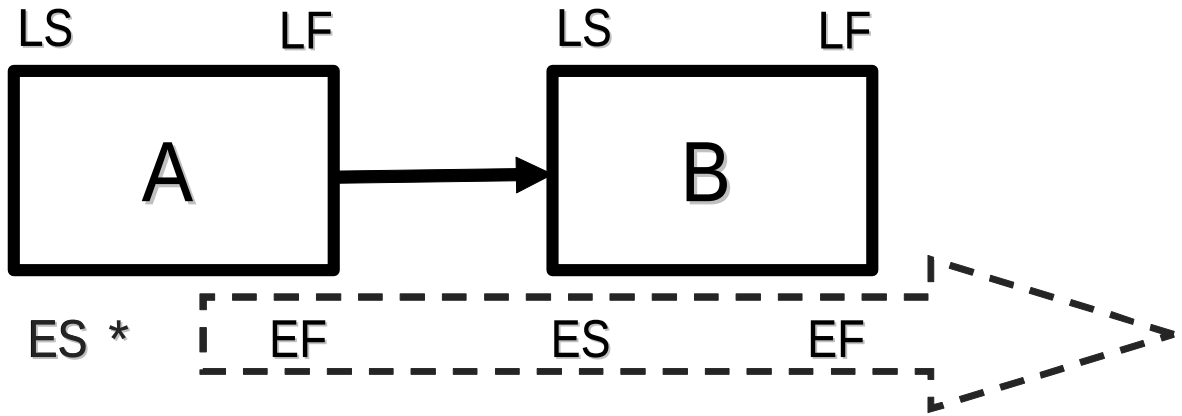
Act ID	Activity Name	Orig Dur	Rem Dur	%	Early Start	Early Finish	Late Start	Late Finish	Total Float
Before Applying Constraint		20d	20d	0%	01-Jan-05	20-Jan-05	01-Jan-05	20-Jan-05	0d
00010	Activity 1	10d	10d	0%	01-Jan-05	10-Jan-05	01-Jan-05	10-Jan-05	0d
00020	Activity 2	5d	5d	0%	11-Jan-05	15-Jan-05	11-Jan-05	15-Jan-05	0d
00030	Activity 3	5d	5d	0%	01-Jan-05	05-Jan-05	11-Jan-05	15-Jan-05	10d
00040	Activity 4	5d	5d	0%	16-Jan-05	20-Jan-05	16-Jan-05	20-Jan-05	0d
After Applying Constraint		20d	20d	0%	01-Jan-05	20-Jan-05	28-Dec-04	20-Jan-05	0d
00010	Activity 1	10d	10d	0%	01-Jan-05	10-Jan-05	28-Dec-04	07-Jan-05	-3d
00020	Activity 2	5d	5d	0%	11-Jan-05*	15-Jan-05	08-Jan-05	12-Jan-05	-3d
00030	Activity 3	5d	5d	0%	01-Jan-05	05-Jan-05	11-Jan-05	15-Jan-05	10d
00040	Activity 4	5d	5d	0%	16-Jan-05	20-Jan-05	16-Jan-05	20-Jan-05	0d

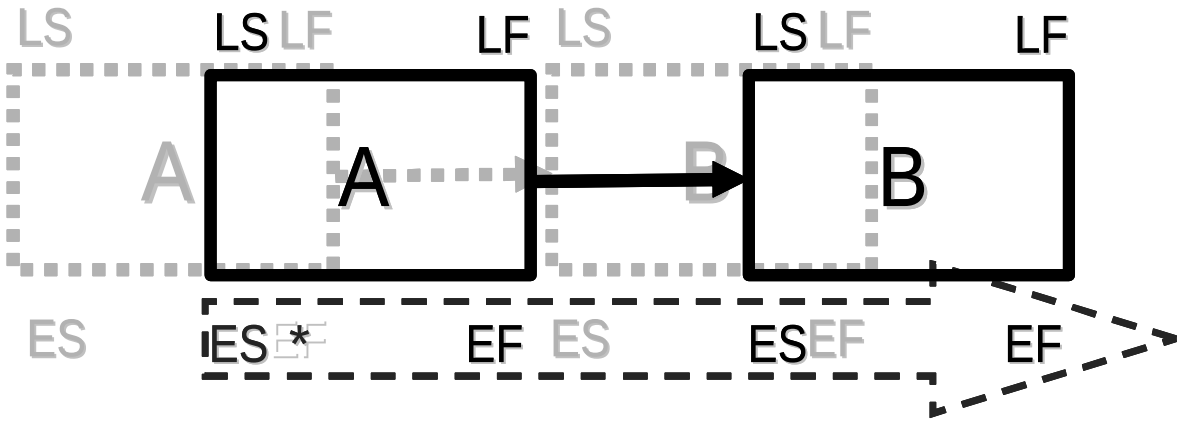


Start On or After

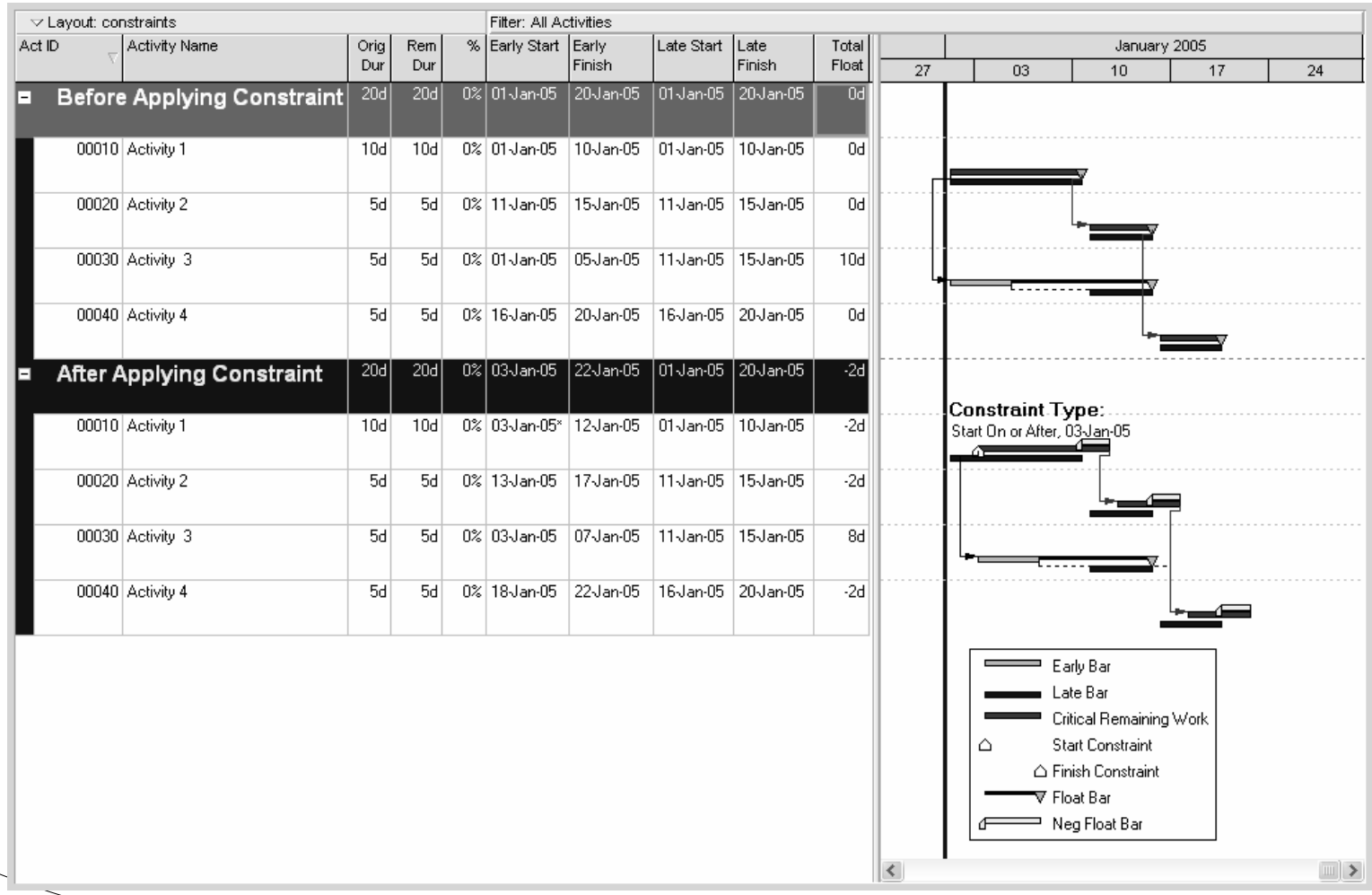
- Used to set the earliest date an activity can begin.
- Forces the activity to start no earlier than the constraint date
- Pushes the early start to the constraint date
- Affects the early dates of its successors

Start On or After





Start On or After



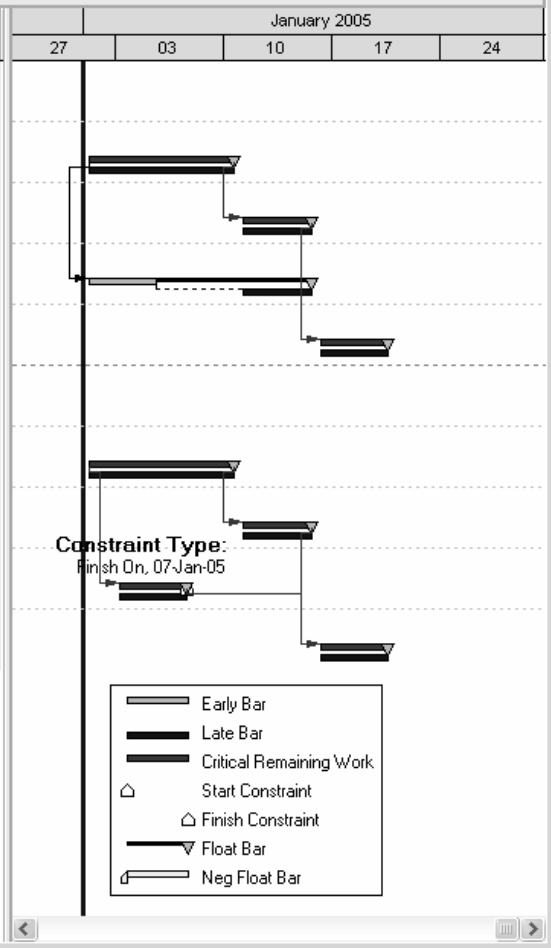
Finish On

- Forces the activity to finish on the constraint date
  - Shifts both early and late finish dates.
  - Delays an early finish or accelerates a late finish
  - Used to satisfy intermediate project deadlines

Finish On

Layout: constraints — Filter: All Activities

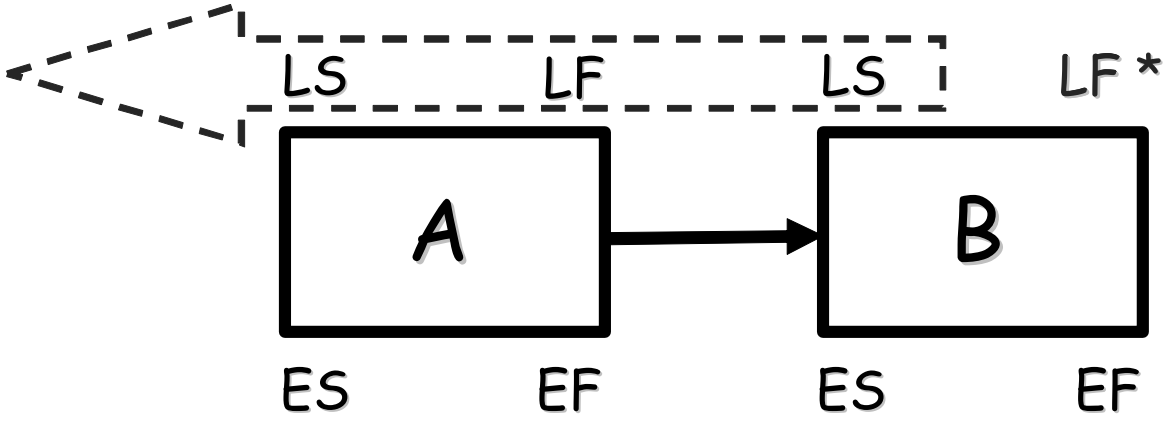
Act ID	Activity Name	Orig Dur	Rem Dur	%	Early Start	Early Finish	Late Start	Late Finish	Total Float
Before Applying Constraint		20d	20d	0%	01-Jan-05	20-Jan-05	01-Jan-05	20-Jan-05	0d
00010	Activity 1	10d	10d	0%	01-Jan-05	10-Jan-05	01-Jan-05	10-Jan-05	0d
00020	Activity 2	5d	5d	0%	11-Jan-05	15-Jan-05	11-Jan-05	15-Jan-05	0d
00030	Activity 3	5d	5d	0%	01-Jan-05	05-Jan-05	11-Jan-05	15-Jan-05	10d
00040	Activity 4	5d	5d	0%	16-Jan-05	20-Jan-05	16-Jan-05	20-Jan-05	0d
After Applying Constraint		20d	20d	0%	01-Jan-05	20-Jan-05	01-Jan-05	20-Jan-05	0d
00010	Activity 1	10d	10d	0%	01-Jan-05	10-Jan-05	01-Jan-05	10-Jan-05	0d
00020	Activity 2	5d	5d	0%	11-Jan-05	15-Jan-05	11-Jan-05	15-Jan-05	0d
00030	Activity 3	5d	5d	0%	03-Jan-05	07-Jan-05*	03-Jan-05	07-Jan-05	0d
00040	Activity 4	5d	5d	0%	16-Jan-05	20-Jan-05	16-Jan-05	20-Jan-05	0d

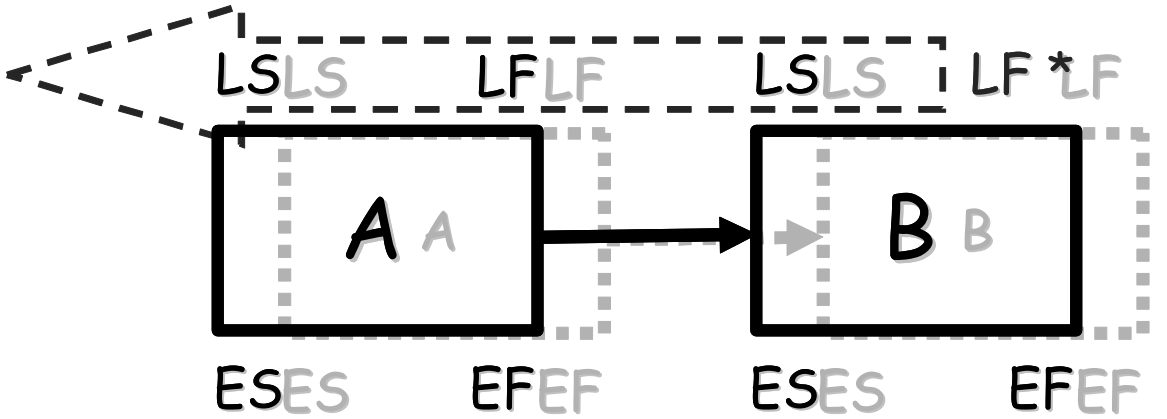


Finish On or Before

- Used to set intermediate completion points in a project.
- Forces the activity to finish no later than the constraint date
- Pulls the late finish date to the constraint date
- Affects the late dates of its predecessors

Finish On or Before

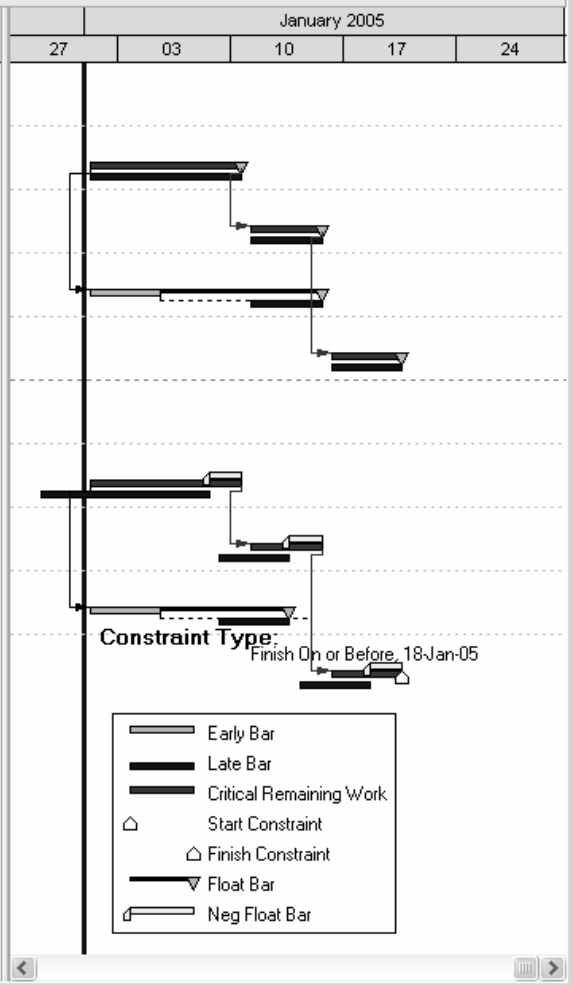




Finish On or Before

Layout: constraints — Filter: All Activities

Act ID	Activity Name	Orig Dur	Rem Dur	%	Early Start	Early Finish	Late Start	Late Finish	Total Float
Before Applying Constraint		20d	20d	0%	01-Jan-05	20-Jan-05	01-Jan-05	20-Jan-05	0d
00010	Activity 1	10d	10d	0%	01-Jan-05	10-Jan-05	01-Jan-05	10-Jan-05	0d
00020	Activity 2	5d	5d	0%	11-Jan-05	15-Jan-05	11-Jan-05	15-Jan-05	0d
00030	Activity 3	5d	5d	0%	01-Jan-05	05-Jan-05	11-Jan-05	15-Jan-05	10d
00040	Activity 4	5d	5d	0%	16-Jan-05	20-Jan-05	16-Jan-05	20-Jan-05	0d
After Applying Constraint		20d	20d	0%	01-Jan-05	20-Jan-05	29-Dec-04	18-Jan-05	-2d
00010	Activity 1	10d	10d	0%	01-Jan-05	10-Jan-05	29-Dec-04	08-Jan-05	-2d
00020	Activity 2	5d	5d	0%	11-Jan-05	15-Jan-05	09-Jan-05	13-Jan-05	-2d
00030	Activity 3	5d	5d	0%	01-Jan-05	05-Jan-05	09-Jan-05	13-Jan-05	8d
00040	Activity 4	5d	5d	0%	16-Jan-05	20-Jan-05*	14-Jan-05	18-Jan-05	-2d



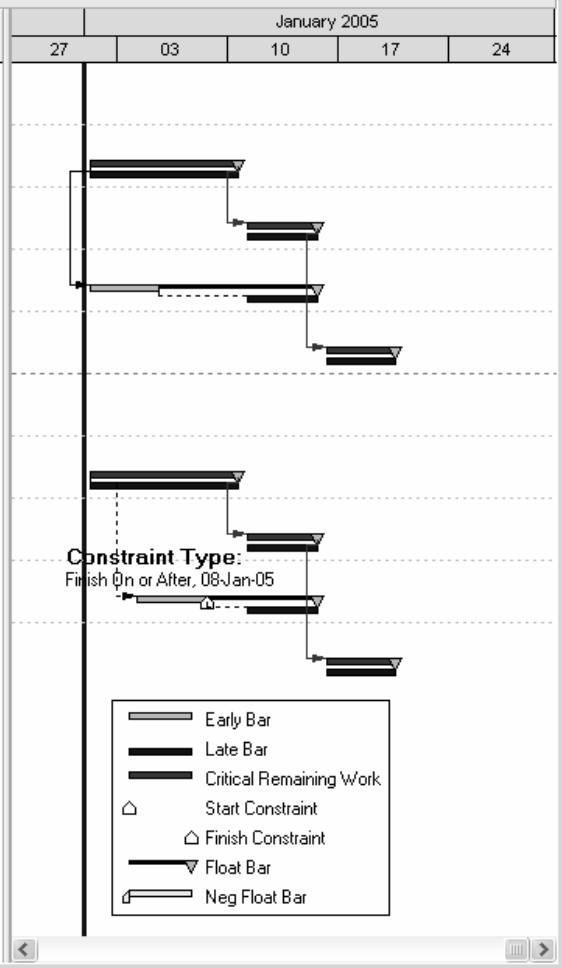
Finish On or After

- Forces the activity to finish no earlier than the constraint date
  - Shifts the early finish to the constrained date
  - Affects the early dates of its successors
  - Used to prevent an activity from finishing too early

Finish On or After

Layout: constraints | Filter: All Activities

Act ID	Activity Name	Orig Dur	Rem Dur	%	Early Start	Early Finish	Late Start	Late Finish	Total Float
Before Applying Constraint		20d	20d	0%	01-Jan-05	20-Jan-05	01-Jan-05	20-Jan-05	0d
00010	Activity 1	10d	10d	0%	01-Jan-05	10-Jan-05	01-Jan-05	10-Jan-05	0d
00020	Activity 2	5d	5d	0%	11-Jan-05	15-Jan-05	11-Jan-05	15-Jan-05	0d
00030	Activity 3	5d	5d	0%	01-Jan-05	05-Jan-05	11-Jan-05	15-Jan-05	10d
00040	Activity 4	5d	5d	0%	16-Jan-05	20-Jan-05	16-Jan-05	20-Jan-05	0d
After Applying Constraint		20d	20d	0%	01-Jan-05	20-Jan-05	01-Jan-05	20-Jan-05	0d
00010	Activity 1	10d	10d	0%	01-Jan-05	10-Jan-05	01-Jan-05	10-Jan-05	0d
00020	Activity 2	5d	5d	0%	11-Jan-05	15-Jan-05	11-Jan-05	15-Jan-05	0d
00030	Activity 3	5d	5d	0%	04-Jan-05	08-Jan-05*	11-Jan-05	15-Jan-05	7d
00040	Activity 4	5d	5d	0%	16-Jan-05	20-Jan-05	16-Jan-05	20-Jan-05	0d



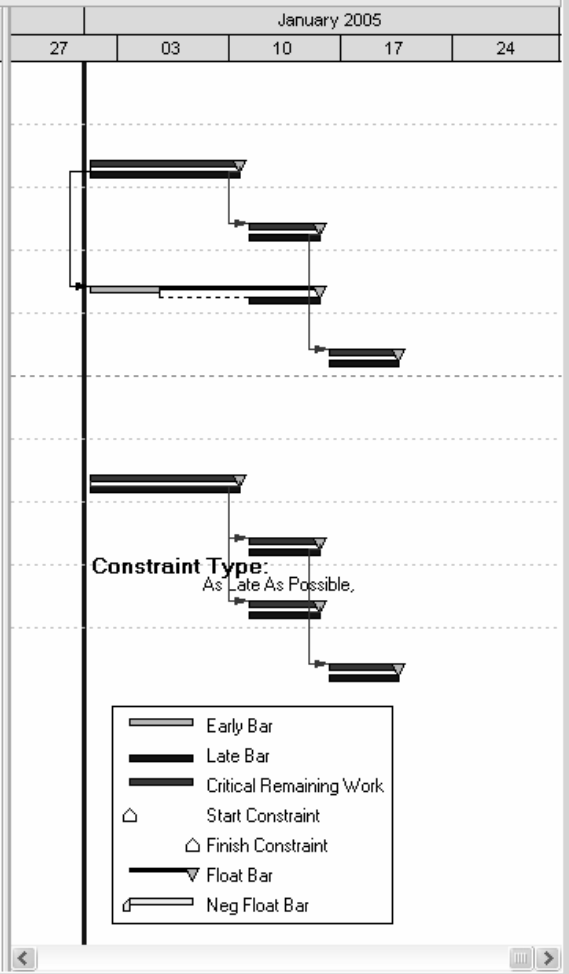
As Late
As Possible

- Delays an activity as late as possible without delaying its successors
  - Shifts the early dates as late as possible
  - Also called a zero free float constraint

As Late as Possible

Layout: constraints | Filter: All Activities

Act ID	Activity Name	Orig Dur	Rem Dur	%	Early Start	Early Finish	Late Start	Late Finish	Total Float
Before Applying Constraint		20d	20d	0%	01-Jan-05	20-Jan-05	01-Jan-05	20-Jan-05	0d
00010	Activity 1	10d	10d	0%	01-Jan-05	10-Jan-05	01-Jan-05	10-Jan-05	0d
00020	Activity 2	5d	5d	0%	11-Jan-05	15-Jan-05	11-Jan-05	15-Jan-05	0d
00030	Activity 3	5d	5d	0%	01-Jan-05	05-Jan-05	11-Jan-05	15-Jan-05	10d
00040	Activity 4	5d	5d	0%	16-Jan-05	20-Jan-05	16-Jan-05	20-Jan-05	0d
After Applying Constraint		20d	20d	0%	01-Jan-05	20-Jan-05	01-Jan-05	20-Jan-05	0d
00010	Activity 1	10d	10d	0%	01-Jan-05	10-Jan-05	01-Jan-05	10-Jan-05	0d
00020	Activity 2	5d	5d	0%	11-Jan-05	15-Jan-05	11-Jan-05	15-Jan-05	0d
00030	Activity 3	5d	5d	0%	11-Jan-05	15-Jan-05	11-Jan-05	15-Jan-05	0d
00040	Activity 4	5d	5d	0%	16-Jan-05	20-Jan-05	16-Jan-05	20-Jan-05	0d



Mandatory Start and Finish

- Forces early and late dates to be equal to the constraint date
  - Affects late dates of predecessors and early dates of successors
  - May violate network logic