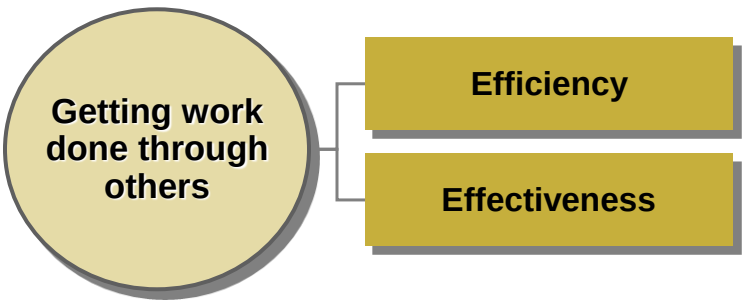
Introduction to Management

Management Is…



Management Is…

Efficiency (To do the things ***right***!**)**
A measure of how well or how productively resources are used to achieve a goal

Effectiveness (To get the ***right*** things done!**)**
A measure of the appropriateness of the goals an organization is pursuing and the degree to which they are achieved

Functions of Management

The four functions of management are:

1. Planning
2. Organizing
3. Leading
4. Controlling

Functions of Management

Planning

the act or process of creating goals and objectives as well as strategies to meet them

Functions of Management

Organizing

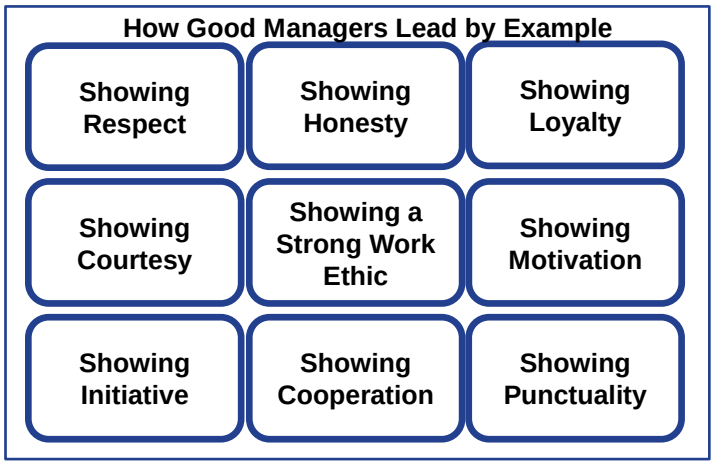
- getting the resources arranged in an orderly and functional way to accomplish goals and objectives
- a manager is responsible for organizing people, work processes, and equipment

Functions of Management

Leading

- providing direction and vision
- Leading involves:
  - Setting standards
  - Delegating work
  - Enforcing policies
  - Resolving conflicts

Functions of Management

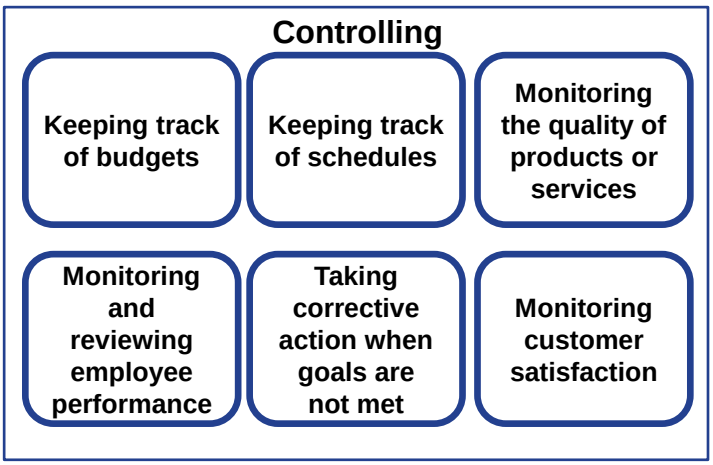


Functions of Management

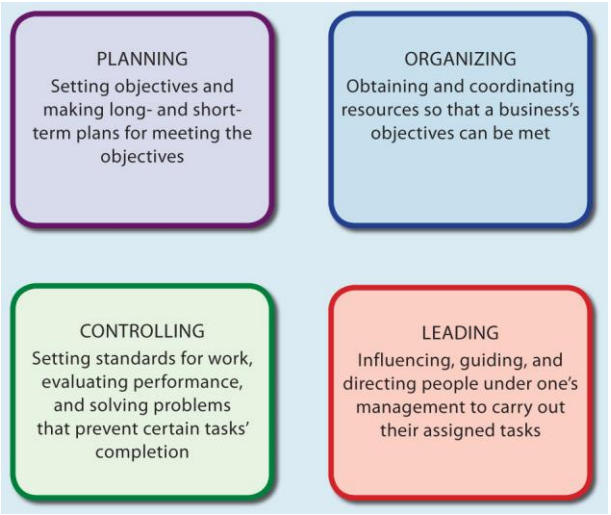
Controlling

- Monitoring progress toward goal achievement and taking corrective action when needed
- keeping the company on track and making sure goals are met

Functions of Management



The four functions of management are:



Managers

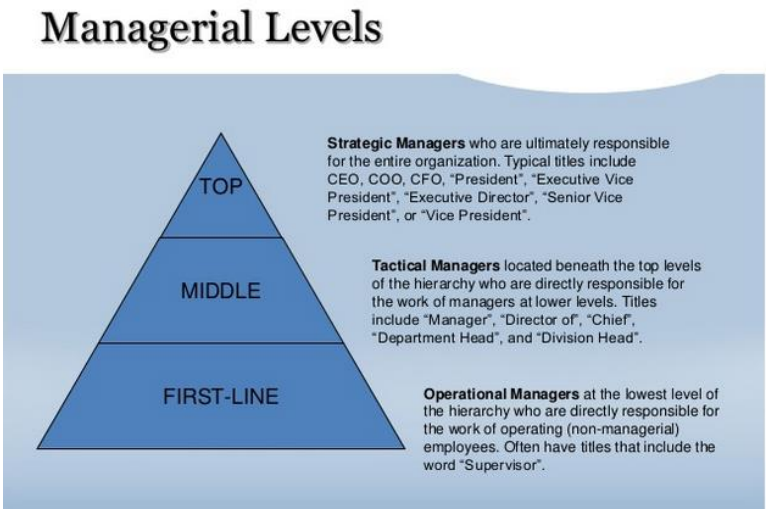
Managers

- The people responsible for supervising the use of an organization's resources to meet its goals
- Effective managers plan, Organize, Lead and Control better

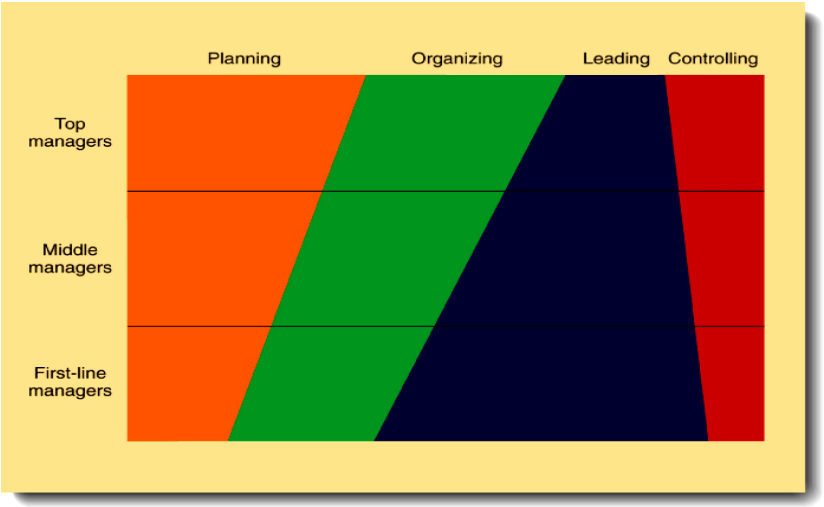
Types of Managers

- **First-line managers**
  - Responsible for day-to-day operations. Supervise people performing activities required to make the good or service.
- **Middle managers**
  - Supervise first-line managers. Are responsible to find the best way to use departmental resources to achieve goals.
- **Top managers**
  - Responsible for the performance of all departments and have cross-departmental responsibility.
  - Establish organizational goals and monitor middle managers.
  - Form top management team along with the CEO and COO.

Levels of Management



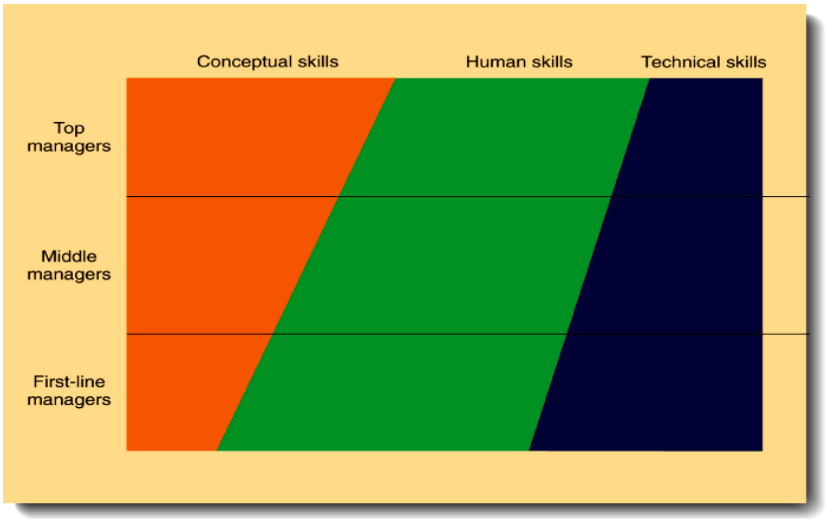
Time That Managers Spend on the Four Managerial Functions



Managerial Skills

- **Conceptual Skills:** (*What should be the right thing?*)
  - The ability to analyze and diagnose a situation and distinguish between cause and effect.
- **Human Skills:**
  - The ability to understand, alter, lead, and control the behavior of other individuals and groups.
- **Technical Skills:** (*How can we do better?*)
  - The specific knowledge and techniques required to perform an organizational role.

Managerial Skills



Managerial Roles

Managerial Role:

- The set of specific tasks that a person is expected to perform because of the position he or she holds in the organization.

- Roles are defined into three role categories:
  - Interpersonal
  - Informational
  - Decisional

Managerial Roles

Interpersonal Roles

Roles that managers assume to provide direction and supervision to both employees and the organization as a whole:

Figurehead—symbolizing the organization's mission and what it is seeking to achieve.

Leader—training, counseling, and mentoring high employee performance.

Liaison—linking and coordinating the activities of people and groups both inside and outside the organization/department.

Managerial Roles

Informational Roles

Roles associated with the tasks needed to obtain and transmit information in the process of managing the organization:

Monitor—analyzing information from both the internal and external environment.

Disseminator—transmitting information to influence the attitudes and behavior of employees.

Spokesperson—using information to positively influence the way people in and out of the organization respond to it.

Managerial Roles

Decisional Roles

Roles associated with methods managers use in planning strategy and utilizing resources:

Entrepreneur—deciding which new projects or programs to initiate and to invest resources in.

Disturbance handler—managing an unexpected event or crisis.

Resource allocator—assigning resources between functions and divisions, setting the budgets of lower managers.

Negotiator—reaching agreements between other managers, unions, customers, or shareholders.

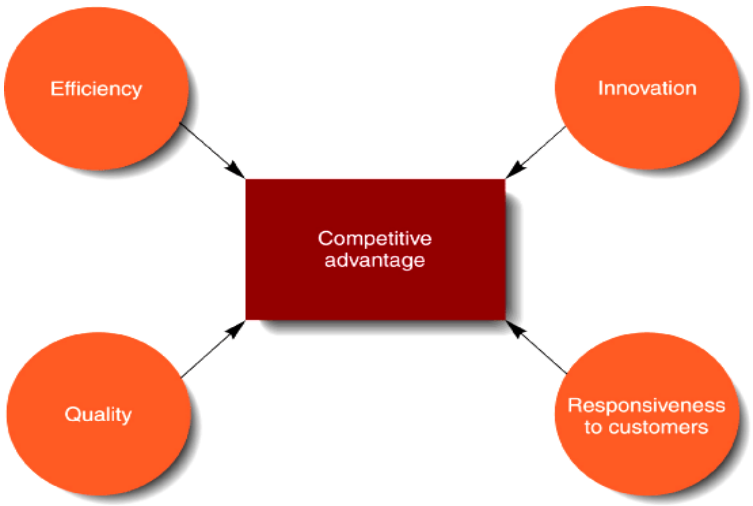
To be an Effective Manager

1. Accept that you still have a lot to learn
2. Communicate clearly
3. Set a good example
4. Encourage feedback
5. Offer recognition
6. Be decisive
7. Help your team see the “big picture”
8. Create an environment of constant learning and development—be sure to include yourself in this process
9. Provide professional guidance
10. Be patient with yourself

Why Organizations Need Managers

1. The prime purpose of the manager is to ensure that his organization serves its basic purpose and maintains efficient production of its specific goods or services.
2. The manager must design and maintain the stability of their organizational operations. (leader)
3. The manager must take charge of their organization's strategy making system, and therein adapt his organization in a controlled way to its changing environment. (monitor, entrepreneur, leader)
4. The manager must ensure that his organization serves the ends of those persons who control it.
5. The manager must serve as the key informational link between his organization and its environment. (liaison, monitor, disseminator, spokesman, negotiator)
6. As a formal authority, the manager is responsible for the operating of his organization's status system. (figurehead, spokesman, negotiator)

Building a Competitive Advantage



Leadership vs. Management

Leadership is setting a new direction or vision for a group that they follow, i.e. a leader is the spearhead for that new direction

Management controls or directs people/resources in a group according to principles or values that have already been established.

“Tell us about yourself!”

How should you answer this?

Stick to talking about the job, and why you’re interested in it.

Talk about yourself in terms of your interpersonal and communication skills.

Let them know that you’re a serious person who is goal and achievement oriented. (Have an anecdote prepared.)

INTRODUCTION TO PROJECT MANAGEMENT

PROJECT

A project is a temporary endeavor undertaken to create a unique product, service, or result.

A project is a sequence of temporary, unique, complex and connected activities having one goal or purpose and that must be completed by a specific time, within budget, and according to specifications.

THE RELATIONSHIPS AMONG PORTFOLIOS, PROGRAMS, AND PROJECTS

The relationship among portfolios, programs, and projects is such that a portfolio refers to a collection of projects, programs, sub portfolios, and operations managed as a group to achieve strategic objectives. Programs are grouped within a portfolio and are comprised of subprograms, projects, or other work that are managed in a coordinated fashion in support of the portfolio. Individual projects that are either within or outside of a program are still considered part of a portfolio. Although the projects or programs within the portfolio may not necessarily be interdependent or directly related, they are linked to the organization's strategic plan by means of the organization's portfolio.

PROJECT MANAGEMENT

Project management is the application of knowledge, skills, tools, and techniques to project activities in order to meet or exceed stakeholder needs and expectations from a project. Meeting or exceeding stakeholder needs and expectations invariably involves balancing the competing project constraints:

• Scope, Quality, Schedule, Budget, Resources and Risks. (PMBOK)

The term project management is sometimes used to describe an organizational approach to the management of ongoing operations. This approach, more properly called management by projects, treats many aspects of ongoing operations as projects in order to apply project management to them. Although an understanding of project management is obviously critical to an Organization that is managing the projects.

PROJECT MANAGEMENT KNOWLEDGE AREAS

The Project Management Knowledge Areas describes project management knowledge and practice in terms of its component processes. These processes have been organized into ten knowledge areas:

INTRODUCTION TO PROJECT MANAGEMENT

1. Project Integration Management

Project Integration Management includes the processes and activities to identify, define, combine, unify, and coordinate the various processes and project management activities within the Project Management Process Groups. It consists of Develop Project Charter, Develop Project Management Plan, Direct and Manage Project Work, Monitor and Control Project Work, Perform Integrated Change Control, C lose Project or Phase.

2. Project Scope Management

Project Scope Management includes the processes required to ensure that the project includes all the work required, and only the work required, to complete the project successfully. It consists of Plan Scope Management, Collect Requirements, Define Scope, Create WBS, Validate Scope, Control Scope.

3. Project Time Management

Project Time Management includes the processes required to manage the timely completion of the project. It consists of Plan Schedule Management, Define Activities, Sequence Activities, Estimate Activity Resources, Estimate Activity Durations, Develop Schedule, Control Schedule.

4. Project Cost Management

Project Cost Management describes the processes required to ensure that the project is completed within the approved budget. It consists of Plan Cost Management, Estimate Costs, determine Budget, Control Costs.

5. Project Quality Management

Project Quality Management describes the processes required to ensure that the project will satisfy the needs for which it was undertaken. It consists of quality planning, quality assurance, and quality control.

INTRODUCTION TO PROJECT MANAGEMENT

6. Project Human Resource Management

Project Human Resource Management includes the processes that organize, manage, and lead the project team. The project team is comprised of the people with assigned roles and responsibilities for completing the project. It consists of Plan Human Resource Management, Acquire Project Team, Develop Project Team, Manage Project Team.

7. Project Communications Management

Project Communications Management includes the processes that are required to ensure timely and appropriate planning, collection, creation, distribution, storage, retrieval, management, control, monitoring, and the ultimate disposition of project information. It consists of Plan Communications Management, Manage Communications, Control Communications

8. Project Risk Management

Project Risk Management includes the processes concerned with identifying, analyzing, and responding to project risk. It consists of risk management planning, identification, analysis, response planning, and controlling risk on a project.

9. Project Procurement Management

Project Procurement Management includes the processes necessary to purchase or acquire products, services, or results needed from outside the project team. The organization can be either the buyer or seller of the products, services, or results of a project. It consists of Plan Procurement Management, Conduct Procurements, Control Procurements, Close Procurements.

10. Project Stakeholder Management

Project Stakeholder Management includes the processes required to identify the people, groups, or organizations that could impact or be impacted by the project, to analyze stakeholder expectations and their impact on the project, and to develop appropriate management strategies for effectively engaging stakeholders in project decisions and execution. It consists of Identify Stakeholders, Plan Stakeholder Management, Manage Stakeholder Engagement, Control Stakeholder Engagement.

INTRODUCTION TO PROJECT MANAGEMENT

PROJECT PROCESSES

Projects are composed of processes. A process is “a series of actions bringing about a result”.

Project management processes are concerned with describing and organizing the work of the project.

PROCESS GROUPS

Project management processes can be organized into five groups of one or more processes each:

1. Initiating: recognizing that a project or phase should begin and committing to do so.

2. Planning: devising and maintaining a workable scheme to accomplish the business need that the project was undertaken to address.

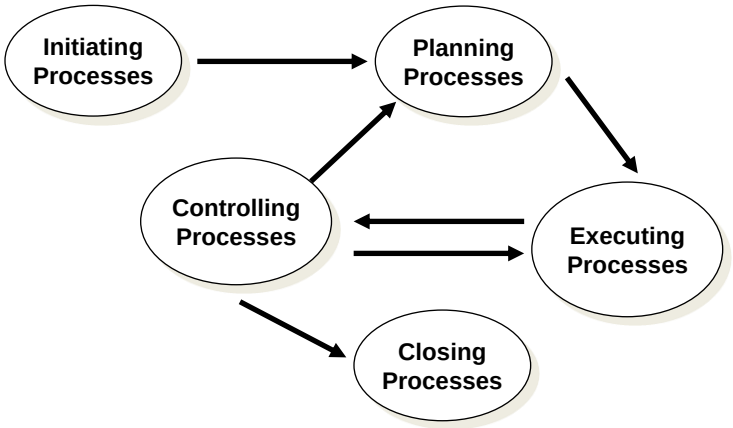
3. Executing: coordinating people and other resources to carry out the plan.

4. Monitoring and Controlling: ensuring that project objectives are met by monitoring and measuring progress and taking corrective actions when necessary.

5. Closing: formalizing acceptance of the project or phase and bringing it to an orderly end.

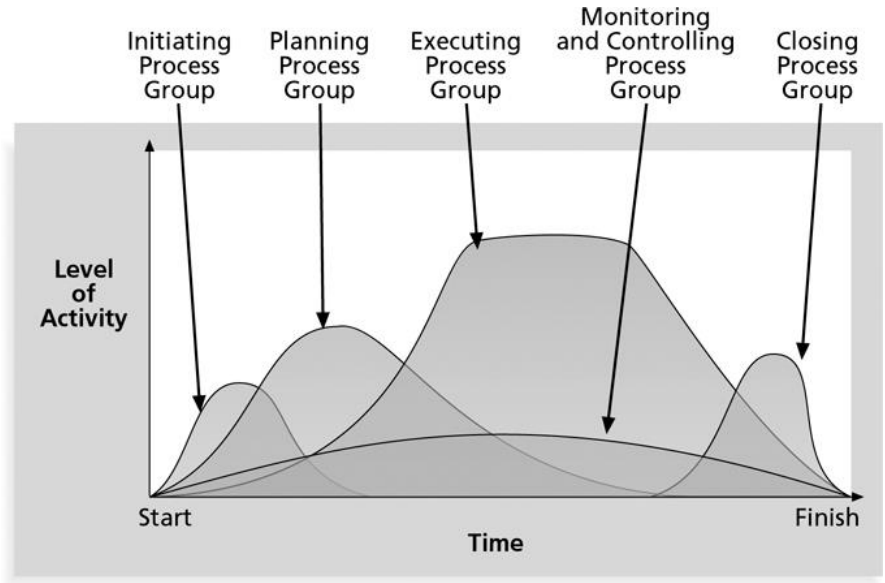
Project Management Processes

» PM processes are divided into five phases or process groups



INTRODUCTION TO PROJECT MANAGEMENT

Level of Activity and Overlap of Process Groups Over Time



PROJECT PHASES AND THE PROJECT LIFE CYCLE

Because projects are unique undertakings, they involve a degree of uncertainty. Organizations performing projects will usually divide each project into several project phases to provide better management control and appropriate links to the ongoing operations of the performing organization. Collectively, the project phases are known as the project life cycle.

INTRODUCTION TO PROJECT MANAGEMENT

. Project Management Process Group and Knowledge Area Mapping

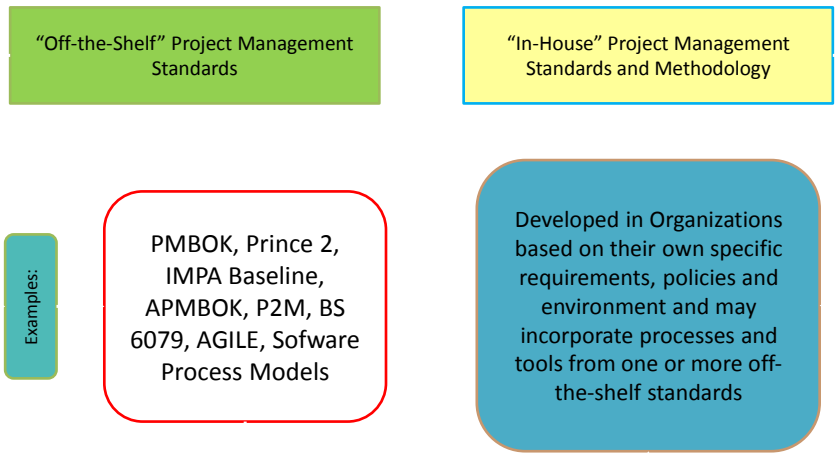
Knowledge Areas	Project Management Process Groups				
	Initiating Process Group	Planning Process Group	Executing Process Group	Monitoring and Controlling Process Group	Closing Process Group
. Project Integration Management	4.1 Develop Project Charter	4.2 Develop Project Management Plan	4.3 Direct and Manage Project Work	4.4 Monitor and Control Project Work 4.5 Perform Integrated Change Control	4.6 Close Project or Phase
. Project Scope Management		5.1 Plan Scope Management 5.2 Collect Requirements 5.3 Define Scope 5.4 Create WBS		5.5 Validate Scope 5.6 Control Scope	
. Project Time Management		6.1 Plan Schedule Management 6.2 Define Activities 6.3 Sequence Activities 6.4 Estimate Activity Resources 6.5 Estimate Activity Durations 6.6 Develop Schedule		6.7 Control Schedule	
. Project Cost Management		7.1 Plan Cost Management 7.2 Estimate Costs 7.3 Determine Budget		7.4 Control Costs	

Project Quality Management		8.1 Plan Quality Management	8.2 Perform Quality Assurance	8.3 Control Quality	
Project Human Resource Management		9.1 Plan Human Resource Management	9.2 Acquire Project Team 9.3 Develop Project Team 9.4 Manage Project Team		
. Project Communications Management		10.1 Plan Communications Management	10.2 Manage Communications	10.3 Control Communications	
. Project Risk Management		11.1 Plan Risk Management 11.2 Identify Risks 11.3 Perform Qualitative Risk Analysis 11.4 Perform Quantitative Risk Analysis 11.5 Plan Risk Responses		11.6 Control Risks	
. Project Procurement Management		12.1 Plan Procurement Management	12.2 Conduct Procurements	12.3 Control Procurements	12.4 Close Procurements
. Project Stakeholder Management	13.1 Identify Stakeholders	13.2 Plan Stakeholder Management	13.3 Manage Stakeholder Engagement	13.4 Control Stakeholder Engagement	

PM Framework and Integration

- **Key Definitions**
- Accountability
  - Acceptance of success or failure
- Responsibility
  - Assignment for completion of specific event or activity
- Authority
  - Right of an individual to make necessary decisions required to achieve his objectives or responsibility
- Power
  - Granted to an individual by the subordinates, peer and is a measure of their respect for the individual

Major Project Management Standards
(Conventional Types and Customized)



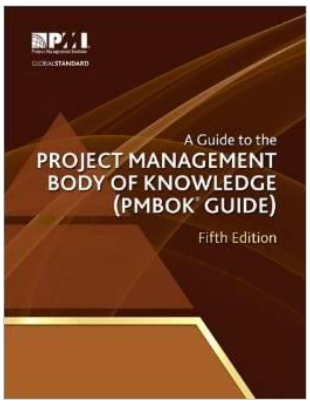
Project Management Methodology

A methodology is a framework of processes and tools tested on diverse projects.

Some of the reputable International organizations for maintaining world wide standards and certifications for project management are**;**

PMI – Project Management Institute (www.pmi.org)
PRINCE2 – PRojects IN Controlled Environments
IPMA - The International Project Management Association
APM - The Association of Project Management

The Project Management Body of Knowledge



The Project Management Institute's Body of Knowledge – PMBOK – is perhaps the most widely acknowledged and popular project management standard in existence. It is the basis for the PMI's coveted PMP certification examinations.

Presently in its fifth version (2013), PMBOK offers a comprehensive and sophisticated best practices and process-based standard which can be applied to different categories of projects. At the heart of the PMBOK are the ten areas of knowledge and five process groups which find application over the project life-cycle.

REQUIREMENT GATHERING FOR A PROJECT

Interviewing

Focus groups

- Help from subject matter experts

Brainstorming

- Group thinking
- An idea is floated which leads to another and so on

Delphi techniques

- Request for information is sent to subject experts who participate anonymously

Surveys

Observations

WORK BREAKDOWN STRUCTURE (WBS)

A work breakdown structure is a key project deliverable that organizes the team's work into manageable sections.

The Project Management Body of Knowledge (PMBOK) defines the work breakdown structure as a

"deliverable oriented hierarchical decomposition of the work to be executed by the project team."

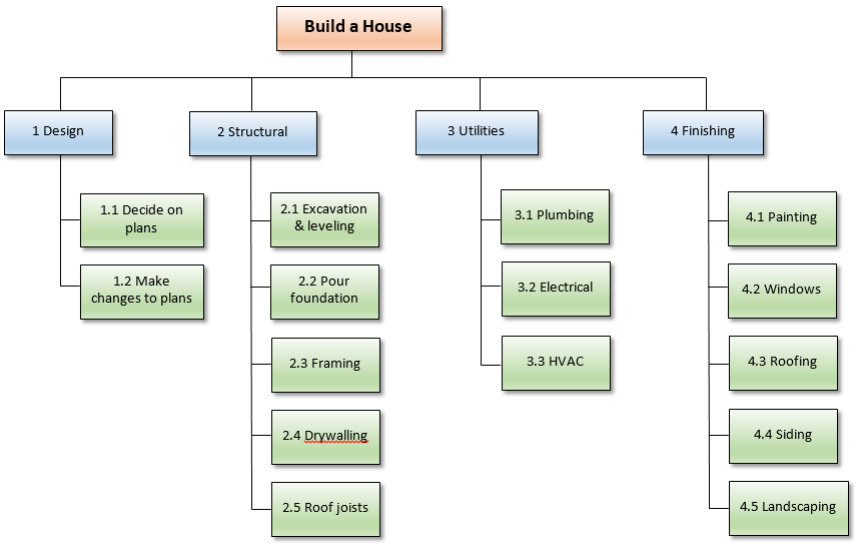
The work breakdown structure visually defines the scope into manageable chunks that a project team can understand, as each level of the work breakdown structure provides further definition and detail.

WBS Dictionary

WBS Dictionary describes each component of the WBS e.g.

- Milestone
- Deliverables
- Activities
- Scope
- Resources
- Quality
- Cost
- Sometime dates

WORK BREAKDOWN STRUCTURE (WBS)



ORGANIZATION BREAKDOWN STRUCTURE (OBS)

The OBS displays organizational relationships and then uses them for assigning work to resources in a project.

The hierarchical nature of the Organizational Breakdown Structure allows for the appropriate resources and responsibilities to be assigned.

It allows an at-a-glance look at the organizational resources structured in a hierarchical manner. An OBS is helpful in:

· Project Management

· Workforce Management

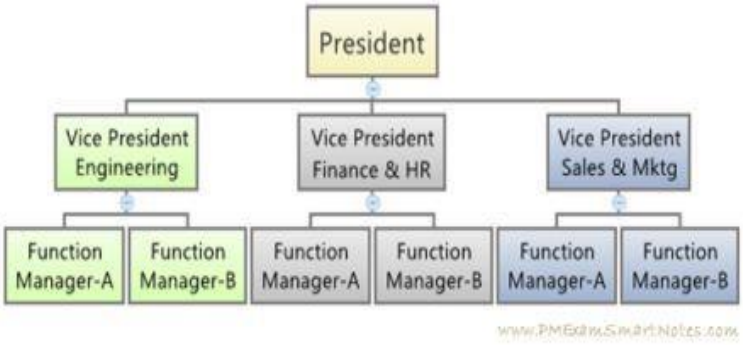
· Work Breakdown Structure

· Having a visual reference of the resources for any project

· Viewing costs by resource

· Viewing responsibilities by resource

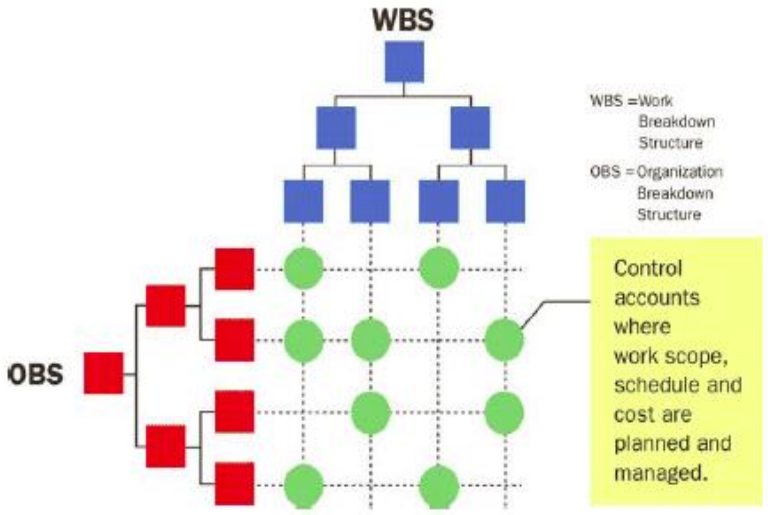
ORGANIZATION BREAKDOWN STRUCTURE (OBS)



RESPONSIBILITY ASSIGNMENT MATRIX (RAM)

RAM uses the WBS and OBS to link deliverables and/or activities to resources. The RAM provides a realistic picture of the resources needed and can identify if you have enough resources for the project.

RESPONSIBILITY ASSIGNMENT MATRIX (RAM)



BASIC TERMINOLOGIES

Activity:

Activity represent work to be done in order to complete a project.

OD (original duration) and RD (remaining duration):

The estimated time required to complete an activity is called OD. The amount of time left to complete an activity after it has started is known as RD.

Critical Path

The Critical Path of a project is the sequence of activities that determine the project completion date – any delay in an activity or activities comprising the critical path will delay the project by a corresponding amount of time. It has zero float and is the longest path in the network.

Predecessor:

An activity that must occur before another activity. A predecessor activity controls the start or finish date of its successor (s). An activity can have multiple predecessors, each with different relationship to it.

Successor:

An activity that must occur after another activity. An activity can have multiple successor, each with different relationships to it.

Relationships/Task Dependencies:

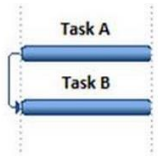
Any sort of connection between two activities is known as relationship. There are four types of relationships:

- SS (start to start)
- FS (finish to start)
- FF (finish to finish)
- SF (start to finish)

BASIC TERMINOLOGIES

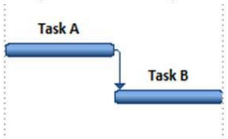
SS- Relationship

Relationship between activities in which the start of a successor activity depends on the start of its predecessor.



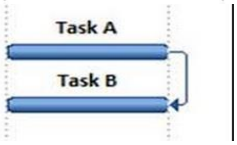
FS – Relationship

Relationship in which the start of successor activity depends on the completion of its predecessor activity.



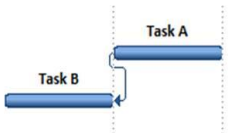
FF – Relationship

Relationship in which the finish of successor activity depends on the finish of its predecessor activity.



SF – Relationship

Relationship in which the finish of successor activity depends on the start of its predecessor activity.



BASIC TERMINOLOGIES

Lag:

Delay from an activity to its successors is known as Lag.

Lead:

To start an activity before the predecessor activity is completed is called Lead.

TF (Total Float):

Duration, measured in planning units, the activity can be delayed without affecting the project finish date. Zero Total Float indicates that timely completion of the activity is critical to the completion of the project. Such activities are called Critical Activities.

FF (Free Float)

The amount of time, measured in planning units, the early start of an activity can be delayed without delaying early start of a successor activity. Such activities are called Non-Critical Activities.

Baseline

The project's baseline is used to measure how performance deviates from the plan. Your performance measurement would only be meaningful if you had an accurate baseline. A project's baseline is defined as the original scope, cost and schedule. The project's baseline must be completely defined and documented before the project execution and control activities can begin.

BASIC TERMINOLOGIES

Schedule Compression

Schedule compression is used when the desired result is to create output faster than indicated in the original project, without having to change the project scope. This is particularly beneficial if a competitor is working on the same type of project and you need to finish first or may be a company decision. The schedule compression techniques are:

- Crashing

When the crashing approach is used, any additional costs associated with rushing the project are reviewed against the possible benefits of completing the project on a faster timeline. Adding more resources for the project, Allowing additional overtime, Paying extra to receive delivery of critical components more quickly, etc. Crashing may not work in situations like "the concrete in the foundation has to dry for 3 days".

- Fast Tracking

Re-Scheduling various activities within the project to be worked on simultaneously instead of waiting for each piece to be completed separately. This method is best used when activities can be overlapped. Problem is dependencies. So if you work on design and production at the same time your risk is that you need to rework production if the design is changed half way through the process.

BASIC TERMINOLOGIES

RESOURCES

Resources include the personnel and equipment that perform work on activities across all projects. Resources are generally reused between activities and/or projects. In the Project Management module, you can create a resource pool that reflects your organization's resource structure and supports the assignment of resources to activities. The Project Management module also enables you to distinguish between **labor, material, and non-labor resources.** Labor and non-labor resources are always time-based, and material resources, such as consumable items, use a unit of measure you can specify. You can create and assign resource calendars and define a resource's roles, contact information, and time-varying prices. If a resource uses Timesheets, you can also assign a login name and password to the resource.

Over Allocation

Over Allocation is when a project calls for more time than a team member has.

Resource Leveling

To get the best performance and results from resources, you need to manage resource workloads to avoid over-allocations and under-allocations. Over Allocation can be solved by number of ways for example: Changing the relationships i.e. (SS, FS, SF, FF), Changing lag to "zero" or change it to lead, Changing working time, Changing Units, Adding extra overtime hours to that particular resource.

PLANNING

The ultimate purpose of planning is to build a model that enables you to predict which activities and resources are critical to the timely completion of the project. Strategies may then be implemented to ensure that these activities and resources are managed properly, thus ensuring that the project will be delivered On Time and Within budget.

The components that may be measured and controlled using planning and scheduling software are:

- Scope
- Time
- Resource effort/Work
- Cost

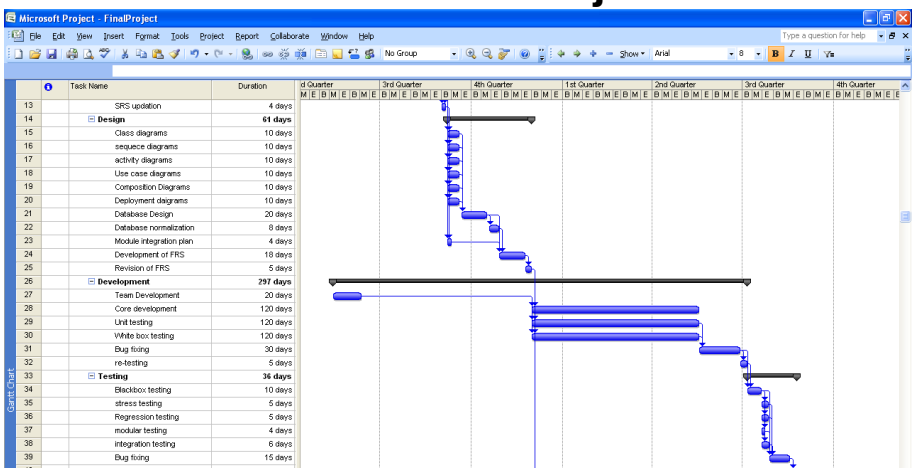
A change in any one of these components normally results in a change in one or more of the others.

The planning cycle is an integral part of managing a project. When the original plan is agreed to, the Baseline or Target is set. The baseline is a copy of the original plan and is used to compare progress with. Each project may have up to 50 baselines in Primavera. After project planning has ended and project execution has begun, the actual progress is monitored, recorded and compared to the Baseline dates.

GANTT CHARTS

- **Gantt charts** provide a standard format for displaying project schedule information by listing project activities and their corresponding start and finish dates in a calendar format.
- Symbols include:
  - **Black diamonds**: Milestones
  - **Thick black bars**: Summary tasks
  - **Lighter horizontal bars**: Durations of tasks
  - **Arrows**: Dependencies between tasks

Gantt Chart for Project-X

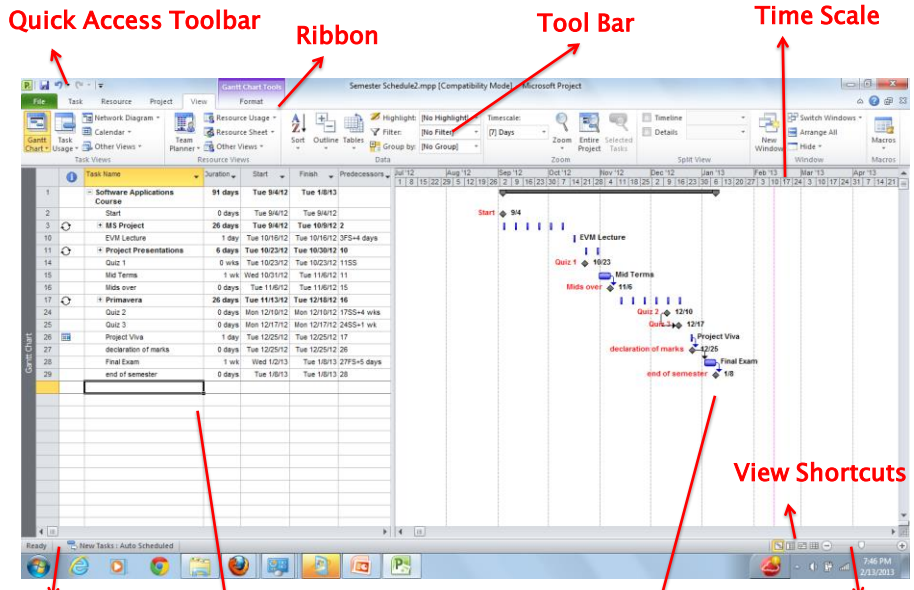


UNDERSTANDING PLANNING AND SCHEDULING SOFTWARE

Planning & Scheduling software enables the user to:

- Enter the breakdown structure of the project deliverables or products into the software. This is often called a Work Breakdown Structure (WBS) or product Breakdown Structure (PBS),
- Break a project down into the work required to create the deliverables and enter these into the software as the Activities under the appropriate WBS,
- Assign durations, constraints, predecessors and successors of the activities and then calculate the start and finish date of all the activities,
- Assign resources and/or costs, which represent people, equipment or materials, to the activities and calculate the project resource requirements and/or cash flow,
- Optimize the project plan,
- Set the Baseline Dates and Budget to compare progress against,
- Use the plan to approve the commencement of work,
- Record the consumption of resources and/or costs and re-estimate the resources and/or costs required to finish the project , and
- Produce management reports.

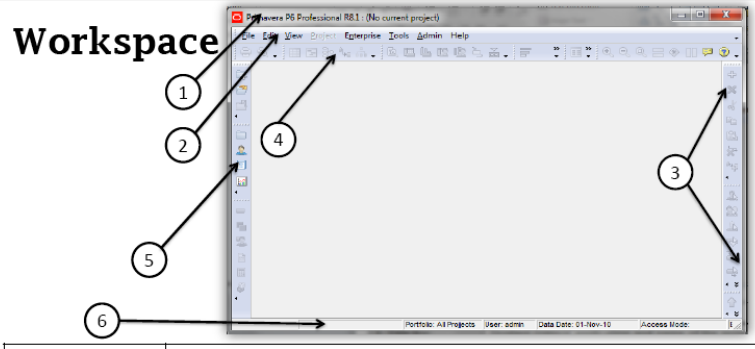
Getting started with
MS Project 2010



Oracle's Primavera P6

- Oracle's Primavera P6 Professional Project Management gives today's project managers and schedulers the one thing they value most: control.
- Primavera P6 Professional Project Management, the recognized standard for high-performance project management software, is designed to handle large-scale, highly sophisticated and multifaceted projects.
- It can be used to organize projects up to 100,000 activities, and it provides unlimited resources and an unlimited number of target plans.
- Massive data requires sophisticated, yet highly flexible organization tools to provide you a multitude of ways to organize, filter and sort activities, projects, and resources.

PRIMAVERA P6 ENVIRONMENT



Item	Functionality
1. Title Bar	Displays current application and name of the project
2. Menu Bar	Perform functions in Primavera
3. Command Bar	Actions that are performed in an open window (Add, Delete etc.)
4. Tool Bar	Displays icons that allow you to change the look and feel of the layout
5. Directory Bar	Quickly displays Primavera window (Activities, Project, Resources etc.)
6. Status Bar	Login Name, Data Date of open project, Access Mode, and Current Baseline

NETWORK DIAGRAM & CRITICAL PATH METHOD ANALYSIS

The Network Diagram is about creating relationships between activities.

Relationships are also referred to as dependencies, the most basic is finish to start.

Task 1 is to create these dependencies by indicating the predecessors for each activity.

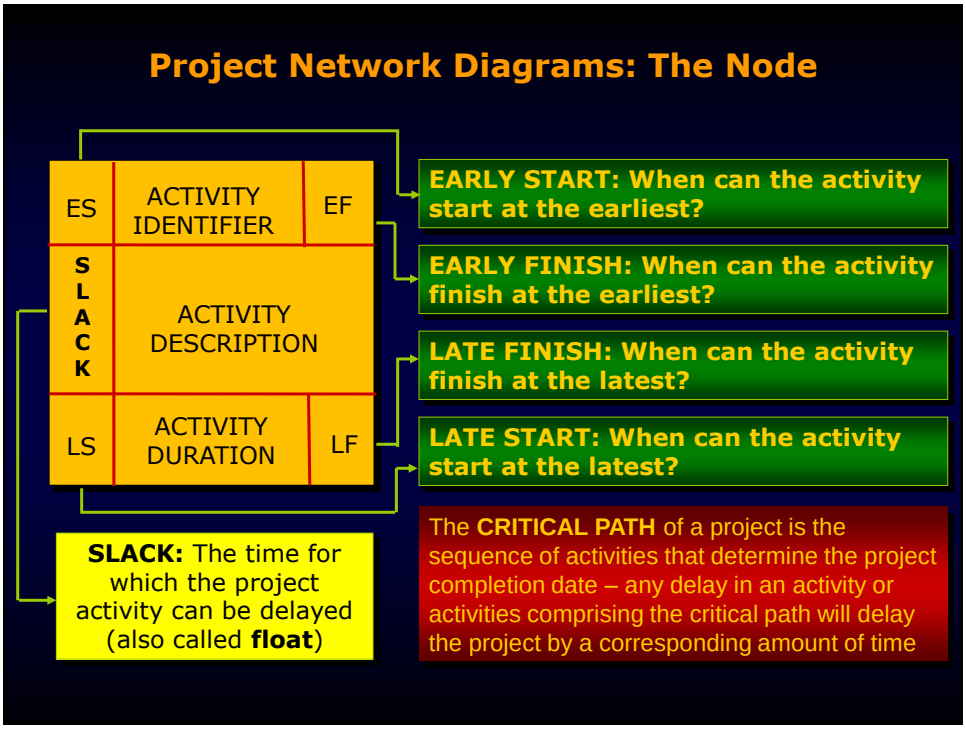
Task 2 is to test the logic by constructing the Network Diagram.

Task 3 is to determine the durations for each activity

Task 4 is to fill each Node

Task 5 is to calculate the forward and the backward pass

Task 6 is to determine the critical Path



Project Network Diagram Example
(Network Components and Details)

Koll Business Information Center

Activity	Description	Preceding Activity	Activity Duration
A	Approval of Application	None	5
B	Construction Plans	A	15
C	Traffic Study	A	10
D	Service Availability Check	A	5
E	Staff Report	B, C	15
F	Commission Approval	B, C, D	10
G	Wait for Construction	F	170
H	Occupancy	E, G	35

NETWORK DIAGRAM & CRITICAL PATH METHOD ANALYSIS

A Forward Pass through the network determines the earliest times each activity can start and finish – ALSO DETERMINE THE TOTAL DURATION OF THE PROJECT

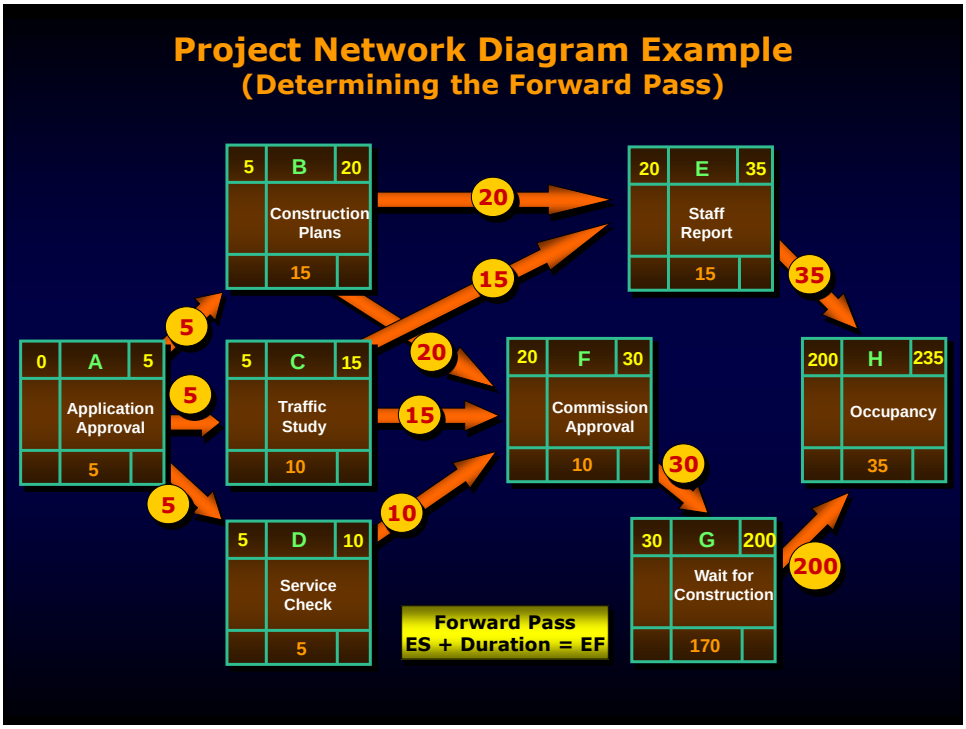
A Backward Pass through the network determines the latest times each activity can start and finish without delaying completion of the project – WITH THIS INFORMATION WE CAN DETERMINE WHERE WE CAN DELAY ACTIVITIES (HAVE SLACK) AND WHERE WE CANNOT

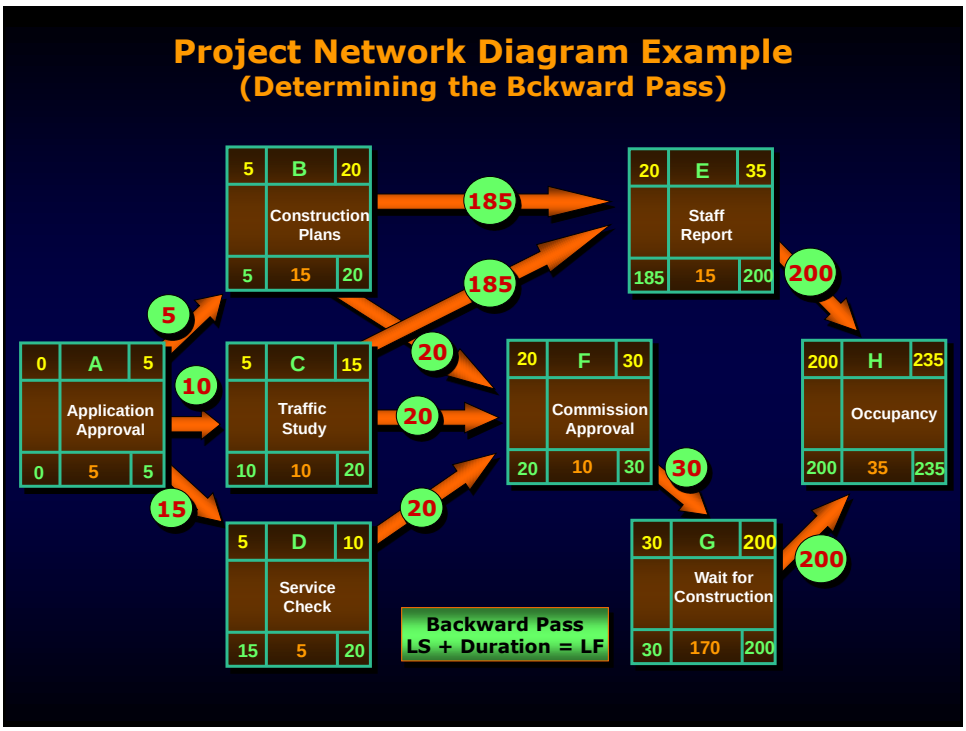
The Forward Pass

- The earliest start (EST) for the initial activity in a project is “time zero”
- The EST of an activity is equal to the latest (or maximum) early finish of the activities directly preceding it
- The EFT of an activity is equal to its EST plus the duration required to perform the activity.

The Backward Pass

- The latest finish (LFT) for the final activity in a project is equal to its EFT as determined by the forward pass
- The LFT for any other activity is equal to the earliest (or minimum) LST of the activities directly following (or succeeding) it
- The LST of an activity is equal to its LFT minus the time required to perform the activity.

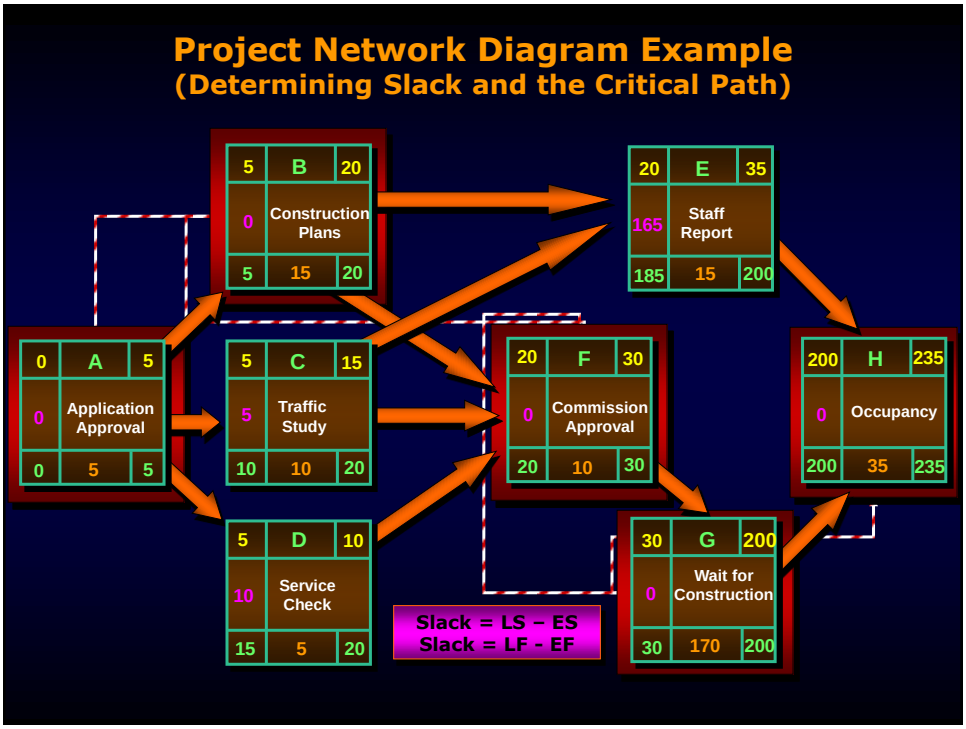

Project Network Diagram Example
(Determining the Forward Pass)
0 A 5
Application Approval
5
5 B 20
Construction Plans
15
5 C 15
Traffic Study
10
5 D 10
Service Check
5
20 E 35
Staff Report
15
20 F 30
Commission Approval
10
30 G 200
Wait for Construction
170
200 H 235
Occupancy
35
5
5
5
20
15
20
15
10
30
35
200
Forward Pass
ES + Duration = EF


Project Network Diagram Example
(Determining the Bckward Pass)
0 A 5
Application Approval
0 5 5
5 B 20
Construction Plans
5 15 20
5 C 15
Traffic Study
10 10 20
5 D 10
Service Check
15 5 20
20 E 35
Staff Report
185 15 200
20 F 30
Commission Approval
20 10 30
30 G 200
Wait for Construction
30 170 200
200 H 235
Occupancy
200 35 235
5
10
15
185
185
20
20
20
30
200
200
Backward Pass
LS + Duration = LF

NETWORK DIAGRAM & CRITICAL PATH METHOD ANALYSIS

DETERMINING THE CRITICAL PATH

- Critical activities have zero slack and cannot be delayed without delaying the completion of the project
- The slack for non-critical activities represents the amount of time by which the start of these activities can be delayed without delaying the completion of the entire project (assuming that all predecessor activities start at their earliest start times)
- The longest path on the network
- Could also be those activities with the least slack.



Standard forms for pay requests, such as AIA G702 (Application and Certification for Payment) and G703 (continuation to form G702), are used in the industry. In Europe and some other parts of the world, FIDIC (International Federation of Consulting Engineers) and NEC (New Engineering Contract) forms are used.

Earned Value Analysis

Earned value analysis (EVA) is an integrated cost-schedule approach used to monitor and analyze the progress of a project. Popescu and Charoenngam (1995) defined it as "the performance measurement to report the status of a project in terms of both cost and time at a given data date" (p. 252).

Earned value management (EVM), started in the 1960s as a method for integrated project cost and schedule control, was designed by the U.S. Air Force and named the *cost/schedule planning and control system*. In 1967, it became Department of Defense (DoD) policy and was renamed the **cost/schedule control systems criteria (C/SCSC)**. The objectives of the C/SCSC policy were (a) for contractors to use effective internal cost and schedule management control systems, and (b) for the government to be able to rely on timely data produced by these systems for determining product-oriented contract status. C/SCSC implementation was governed by DoD Instruction 7000.2, "Performance Measurement for Selected Acquisitions," issued by the comptroller in 1967 in the financial management regulatory series. The C/SCSC and DoD Instruction 7000.2 had several implementation problems and went through several cycles of research and redefining. The name changed several times, from cost/schedule planning and control system to cost/schedule control systems criteria, or C/SCSC, then to earned value management.[10]

The concept of **earned value (EV)** is simple; at any given point, take the following five steps:

1. Determine how much work you have done and how much you should have done according to the plan.
2. Determine how much money you have earned and how much money you have spent.
3. Calculate the time (schedule) and money (budget) deviations (variances) so far.
4. Analyze the causes for the major deviations and determine possible remedies.
5. Extrapolate these deviations to the end of the entire project.

To understand the math involved in EV analysis, consider the following simplistic example.

[10] For more information, see the Earned Value Management Web site (http://www.acq.osd.mil/pm) and the papers "Earned Value Management and Acquisition Reform" (http://www.acq.osd.mil/pm/paperpres/standown.html) and "Earned Value Management Rediscovered" (http://www.acq.osd.mil/pm/newpolicy/misc/abba_art.html), both by Wayne Abba.

Example 7.3

A contractor agreed to build 30 doghouses in 90 days at a price of \$800 per unit. Twenty days later, the contractor has finished 8 doghouses with an actual total cost (that includes his overhead and profit) of \$6,800. What is the status of the project?

Solution

The following analysis applies only if work is sequential and not parallel (that is, the contractor works on one unit till it is finished then starts the next unit and so on). Linearity of production and no learning curve effect are also assumed.

$$\text{Total planned budget (TB)} = 30 \text{ units} * \$800 \text{ each} = \$24,000,$$

$$\text{Daily planned production} = 30 \text{ units}/90 \text{ days} = 0.33 \text{ units/day (or 3 days per unit)},$$

$$\text{Daily planned budget} = \$24,000/90 \text{ days} = \$266.67$$

$$= 0.33 \text{ units/day} * \$800 \text{ each} = 266.67,$$

and

$$\text{Percent complete} = 8/30 = 26.7\%.$$

After 20 days, the contractor's plan calls for 0.33 units/day $*$ 20 days $=$ 6.66 units to be finished, with a total cost of 6.66 $*$ \$800 $=$ \$5,333.We call this amount the **budgeted cost for work scheduled (BCWS)**. In other words, if everything (schedule and budget) worked according to plan, in 20 days the contractor would have finished 6.66 units and earned \$5,333.

The contract price was \$800 and the contractor actually finished 8 units, so he earned 8 $*$ \$800 = \$6,400 from the owner (disregarding what it actually cost him). This is called the *earned value (EV),* or **budgeted cost for work performed (BCWP)**.

However, the contractor's actual cost was \$6,800. This is called **actual cost for work performed (ACWP)**.

Cost Variance (CV) $= \text{BCWP} - \text{ACWP} = 6,400 - 6,800 = -\$400$

Schedule variance (SV) $= \text{BCWP} - \text{BCWS} = 6,400 - 5,333 = \$1,067$

Schedule variance in days (SV, days) $=$ SV (\$)/Daily planned budget

$= \$1,067/\$266.67 = 4$ days

Cost performance index (CPI) $= \text{BCWP}/\text{ACWP} = 6,400/6,800 = 0.94$

Schedule performance index (SPI) $= \text{BCWP}/\text{BCWS} = 6,400/5,333 = 1.20$

Forecasted cost variance (FCV) $= \text{CV}/\%\,\text{Complete} = \$400/26.7\% = \$1,500$

Forecasted schedule variance (FSV) $= \text{SV}/\%\,\text{Complete} = 4/26.7\% = 15$ days

The results are tabulated as follows:

Activity	Dog houses
TOTAL BUDGET ($)	24,000
% COMPLETE	26.7
ACWP ($)	6,800
BCWP ($)	6,400
BCWS ($)	5,333
CV ($)	400
SV ($)	1,067
SV (DAYS)	4
CPI	0.94
SPI	1.20
FCV ($)	1,500
FSV (DAYS)	15

From simple observation, we can tell the following:

- The project is 26.7% complete.
- The project is ahead of schedule by 4 days (planned to finish 6.66 units in 20 days but finished 8).
- The project is over budget by $400 (earned $6,400 but spent[11] $6,800).
- If work continues at the same pace and pattern, the contractor will finish this project 15 days ahead of schedule but with a budget deficit of $1,500.

Several factors must be taken into consideration when interpreting the preceding numbers. One factor is the effect of the learning curves. It is possible that slightly below average productivity is expected and acceptable if the crew is ''learning'' this task and the project manager expects an improvement later that will erase this negative variance. It is also possible that the contractor is accelerating the project and that is costing him extra money. It is very possible that this extra cost is justifiable to the contractor.

The BCWS represents the baseline schedule and budget. The BCWP represents the ''earned value'' (i.e., the contract earning for performed work). The ACWP represents actual budget spending.

Both the variances and performance indexes are measures of deviation from the baseline. The variances are absolute measures in units of dollars and days. The performance indexes are relative measures in percentages. To ''dramatize'' the

[11] The contractor's overhead and profit are part of the ''expenses.''

difference between absolute and relative measures, let us consider two activities: the first with a $100 budget, and the second with a $10,000 budget. If we have a cost variance, CV, of −$25 in *each* activity, the CPI for the first is 0.75 (seriously low) and 0.998 for the other (consider it perfect). Contractors strive for a nonnegative cost and schedule variances, and cost and schedule performance indexes at or exceeding 1.0.

In most cases, the forecasted amounts are used to raise a red (or yellow) flag rather than to accurately predict future amounts. For example, in the previous example, the contractor can tell his crew, "We are running $400 over budget and we are just 27% complete. If we don't do anything about it, we will end up with a $1,500 deficit." In projects in which a penalty is imposed for finishing late and/or a bonus for finishing early, forecasting can be a key tool for making a decision to accelerate the project.[12] Analysis of the causes for variance is beyond the scope of this book. However, it is important to point out four issues:

1. Minor variances are usually expected and tolerated (although discouraged when negative). Major variances should be investigated.
2. For a negative variance (schedule or cost), something must have gone wrong in the actual work or in the baseline. For example, labor productivity may have been lower than expected. This could be due to uncontrolled circumstances (whether forgivable or not) or due to underestimation in the baseline. Material prices could have risen unexpectedly or waste may have taken a larger-than-expected percentage. This causes major concern, especially in fixed-price contracts.
3. A large positive variance may not be a reason for celebration. It may indicate an error or an overestimation in the baseline budget and/or schedule.
4. Schedule performance and budget performance are independent. The contractor may find him- or herself operating under the conditions in one of the four quadrants shown in Figure 7.17. Quadrant I means the project is ahead of schedule and under budget (where you want to be). Quadrant II gives you bad news (you are behind schedule) and good news (and under budget). Quadrant III is the worst: you are behind schedule and over budget. Quadrant IV is the opposite of quadrant II: you are ahead of schedule but over budget.

Another parameter that was suggested is the Cost-Schedule Index (CSI), which is the product of the CPI and the SPI. The main problem with this parameter is the possibility that good performance in one area masks substandard performance in the other. For example, in our previous sample project, the CSI was $0.94 * 1.20 = 1.13$, which is good but misleading.

[12] For example, see the discussion on *contractor-created float* previously in this chapter or the introduction to chapter 8.

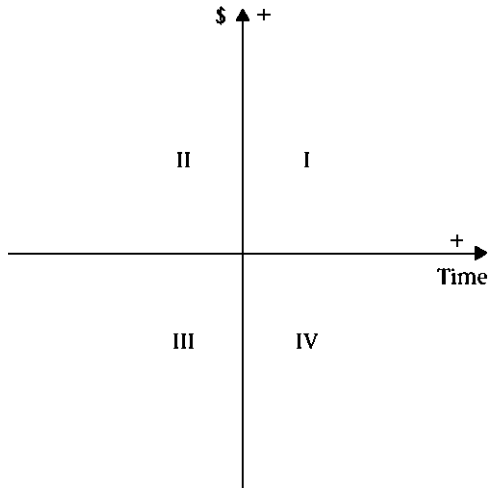


Figure 7.17 Schedule performance versus budget performance: quadrant I, ahead of schedule and under budget; quadrant II, behind schedule and under budget; quadrant III, behind schedule and over budget; quadrant IV, ahead of schedule but over budget.

Earned Value versus CPM: It is important to note that EV analysis and schedule updating may yield conflicting results. The schedule variance (SV) may be positive, but the schedule update may show that the project is behind, or vice versa. This situation occurs mainly because the EV analysis is budget-driven, whereas schedule updating focuses on the critical path, without regard to monetary issues. For example, the contractor may get a positive schedule variance in Earned Value Analysis by completing noncritical activities ahead of schedule while the critical path may be behind. CPM still gives the most accurate readings on whether the project is ahead of or behind schedule. Several authors suggested schedule variance (SV) that is time-based with several approaches[13] Such suggestions are beyond the scope of this book.

S Curves

Earned value (BCWP) and actual cost (ACWP) may be plotted against the baseline (BCWS), as shown in Figure 7.18. Both curves, representing the ACWP and the BCWP, are usually extrapolated to forecast an **estimate at completion (EAC)** and the date of completion.

EV Analysis at Different Levels When using the WBS, project managers may look at work at different summary levels.

[13] Warburton and Kanabar (2008), Anbari (2003).

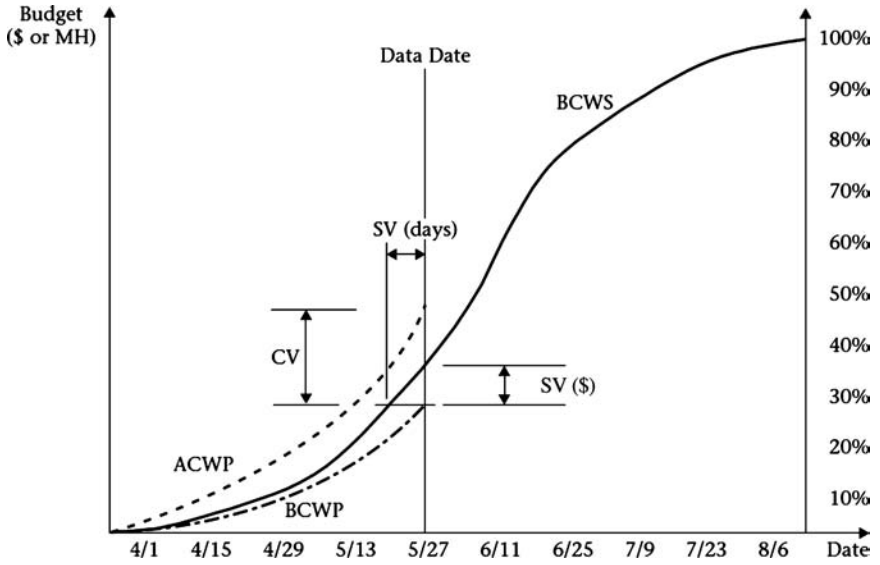


Figure 7.18 Earned value (budgeted cost for work performed, or BCWP) and actual cost (actual cost for work performed, or ACWP) plotted against the baseline (budgeted cost for work scheduled, or BCWS).

Example 7.4

The total estimated duration of the mass excavation activities in an office building project is 40 days. After 15 days, the project manager receives the following information:

Type of Excavation	Task No.	Total Quantity (CY)	Unit Price ($)	Total Budget ($)	Actual CY	Actual Cost ($)
Mass Excavation	T0B11110	39,000	—	176,500	13,200	59,700
Common Earth	T0B11111	20,000	2.50	50,000	7,800	17,950
Clay	T0B11112	8,000	5.50	44,000	1,200	5,850
Rock	T0B11113	11,000	7.50	82,500	4,200	35,900

Perform an EV analysis. Note that the ''Mass Excavation'' line is a summary of the 3 lines below.