INDIANA DEPARTMENT OF TRANSPORTATION
PROJECT MANAGEMENT TRAINING PROGRAM

Advanced Project Management

TRAINING MANUAL

TRAUNER
CONSULTING SERVICES

Advanced Project Management

TRAINING MANUAL

Course Development and Seminar Leaders:

Contents

Introduction

This course identifies the principles and methodologies adopted by the Indiana Department of Transportation (INDOT) to support successful project management and delivery. Project management requires the application of knowledge, skills, tools, and techniques to deliver the project on time, within budget, and according to specifications. INDOT's project management process is based on proven industry standards for project management, such as the Project Management Body of Knowledge (PMBOK) prepared by the Project Management Institute (PMI) and INDOT's accumulated experience with the management and delivery of transportation construction projects.

A. INDOT's Vision

Driving Indiana's Economic Growth

B. INDOT's Mission

Build, maintain, and operate a superior transportation system enhancing safety, mobility, and economic growth.

C. INDOT's Values

Customer Focus

We will understand and meet the needs of our customers in our policy, program development, and decision-making process.

Integrity

We will maintain the highest ethical standards in our dealings with each other, our customers, our business partners, and the environment.

People

We commit to developing and supporting a flexible, technically skilled work force with individual teams that work toward our shared mission and goals.

Agility

We will have the knowledge and ability to rapidly adapt to the opportunities and challenges offered by changing technology and business processes.

Continuous Improvement

We will continually improve our business processes through better products, practices, procedures, and information-based decision making.

Safety

We will create, maintain, and promote a safe work environment for our employees and continually strive to reduce incidents and the severity of traffic-related accidents and injuries.

INDOT's *Vision:* Driving Indiana's economic growth

INDOT's *Mission:* Build, maintain, and operate a superior trans-portation system enhancing safety, mobility, and economic growth.

Source:http://www.ai.org/dot (7/14/06)

INDOT's *Values:*

Customer Focus
Integrity
People
Agility
Continuos improvement
Safety

Source:http://www.ai.org/dot (7/14/06)

D. Course Goal and Outcomes

1. Course Goal

The goal of this course is to provide participants with advanced management tools and techniques in a form that allows application to their projects.

2. Learning Outcomes

Upon completion of this course you will be able to:

- Identify project team roles and methods of project conflict resolution
- Plan and estimate percent complete for schedule and budget management
- Identify methods for schedule compression or recovery of time
- Develop risk management plans
- Identify methods for budget and scheduling estimates
- Develop a resource histogram and balance resources
- Perform earned value analysis on an actively tracked project plan

E. Ground Rules for Seminar

- Participate
- Be on time
- Stay on task
- Share responsibility for training
- Listen when others talk
- Respect the opinions and attitudes of others
- Turn off cell phones, pagers, PDAs, and Blackberries

Ground Rules For Seminar

- Participate
- Be *on time*
- Stay *on task*
- Share responsibility for training
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- Respect the opinions and attitudes of others
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F. Administriva

- Facilities – Restrooms, water, vending machines, phone, lunch
- Breaks and Lunch (Lecture will resume promptly at the conclusion of each break and lunch)
- Course Evaluation (Please use a blue or black pen or soft pencil)
- Please sign the roster

Administrivia

- Facilities
- Breaks and lunch
- Course evaluation
- Please sign the roster

G. Course Agenda

TIME	MODULE TITLE	LENGTH (min.)
Day 1		
8:00 - 8:15	Course Introduction	15
8:15 - 9:00	Module 1	45
9:00 -9:30	Module 2	30
9:30 -9:45	Break	15
9:45 -11:00	Module 2 (continued)	75
11:00 -11:15	Break	15
11:30 -12:00	Module 3	30
12:00 -1:00	Lunch	60
1:00 - 2:30	Module 3 (continued)	90
2:30 - 2:45	Break	15
2:45 - 3:45	Module 3 (continued)	60
3:45 - 4:00	Break	15
4:00 - 4:30	Module 3 (continued)	30
Day 2		
8:00 - 10:00	Module 4	90
10:00 - 10:15	Break	15
10:15 -11:15	Module 4 (continued)	60
11:15 - 11:30	Break	15
11:30 -12:30	Module 5	60
12:30 -1:30	Lunch	60
1:30 - 2:30	Module 5 (continued)	60
2:30 - 2:45	Break	15
2:45 - 3:45	Module 6	60
3:45 - 4:00	Break	15
4:00 - 4:30	Module 6 (continued)	30

H. Resources

- Project Management Process Training Manual
- Schedule Training Manual
- A Guide to the Project Management Body of Knowledge, 3rd Edition (PMBOK Guide). Project Management Institute, Inc. 2004.
- Harold Kerzner, Ph.D. Project Management, A Systems Approach to Planning, Scheduling, and Controlling, 8th Edition. John Wiley & Sons, Inc. 2000
- International Institute for Learning (IIL). "Advance Project Risk Management" training manual, version 4.0. International Institute of Learning, Inc. 2004

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Module

1

INDOT Project Management Overview

Learning Outcomes

- Explain what a project management plan is.
- Describe what a Project Performance Baseline is.

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Learning Outcomes

- **Explain what a project management plan is.**
- **Describe what a Project Performance baseline is.**

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Project Management Process

Initiate and Align
- Project Description
- Team Mission/Assignment
- Major Milestones
- Boundaries
- Team Identification
- Roles and Responsibilities
- Operating Guidelines
- Measures of Success

Plan the Work
- Work Breakdown Structure (WBS)
- Task Planning and Scheduling
- Risk Planning
- Budget Development
- Change Management Plan
- Communication Plan
- Quality Plan (QA/QC)
- Transition and Closure Plan

Endorse the Plan
- Project Team Commitment
- Management Endorsement

Work the Plan
- Managing Scope, Schedule, and Budget
- Manage Risks
- Managing Change
- Communication

Transition and Close
- Implement Transition Plan
- Review Lessons Learned
- Reward and Recognize
- Archive

Continuous Communication

INDOT Project Management Overview

Project Management Process

INDOT's project management process is a 5-step process very similar to other project management approaches being used around the world by Project Managers in both the private and public sectors.

A. Initiate & Align the Project Team

This is the first step in the project management process. Initiation is the formal recognition that a project exists. Organizational senior management will initiate the project and assign the project to a Project Manager. The Project Manager will identify the project team and align the team with a common goal and purpose. The elements of the Initiate & Align process are:

- <u>Project Description</u>: A description of the project's product, purpose, or intended outcome.

- <u>Team Mission/Assignment</u>: A high-level description of the approach the project team will use to achieve the Project Description.

- <u>Major Milestone</u>: A listing of expected milestones for the project.

- <u>Boundaries</u>: Identification of physical boundaries, operational limitations, and other objective constraints for the project.

- <u>Team Identification</u>: The Project Manager will identify the functional teams required to deliver the project.

- <u>Roles & Responsibilities</u>: "Who will do what?" The project team roles (the "who") and the project responsibilities (the "what") will be identified by the project team.

- <u>Measures of Success</u>: Identifying critical success factors and methods to measure performance relative to these factors.

- <u>Operating Guidelines</u>: The project team will identify how decisions will be made and plan methods for managing project conflicts.


INDOT Project Management Overview

Initiate& Align

- **Project Description**
- **Team Mission / Assignment**
- **Major Milestones**
- **Boundaries**
- **Team Identification**
- **Roles and Responsibilities**
- **Measures of Success**
- **Operating Guidelines**

B. Plan the Work

This is the second step in the project management process. This step produces the Project Management Plan that will be used by the project team to deliver the project. The elements of the Plan the Work phase are:

- Work Breakdown Structure (WBS): Using, for example, the Project Delivery Process Master Schedule, the project team will decompose the list and develop a project specific WBS.

- Task Planning & Scheduling: The project team will use the WBS to develop tasks to deliver the project deliverables. These activities are entered into the project's scheduling program. This will define the project schedule.

- Budget: The project team may resource-load the project schedule to develop a "bottom-up" or engineering estimate for the project. This will define the project's cost requirements (the project budget). This is compared against programmed budgets. The project team will look at ways to optimize the scope, schedule, and budget to match the earlier identified project boundaries.

- Risk Planning: The project team will develop a Risk Management Plan and Risk Register to identify, analyze, plan response action strategy, and monitor risk events.
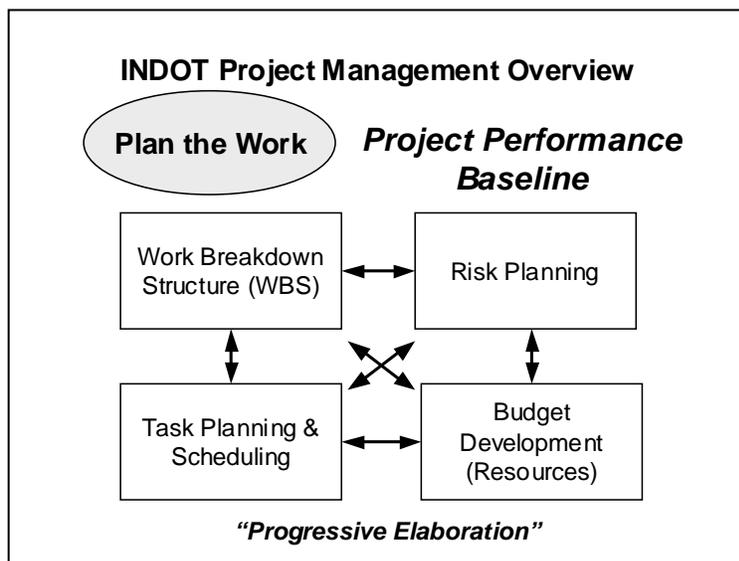
- Communication Plan: The project team will develop a Communication Plan to identify and describe the methods, media, frequency, required details, and information needed. Both external and internal communications are planned.

- Change Management Plan: The project team will develop a Change Management Plan that will provide a framework and process for the team to use when change occurs.

- Quality Plan: The project team will identify the quality methods to be planned and implemented to prevent errors from reaching the customer (Quality Control-QC) and to ensure that the team is "doing the right things" (Quality Assurance-QA).

- Transition & Closure Plan: "Beginning with the end in mind." The project team will develop the Transition & Closure Plan for the transition of the project to the next phase or the closure of the project.

INDOT Project Management Overview

Plan the Work

- **Communication Plan**

- **Change Management Plan**

- **Quality Plan**

- **Transition & Closure Plan**

The first four elements (WBS, schedule, budget, risk) define the Project Performance Baseline.   The last four elements (Communication Plan, Change Management Plan, Quality Plan, and Transition & Closure Plan) are developed to help facilitate project management.

C. Endorse the Plan

Endorsement is the third step in the project management process. Endorsement also completes the "Plan the Work" phase of project management. Once the Project Management Plan is endorsed, the project team will move to the "Work the Plan" phase of project management. The elements of endorsement are:

- <u>Project Team Commitment</u>: Getting an agreement or pledge from the project team that they will perform and deliver the project deliverables as documented in the Project Management Plan.

- <u>Management Endorsement</u>: Getting approval and a commitment from senior management that the resources required and documented in the Project Management Plan will be available.

Once the Project Management Plan is endorsed, it becomes the baseline for the project, a metric for project performance, and the guide for project management.

Endorsement is not a "one-time" event, but is done throughout the life of the project. As changes occur, the project team will need to review and re-commit and re-endorse the updated plan.

INDOT Project Management Overview

Endorse the Plan

- **Project Team Commitment**
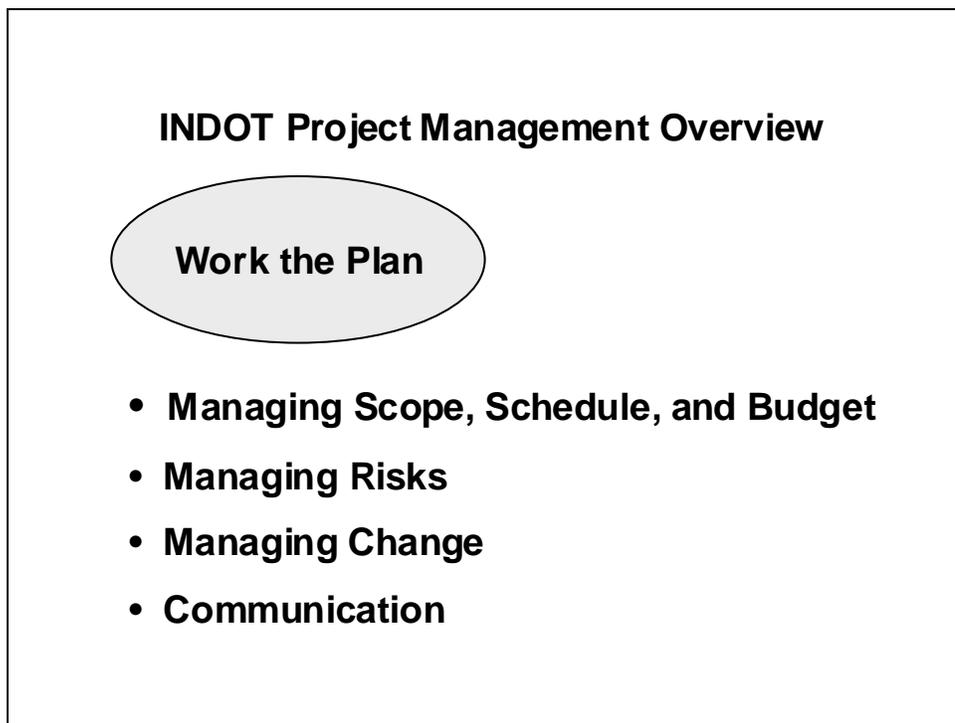- **Management Endorsement**

D. Work the Plan

"Work the Plan" is the fourth step of the project management process. Although the steps have been listed in a linear order, working the plan requires the Project Manager to continually update the plan, requiring some additional planning and possible re-endorsement in the case of change. This updating process is referred to as "progressive elaboration." It is an iterative process. As the project team knows more about the project, further refinement of the plan is required. The elements of "Work the Plan" are as follows:

- Managing scope, schedule, and the budget: These are the components of the Project Performance Baseline. The Project Manager will continually update the Project Performance Baseline by tracking what work was actually completed, when that work was actually completed, and how much was actually expended to complete the work planned. Comparing these actuals against the Project Performance Baseline will give the project team a sense of how the project is performing with respect to schedule and budget.

- Managing Risks: The project team created a risk management plan and a risk register during the "Plan the Work" step. During the "Work the Plan" step, the Project Manager and the project team will monitor the identified risk, continue to update the plan with new identified risks, evaluate the impact and probability of the new identified risks, and monitor the effectiveness of the risk response strategy.

- Managing Change: Change is inevitable on a project. A Project Manager will manage change by implementing the Change Management Plan for the project.

- Communication: The most important skill set for a Project Manager is the ability to communicate clearly and appropriately. The Communication Plan developed during the "Plan the Work" step is implemented and updated as needed. The items required for reporting are progress reporting (schedule and budget performance); issues (risks and changes); and lessons learned. These items should be a standing agenda item for all team meetings.

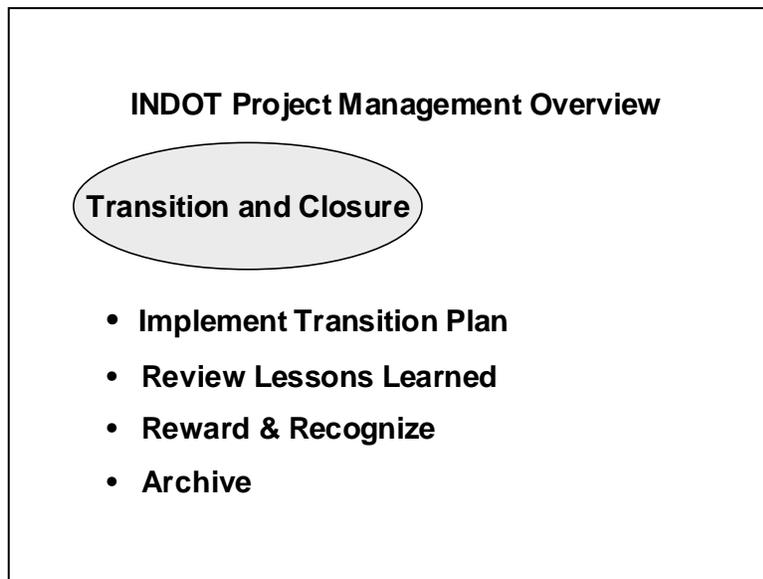Throughout the project life, the Project Manager will need to manage a dynamic project team. These teams must be built and sustained to attain high performance, produce effective results, and successfully deliver the project.

INDOT Project Management Overview

Work the Plan

- **Managing Scope, Schedule, and Budget**
- **Managing Risks**
- **Managing Change**
- **Communication**

E. Transition and Closure

The final step in the project management process is "Transition & Closure." This is the step of transitioning the project to the next phase or completing the project as described in the project description and delivering the product to the customer. The elements for this project management step are as follows:

- Implement the Transition Plan: During the "Plan the Work" step, the project team developed a plan for transitioning and closing the project. Implementation of this plan gives a foundation to accomplish this.

- Review Lessons Learned: Lessons learned were identified early on and maintained throughout the project life. The team will review lessons learned from the project and share it with the team and agency.

- Reward & Recognize: Look to recognize and reward the outstanding achievements of the project team. Since teams are dynamic, this is an element that is managed throughout the project's life.

- Archive: Archiving the project information as directed by agency policies and in accordance with the Transition and Closure Plan. Being able to plan early to identify what information will be archived and in what format or media, will allow the team to archive as it develops and completes the project.

INDOT Project Management Overview

Transition and Closure

- **Implement Transition Plan**
- **Review Lessons Learned**
- **Reward & Recognize**
- **Archive**

F. Project Management Plan

During the "Plan the Work" phase of the project, which encompasses the first three project management process steps, the project team creates and endorses a Project Management Plan. This plan will typically consist of the following:

- Completed Initiate and Align Phase

- Project Work Breakdown Structure (WBS)

- Project Schedule

- Project Budget with appropriate forecasted expenditures

- Risk Management Plan with Risk Register

- Communication Plan

- Change Management Plan

- Quality Plan

- Transition and Closure Plan

- Commitment and Endorsement

1. Project Performance Baseline Management
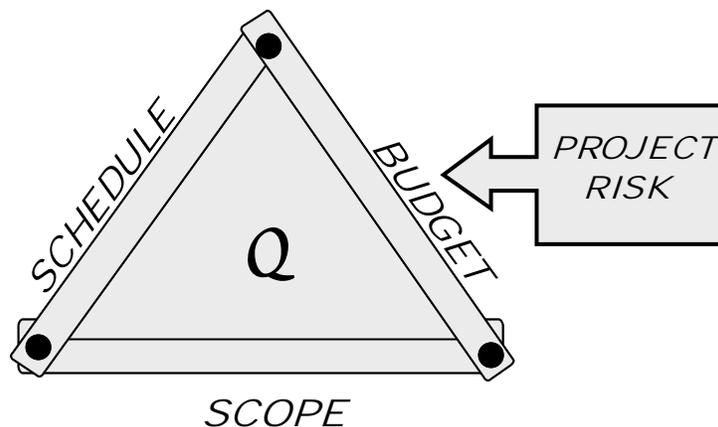
Project Managers often talk of a "triple constraint" or "trade-off triangle" — project requirements (scope), project time (schedule), and project costs (budget). Replacing these project objectives with the tools to manage those objectives gives the "trade-off" triangle of scope, schedule, and budget. The relationship between these parameters is such that if any one of the three parameters is changed, at least one of the other project parameters is likely to be affected. Project quality is affected by balancing these project objectives. High quality projects deliver the required product, service, or result within scope, on time, and within budget.

Project Managers also manage projects in response to uncertainty. Project risk is an uncertain event or condition that, if the risk event occurs, has a positive or negative effect on at least one project parameter.

2. Project Requirements (Scope and Quality)

The project WBS is developed to define the project requirements and project scope. The Project Manager will manage the project scope and the associated quality defined for the project deliverables. If an additional project deliverable is required, the Project Manager will implement the appropriate change management actions to update the project scope. Work completed that is not part of the endorsed project WBS is called "scope creep." Technically oriented team members are motivated not only by meeting specifications, but also by exceeding them. Unfortunately, exceeding specifications can become quite costly. The Project Manager needs to be able to discern between legitimate scope change and scope creep.

3. Project Time (Schedule)

The Project Schedule is developed to define when the work will be completed on a project. During the "Work the Plan" process step, a Project Manager will track the actual dates for the work completed, and analyze the effects of these dates on the remainder of the project network. Schedule performance will be evaluated by comparing the actual dates to the planned dates (project performance baseline). A Project Manager will use schedule compression techniques (discussed later) to recover a project schedule.

4. Project Costs (Budget and Budget Aging)

The Project Budget is developed to define when financial resources will be required. Based on the project WBS (work to be done) and the project schedule (when work will need to be completed), the budget is developed and an appropriate forecasting report, the "Aging Report" is developed. During the "Work the Plan" process step, the Project Manager will track the actual expenditures for the work completed and evaluate or analyze the effects of these actual costs on the remainder of the project aging. Budget performance will be evaluated by comparing the actual expenditures to the planned expenditures (Project Performance Baseline).

Module 1 Exercise

1. The five steps of the project management process are:

   _____

   _____

   _____

   _____

   _____

2. Complete the below "trade-off triangle" with the appropriate project objectives and tools to manage the objectives:

   _____
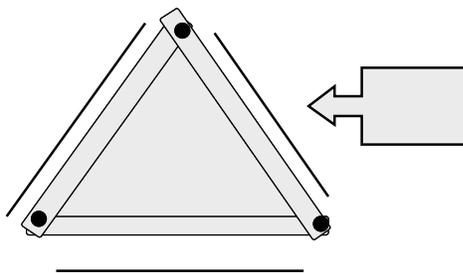
3. The Endorsed Project Performance Baseline consists of:

   _____

   _____

   _____

4. The Project Management Plan consists of:
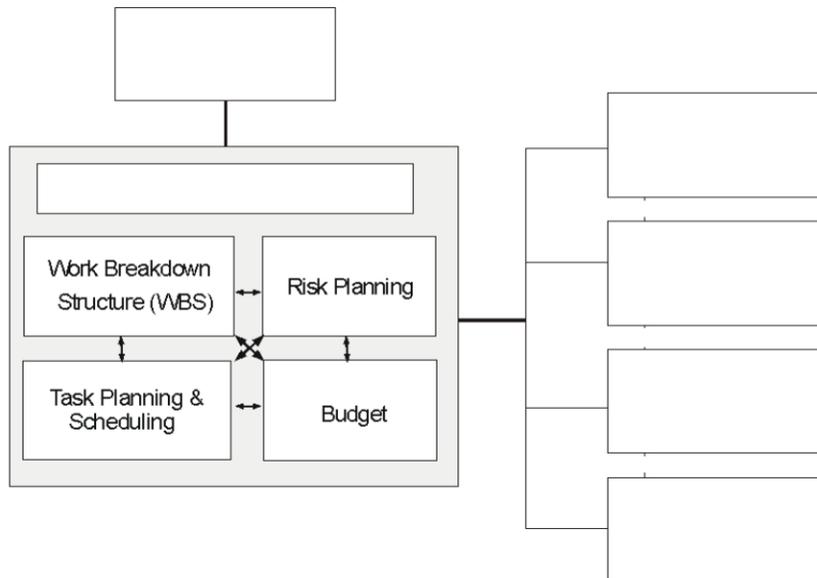
5. The most important skill set for a Project Manager is:
   a. Scheduling expertise
   b. Communication
   c. Technical
   d. Budgeting

Module

1

INDOT Project Management Overview

Learning Outcomes

- Explain what a project management plan is and how it is developed.
- Describe what a Project Performance Baseline is and how that baseline is managed.

Learning Outcomes

- **Explain what a project management plan is.**
- **Describe what a Project Performance baseline is**.

General Project Management Theory

Learning Outcomes

- Describe an Organizational Breakdown Structure (OBS) and a Responsibility Assignment Matrix (RAM) and their uses
- Compare and contrast functional organizations and project organizations
- Describe the difference between "Organizational Power" and "Earned Power," and give examples of each
- List methods for resolving conflicts
- List and describe constructive and destructive team roles

General Project Management Theory

A. Project Management Body of Knowledge

While terminology may vary, the principles of project management are consistent.   Project Managers with the knowledge and skill to lead a team toward a common goal will optimize team member talents to the best benefit of the team and the organization.

The Project Management Body of Knowledge (PMBOK) Guide describes the work planning process as defining and refining objectives and selecting the best from alternative courses of action. There are many tools and techniques unique to project management, such as work breakdown structures, critical path, or earned value. These tools and techniques alone are not sufficient to ensure a successful project outcome, but require a project team possessing adequate project management knowledge and skills. The project team must possess and use knowledge and skills from at least five areas:

1. The Project Management Body of Knowledge

Knowledge both unique to the project management field and overlapping other management disciplines.

2. Application area knowledge, standards, and regulations

Project categories with common elements but not necessary in all projects

- Functional and supporting disciplines — legal, inventory management, personnel, traffic, right-of-way, environmental, etc.

- Technical elements — software development, for example

- Management specializations — government contracting or new product development

- Industry groups — automotive, chemical, agriculture

Each of these areas typically have there own sets of accepted standards and practices.

3. Understanding the project environment

The team needs to understand the positive or negative cultural, political, social, and environmental impacts the project may have and how people (customers, stakeholders, etc.) may affect the project.

4. General management knowledge and skills

Planning, organizing, staffing, controlling ongoing operations through strategic planning, accounting, procurement, human resources, information technology, etc.

5. Interpersonal skills

Effective communication, getting things done, leadership, motivation, conflict management, and problem solving.
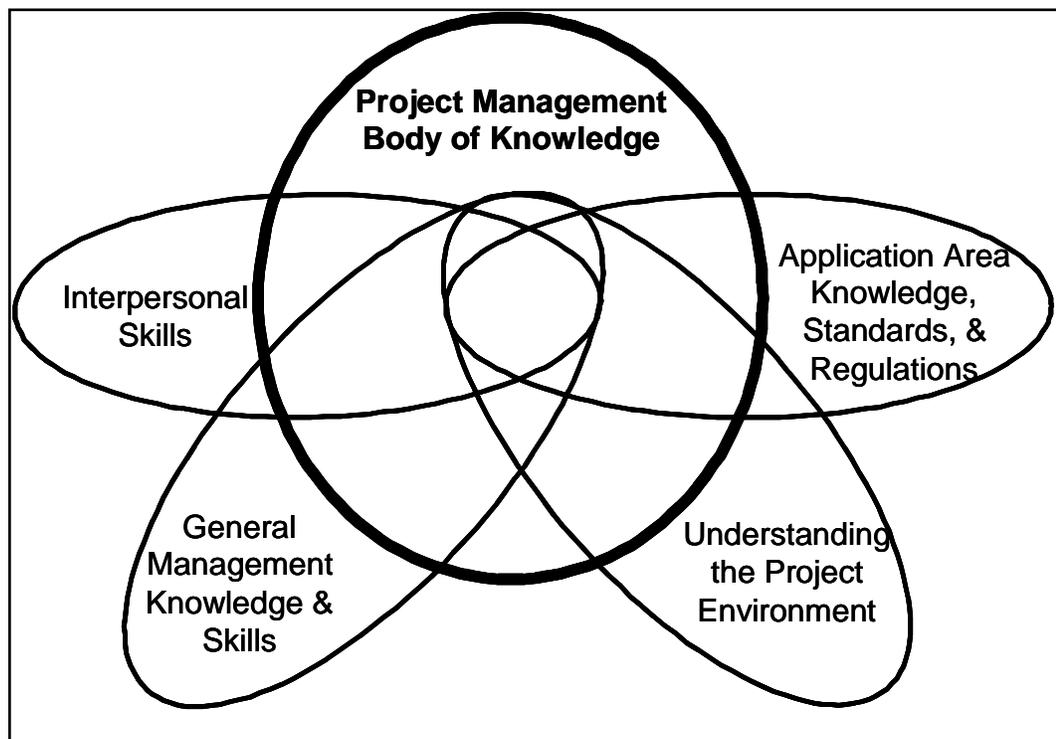
Each of these areas may appear to be discrete elements, but they generally overlap. It is not required that every team member be an expert in all five areas, the combined knowledge of the team leads to an effectively managed project.

B. Organizational Planning

Organizational planning is a process that is primarily concerned with identifying and assigning roles and responsibilities for the project. Everyone on a project has a function or role and a responsibility assigned to that role or function. It is important for the Project Manager to identify these roles and oversee team members in the performance of their responsibilities in order to keep the project running smoothly and ensuring project success. Identifying and defining these roles is a vital part of the "Initiate and Align" step of the project management process.

1. Project Manager

The Project Manager is ultimately responsible for the project. This person uses organizational resources to accomplish the project objectives. The Project Manager is "large and in charge" of the project. The Project Manager leads each step in the project management process.

2. Project Sponsor

The sponsor and the Project Manager are the "owners" of the project. Usually, the project sponsor will come from senior management, but can be the customer in some cases. The project sponsor is the person or group responsible for providing the resources (funding, labor, space, etc.) for the project.

3. Senior Management (Executive Management)

Senior managers are the people above the Project Manager within an organization. Senior management will prioritize projects in the organization. Senior management will *Initiate* the project, which is the formal recognition that a project exists. Senior managers delegate project responsibilities and authority to the Project Manager.

It is also senior management's role to create a productive environment for the project, and to review and endorse the project management plan.

4. Functional Manager

The functional manager manages the specialty or specific resources required to create the deliverables required for the project. Project Managers will coordinate and negotiate with the functional managers for the resources needed for the project. Functional managers are often involved in project planning and setting priorities for the project.

5. Project Team Member

The individuals performing the work required for successful delivery of the project.

6. Stakeholder

A project stakeholder is anyone with a particularly significant interest in the project's outcome including those providing funding or right of way for the project and property owners who are affected by the project. Stakeholders are unique for each project and include anyone actively involved in the project and whose interests may be positively or negatively affected by the execution or completion of the project. A stakeholder may also exert influence over the project and its deliverables.

A Project Manager must manage stakeholder expectations, which can be difficult because stakeholders often have different or even conflicting objectives for the project. A Project Manager will need to work with the project team to identify key stakeholders. Key stakeholders are those stakeholders who have a direct impact on project success. Maintaining effective communication with key stakeholders is vital to project success.

7. Customer

The person or organization that will acquire or use the project's product, service, or result.
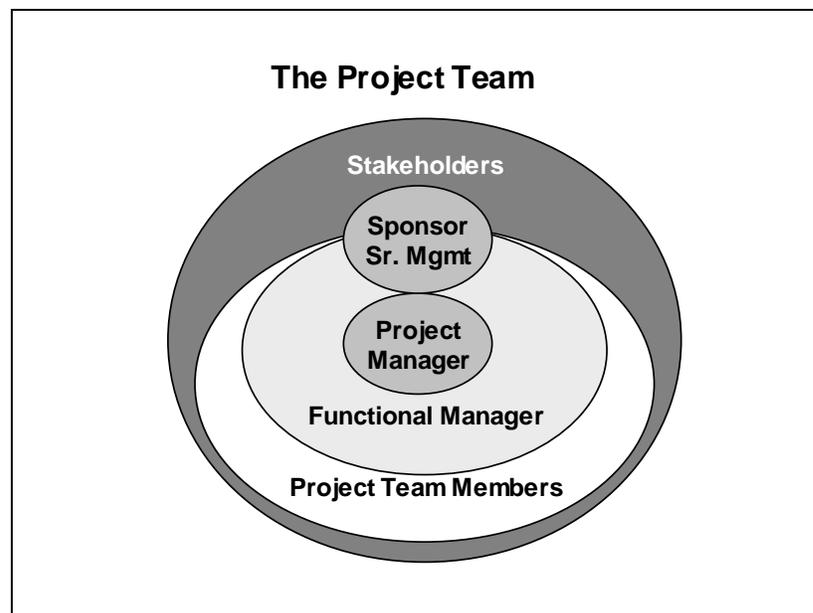
C. Organizational Breakdown Structure

An Organizational Breakdown Structure (OBS) is a hierarchical organized depiction of the project organization arranged so as to relate the work packages to the performing organizational units (functional managers). This is an effective tool for defining roles and responsibilities and facilitates the development of the Project Communication Plan.

Organizational Breakdown Structure (OBS)
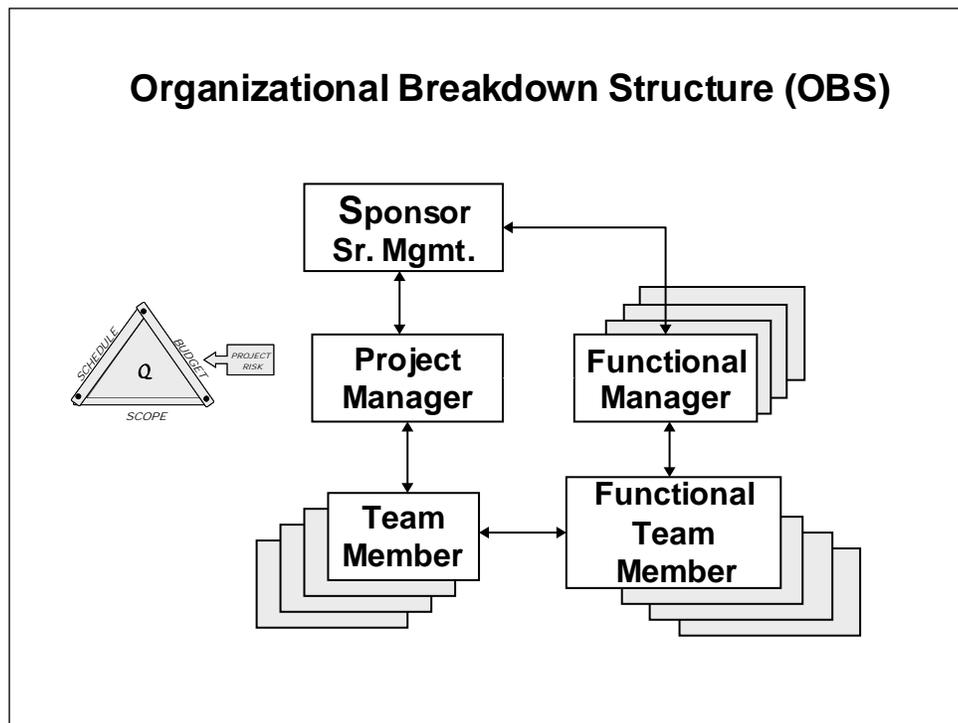
D. Responsibility Assignment Matrix (RAM)

A Responsibility Assignment Matrix (RAM) is a tool that relates the project OBS to the project Work Breakdown Structure (WBS). It is used to help ensure that each component of the project's scope is assigned to a responsible team or person.

Role / WBS Item	Project Manager	Functional Manager A	Functional Manager B	Functional Manager C	Functional Manager D	Functional Manager E	Functional Manager F	Functional Manager G	Functional Manager H	Functional Manager J	Functional Manager K	Functional Manager L	Functional Manager M	Functional Manager N	Functional Manager P
WBS Deliverable 1	R						S			A					
WBS Deliverable 2			P		S	R									A
WBS Deliverable 3	R				I			I				A	S		
WBS Deliverable 4										S					I
WBS Deliverable 5	R			A				I				S			
WBS Deliverable 6		R			I			A				S			
WBS Deliverable 7	R	S					S						A		

P - Participant; A – Accountable; R – Review; I – Input Required; S – Signature Required

E. Organizational Influences and Structure

Projects are typically part of an organization that is larger than the project. Examples of organizations include corporations, governmental agencies, healthcare institutions, international bodies, professional associations, and others.

Project-based organizations are those whose operations consist primarily of projects. These organizations fall into two categories:

- Organizations that derive their revenue primarily from performing projects for others under contract (i.e. architectural firms, engineering firms, consultants, construction contractors, and government contractors).

- Organizations that have adopted management by projects. These organizations usually have a management system in place to facilitate project management.

Organizational Influences and Structure

Project-Based Organizations

- *Organizations that derive their revenue primarily from performing projects for others under contract*

- *Organizations that have adopted management by projects*

The structure of an organization often constrains the availability of resources.

| Org Structure | Functional | Matrix | | | Projectized |
Characteristics		Weak	Balanced	Strong	
Project Mgr's Authority	Little or None	Limited	Low to Moderate	Moderate to High	High to Almost Total
Resource Availability	Little or None	Limited	Low to Moderate	Moderate to High	High to Almost Total
Who controls project budget	Functional Manager	Functional Manager	Mixed	Project Manager	Project Manager
Project Mgr's Role	Part-time	Part-time	Full-time	Full-time	Full-time
Project Mgr Admin Staff	Part-time	Part-time	Part-time	Full-time	Full-time

1. Functional Organization

The typical functional organization is a hierarchy where each employee has one clear supervisor. Staff members are grouped by their specialty. The scope of work is typically bound by the group's specialty or specific function. Projects developed in a functional organization will have a project coordinator in lieu of a Project Manager.

Functional Organization

Org Structure	Functional
Characteristics	
Project Mgr's Authority	Little or None
Resource Availability	Little or None
Who Controls Project Budget	Functional Manager
Project Mgr's Role	Part-Time
Project Mgr. Admin Staff	Part-Time

2. *Projectized Organization*

At the other end of the spectrum from the functional organization is the projectized organization. Often, team members are co-located. Most of the organization's resources are involved with project work. Project Managers have a great amount of independence and project authority.

Projectized Organization	
Org Structure	Projectized
Characteristics	
Project Mgr's Authority	High to Almost Total
Resource Availability	High to Almost Total
Who Controls Project Budget	Project Manager
Project Mgr's Role	Full-Time
Project Mgr. Admin Staff	Full-Time

3. Matrix Organization

Matrix organizations are a blend of functional and projectized characteristics.

a. Strong Matrix

In a strong matrix organization, the Project Manager has considerable authority and usually will have full-time staff assigned. The Project Manager will usually report to a manager of Project Managers, or a Project Management Office.

Strong Matrix Organization	
Org Structure	Strong Matrix
Characteristics	
Project Mgr's Authority	Moderate to High
Resource Availability	Moderate to High
Who Controls Project Budget	Project Manager
Project Mgr's Role	Full-Time
Project Mgr. Admin Staff	Full-Time

b. *Weak Matrix*

Weak matrices maintain many of the characteristics of a functional organization, with the Project Manager actually providing a coordination role, with limited or no project authority.

Weak Matrix Organization	
Org Structure	Weak Matrix
Characteristics	
Project Mgr's Authority	Limited
Resource Availability	Limited
Who Controls Project Budget	Functional Manager
Project Mgr's Role	Part-Time
Project Mgr. Admin Staff	Part-Time

c. Balanced Matrix

A balanced matrix recognizes the need for a Project Manager; this structure does not provide the Project Manager with full authority over the project and project funding.

Balanced Matrix Organization

Org Structure	Balanced Matrix
Characteristics	
Project Mgr's Authority	Low to Moderate
Resource Availability	Low to Moderate
Who Controls Project Budget	Mixed
Project Mgr's Role	Full-Time
Project Mgr. Admin Staff	Part-Time

d. Project Coordinator

In some organizations, Project Managers do not exist. Instead, these organizations use the role of a project coordinator. The project coordinator has less authority than a Project Manager. This person may not be allowed to make budget decisions or overall project decisions, but they have some authority to assign resources. Project coordinators are typically found in weak matrix and functional organizations.

Organizational Influences and Structure

Project Coordinator

- *Less authority than a Project Manager*
- *Does not make project or budget decisions*
- *May assign resources*
- *Functional and Weak Matrix*

e. Project Expeditor

This role has the least amount of authority. The Project Expeditor is a staff member who makes sure things arrive on time and that the tasks and activities are completed on time. An Expeditor is usually found in a functional organization.

Organizational Influences and Structure

Project Expeditor

- *Least authority*
- *Staff member that ensures things arrive on time*
- *Staff member that manages schedules*
- *Functional Organization*

F. Power

Power is the ability to influence behavior in others. Power that is based on the organization and the position or title of the Project Manager is "Organizational" or "Legitimate" power. Power that is based on the characteristics of the person is "Individual" or "Earned" power.

Power

"The ability to influence behavior in others"

- *Organizational / Legitimate*

- *Individual / Earned*

---

1. Legitimate/Formal Power

Legitimate power, also known as formal power, is the power that the Project Manager has due to the position or title. This power comes from being formally in charge of a project and the backing and support from the agency or organization.

Strong, broad-based, formal authority for a Project Manager is rare. This would be characteristic of a projectized organizational structure.

Legitimate / Formal Power
(Organizational / Formal power)

- *Power the Project Manager has due to position*

- *Formally in charge of project with support from agency/organization*

- *Projectized Organization*

---

2. *Reward Power*

Reward power is the ability to give rewards and recognize achievements. Some examples of these rewards and recognition are pay raises, bonuses, time off, or any other type of reward that motivate.

Reward Power
(Organizational / Formal power)

- ***Ability to give rewards and recognize achievements***

- ***Examples: pay raises, bonuses, etc.***

---

3. Punishment Power

Similar to reward power, this type of influence is the ability to punish an employee if a goal is not met. "Nobody is taking vacation next month if we miss this milestone date," or "If you overspend the project budget, you'll be demoted," are examples of a manager using punishment power. This type of power is also known as coercive power.

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Punishment Power
(Organizational / Formal power)

- *Ability to punish employees if goals are not met*

- *Also known as "coercive" power*

- *Examples: demotions, pay reduction, etc.*

</div>

4. Expert Power

Expert power exists when the individual or Project Manager is an expert on the subject. People will listen and respond to an individual that has expert power because that person has credibility. A Subject Matter Expert (SME) has significant power to influence and control behavior.

Expert Power
(Individual / Earned power)

- *Exists when individual is an expert*

- *People will respond and listen because of credibility*

- *Subject Matter Experts (SMEs)*

5. Referent Power

Referent power is a form of power based on the respect or charismatic traits of the individual. This power is based in the persuasive ability of the person.

Another form of referent power is when a less persuasive (powerful) person will use the influence of, or allies with, another person with more persuasive traits, and leverages the power of the ally.

Referent Power
(Individual / Earned power)

- *Respect / charismatic traits of the individual*

or

- *Allies with more powerful individual and leverages the power of the ally*

Most project management references consider Reward and Expert power as the most effective and Punishment or Coercive power as the least effective.

G. Conflict Management

Project Managers need to realize that conflicts during the life of a project are inevitable. Recognizing this fact, developing good procedures or techniques, and planning for conflict resolution can help resolve conflicts as they arise. A project management plan can identify potential conflicts, develop resolution methods, and document the methods for the project team to use throughout the project.

1. Sources of Conflict

Research has shown that the greatest source of conflict is between Project Managers and functional managers. Most of these are the result of disagreements over schedules, priorities, and resources. This runs contrary to commonly held beliefs that most project conflicts are a result of personality differences.
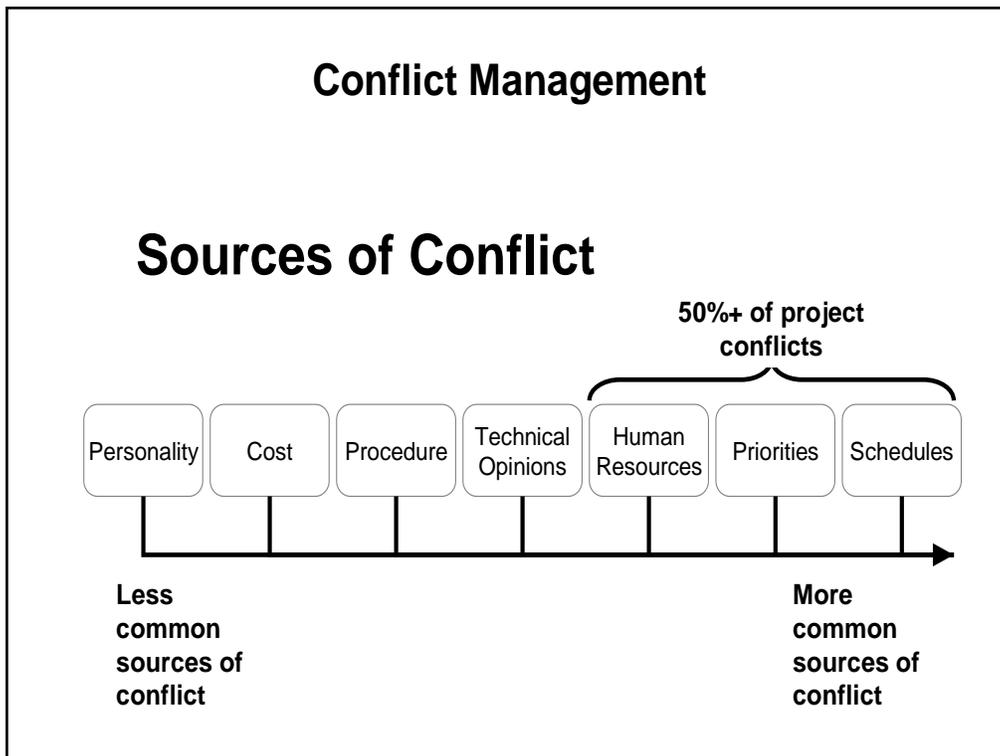
Conflict Management

Conflict Resolution Methods

- *Confronting / Problem Solving*

- *Compromising*

- *Forcing*

- *Smoothing / Accommodating*

- *Withdrawing / Avoiding*

2. Confronting/Problem Solving

Sometimes referred to as "confronting" or "collaborating." Although the term *confronting* may have a negative connotation to it, this method is generally viewed as the best method for conflict resolution. It "confronts" the source of conflict and looks to solve the conflict so it will not be an issue for the project.

Conflict Management

Confronting / Problem Solving

- *Sometimes referred to as "collaborating"*

- *Generally viewed as the best method for conflict resolution*

- *Looks to solve the conflict at the source so it will not be an issue for the project*

Conflict Management

Confronting / Problem-Solving

- *When conflicting parties can get at least what they want and maybe more*
- *To reduce cost*
- *To create a common power base*
- *To attack a common foe*
- *When skills are complimentary*

Conflict Management

Confronting / Problem-Solving

- *When there is enough time*
- *When there is trust*
- *When you have confidence in the other's ability*
- *When the ultimate objective is to learn*

3. Compromising

To compromise is to negotiate or bargain for a solution that gives both parties some degree of satisfaction. Some would call this a "give and take" or "win-win" situation. Others might call it a "lose-lose" position, since neither party will get everything they want or need.

Conflict Management

Compromising

- ***To negotiate or bargain for a solution to give both parties some degree of satisfaction***

- ***"Give and take" or "win-win"***

- ***Neither party gets everything they want or need ("lose-lose")***

Conflict Management

Compromising

- *When both parties need to be "winners"*

- *When you can't win*

- *When others are as strong as you are*

- *When you haven't time to win*

- *To maintain the relationship*

Conflict Management

Compromising

- *When you are not sure you are right*

- *When you get nothing if you don't*

- *When stakes are moderate*

- *To avoid giving the impression of "fighting"*

4. Forcing

Forcing is exactly as the name implies. It is when one party tries to impose the solution on the other party. The result is usually viewed as a "win-lose" situation, where one party wins at the expense of the other. Typically, this method does not address the underlying source of conflict and can reduce team morale. It is not viewed as a good method for long term solutions and relationship building.

Conflict Management

Forcing

- *When one party imposes the solution on the other party*

- *"win-lose" situation, wins at the expense of the loser*

- *Does not always address the underlying source of conflict and often reduces team morale*

Conflict Management

Forcing . . .

- *To gain status or power*
- *In short term (one-time) deals*
- *When the relationship is unimportant*
- *When a quick decision must be made*

Conflict Management

Forcing . . .

- *When you are right*
- *When a do-or-die situation exists*
- *When stakes are high*
- *When important principles are at stake*
- *When you are stronger*

5. *Smoothing /Accommodating*

When using the smoothing or accommodating technique, the Project Manager will emphasize the areas of agreement or turn attention to what is going well and deemphasizing the areas of disagreement or conflict. Smoothing tends to downplay the conflict instead of resolving it.

Conflict Management

Smoothing / Accommodating

- *Emphasizes areas of agreement*

- *Tends to downplay conflict instead of solving conflict*

- *May make sacrifices to satisfy the needs of the other party*

Conflict Management

Smoothing / Accommodating…

- *To maintain harmony*
- *When any solution will be adequate*
- *To create goodwill*
- *When you will lose anyway*
- *To gain time*

Conflict Management

Smoothing / Accommodating…

- *To reach an overarching or higher goal*
- *To create obligation for a trade-off at a later date*
- *When the stakes are low*
- *When liability is limited*

6. Withdrawal/Avoiding

Withdrawal is often regarded as a temporary solution at best. Some argue that this is not conflict resolution at all. A Project Manager that uses this method is merely hoping that the problem will go away by itself over time. Because of the avoidance or temporary nature of this method, the conflict can come up again and again throughout the project life.

Conflict Management

Withdrawing / Avoiding

- *Temporary solution at best*

- *Conflict and source of conflict will continue through project life*

- *Some view as cowardice and unwillingness to address the conflict situation*

Conflict Management

Withdrawing / Avoiding . . .

- *When you can't win*

- *When stakes are low*

- *When stakes are high, but you are not ready*

- *To gain time*

Conflict Management

Withdrawing / Avoiding . . .

- *To unnerve your opponent*

- *To preserve neutrality or reputation*

- *When you think the problem will "go away"*

- *When you win by delay*

Conflict Management

Conflict – Door stuck shut

- *Throw shoulder into door and break it open (Forcing)*

- *Ignore it; hope another will fix the door (Withdrawing/Avoiding)*

- *Determine what is causing the door to be stuck and correct the problem (Confronting / Problem solving)*

Conflict Management

Preferred

- *Confronting / Problem-solving*
- *Compromising*

Last Resort

- *Forcing*

Avoid

- *Withdrawing / Avoiding*

7. Team Roles

A Project Manager's ability to effectively address and manage conflicts on a project will be affected by his or her ability to recognize and deal with constructive and destructive roles on the project team. **An effective Project Manager will be able to identify destructive roles within the team and look to diminish or eliminate them and enhance and maximize the positive effects from constructive team roles.**

Team Roles

- *Constructive Team Roles*

- *Destructive Team Roles*

   "An effective Project Manager will look to diminish or eliminate the effects of destructive team roles and enhance and maximize the effects of constructive team roles"

a. Constructive Team Roles

(1) Initiators

An initiator is a project team member that brings ideas and activities to a project. This role is proactive and is considered highly productive and positive.

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Constructive Team Roles

Initiators

- ***Brings ideas and activities to the project***

- ***Proactive***

- ***Highly productive***

"Let's try this!"

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(2) Information Seekers

An information seeker is a project team member that actively seeks to gain as much project information and project understanding as possible. This role is considered positive because this develops an environment of increased project knowledge and open communications for the project team.

Constructive Team Roles

Information Seekers

- ***Looks to gain as much project information and understanding as possible***

- ***Opens communication***

  "Can we get this information?"

---

(3)   Information Givers

An information giver is a project team member that openly shares project information. Similar to the information seeker, this role is considered positive because it develops an environment of increased project knowledge and open communications for the project team. Be mindful that not all information can be readily shared (i.e. confidential, classified, secret information).

Constructive Team Roles

Information Givers

- ***Openly shares project information***

- ***Increases project knowledge***

- ***Opens communication***

"Studies have shown that…"

(4) Encouragers

Encouragers are project team members that maintain a positive and realistic attitude within the project team. These individuals keep the team focused on what can be accomplished. This role is considered positive because it contributes, improves, and maintains team morale.

Constructive Team Roles

Encouragers

- ***Maintains positive and realistic attitude within the project team***

- ***Keeps focus on what can be accomplished***

- ***Improves team morale***

  "Your idea has a lot of merit."

---

(5) Clarifiers

A clarifier is a project team member that works to ensure that everyone has the same project understanding and project knowledge. This role is considered positive because it is proactive and keeps the team focused on the project objectives. This role also improves communication.

Constructive Team Roles

Clarifiers

- *Ensures everyone has the same project knowledge and understanding*

- *Improves communication*

"Let me restate what I'm hearing from the team..."

---

(6) Harmonizers

A harmonizer is a project team member that actively looks to enhance project information in a way that increases project understanding. This is considered a positive role because it increases project understanding and can contribute to better communication.

Constructive Team Roles

Harmonizers

- ***Enhances project information to increase project knowledge and understanding***

- ***Improves communication***

"Your ideas are similar, let's build from there..."

---

(7) Summarizers

A summarizer can take the minute details of the project and restate or relate them in a summarized form back to the project objectives. This is considered a positive role because the fine details of a project can become overwhelming to project team members. A summarizer will, similar to the harmonizer, help to increase project understanding and can contribute to better communication.

Constructive Team Roles

Summarizers

- *Restate and relate project information back to the project objectives*

- *Improves project understanding*

- *"The details shared by the designers will improve the product and present a cost savings of..."*

---

(8) Gate Keepers

The role of gate keeper has a couple of possible meanings in project management, depending on the reference used. One definition is a project team member that works to draw other team members into the project discussions. This role is considered positive because it encourages participation on the project.

Another definition is the project team member that judges whether the project will continue when a "kill point" or "stage gate" has been reached. This project team member makes decisions whether the project still meets business needs and is justified in transitioning to the next phase.

Constructive Team Roles

Gate Keepers

- *Works to draw all project team members into the discussion*

- *Also: Determines whether a project will continue to the next phase*

- *"We haven't heard from Jim, what are your thoughts?"*

---

b. *Destructive Team Roles*

(1) *Aggressors*

An aggressor is a project team member that is openly opposed and hostile to the project and project objectives. This is a negative role because it serves no productive purpose for the project.

Destructive Team Roles

Aggressors

- *Criticizes everybody and everything on project management*

- *Acts aggressively*

- *Deflates team morale*

(2) Blockers

A blocker is a project team member that blocks access to information and looks to disrupt the flow of communication. Since good project communication is essential for project success, this role is very destructive.

Destructive Team Roles

Blockers

- *Rejects others viewpoints*
- *Likes to criticize*
- *Cites unrelated examples*

(3) Withdrawers

A withdrawer is a project team member who does not participate in discussions, brainstorming sessions, team meetings, etc. This person will likely remain quiet or refuse to participate at all. This is a negative role because it usually produces a project team member that will not commit to the project plan and can have a negative effect on team morale.

Destructive Team Roles

Withdrawers

- *Is afraid to be criticized*

- *May withhold information*

- *May be "pouting"*

- *May be shy*

---

(4) Recognition Seekers

A recognition seeker will look at a project to see how it can personally benefit him or her. Because this person is more interested in personal benefit than project success, he or she can ultimately jeopardize the project.

Destructive Team Roles

Recognition Seekers

- *Only volunteers if status is recognized*

- *Like to hear themselves talk*

- *Boasts, rather than provides meaningful information*

- *Does not give merit to other's ideas*

---

(5) Topic Jumpers

A topic jumper is a project team member that constantly changes the subject and brings up irrelevant facts. This is a destructive role because it disrupts effective communication and could prevent important topics from being fully discussed and brought to closure.

Destructive Team Roles

Topic Jumpers

- ***Brings up irrelevant points***

- ***Constantly changes topics***

- ***Tries to keep project management implementation as an action item forever***

---

(6) Dominator

A dominator is a project team member that disrupts team participation and communication by presenting their own opinions forcefully and without any recognition or consideration of other's contributions or points of view. This person will dominate the communication and bully their way through the project. This is a negative role because is prevents effective communication, quashes other's valid opinions, and may be contrary to the project's objectives.

Destructive Team Roles

Dominator

- ***Disrupts team participation by forcefully presenting ideas without considering others***

- ***Always tries to take over***

- ***Challenges those in leadership roles***

- ***Professes to "know everything"***

---

(7) Devil's Advocate

"*advocatus diaboli*" Although the origins of this role are rooted as a positive role for the critical examination of canonization or beatification in the Roman Catholic Church, for project management this is considered a negative role. The definition of this role is a project team member that takes up the contrary view just for the sake of argument and not on the argument's merits (if any). This role is negative because it often frustrates and disrupts effective communication and discourages people from participating.

Destructive Team Roles

Devil's Advocate

- *Finds faults in all areas of project management*

- *Argues not on merits, but for sake of arguing*

- *More of a "devil" than an "advocate"*

Module 2 References

Harold Kerzner, Ph.D. *Project Management, A Systems Approach to Planning, Scheduling, and Controlling, 8th Edition.* John Wiley & Sons, Inc. 2000.

Project Management Institute. *A Guide to the Project Management Body of Knowledge, 3rd Edition (PMBOK Guide).* Project Management Institute, Inc. 2004.

Velociteach. *The PMP Exam, 2005 Edition.* Andy Crowe, PMP. 2004.

Module 2 Exercise

1) The project team member who is responsible for providing the financial resources (funding) for the project is the:

   a) Project Manager

   b) Functional Manager

   c) Project Sponsor

   d) Senior Manager

2) An effective tool for identifying roles and responsibilities and facilitating the development of the project communication plan is the:

   a) Organizational Breakdown Structure (OBS)

   b) Responsibility Assignment Matrix (RAM)

   c) Work Breakdown Structure (WBS)

   d) Key Stakeholder Analysis

3) Who manages the project budget in a functional matrix organization?

   a) Project Manager

   b) Functional Manager

   c) Customer

   d) Key Stakeholder

4) In what type of matrix organization does the Project Manager have high to total authority of the project?

   a) Balanced Matrix

   b) Functional Matrix

   c) Projectized Matrix

   d) Weak Matrix

5) Which one of the following is an example of "Earned" or "Individual" power?

   a) Referent power

   b) Reward power

   c) Punishment power

   d) Legitimate power

6) A project team member is an expert in hydraulic analysis. The other project team members, including the Project Manager, look to this team member for guidance through the hydraulic design and permitting process. What type of power is this?

a) Punishment power

b) Referent power

c) Reward power

d) Expert power

7) Which of the following is a productive team role?

a) Recognition seeker

b) Withdrawer

c) Clarifier

d) Topic Jumper

8) If the Project Manager is heard saying, "We agree that this deliverable is important and we have agreed on all of the other deliverables, let's not fight over a few thousand dollars." What conflict resolution method is this Project Manager using?

a) Smoothing

b) Confronting

c) Compromising

d) Forcing

9) Which conflict resolution method produces the most lasting results and in considered the most effective method?

a) Smoothing

b) Confronting

c) Compromising

d) Forcing

10) According to research, what is the most common source of conflict on a project?

a) Personality conflicts

b) Procedures

c) Resource priority (availability) / Schedules

d) Technical Opinions

General Project Management Theory

Learning Outcomes

- Describe an Organizational Breakdown Structure (OBS) and a Responsibility Assignment Matrix (RAM) and their uses
- Compare and contrast functional organizations and project organizations
- Describe the difference between "Organizational Power" and "Earned Power," and give examples of each
- List methods for resolving conflicts
- List and describe constructive and destructive team roles

Learning Outcomes

- **Describe an Organizational Breakdown Structure (OBS) and a Responsibility Assignment Matrix (RAM) and their uses**
- **Compare and contrast functional organizations and project organizations**
- **Describe the difference between "Organizational Power" and "Earned Power," and give examples of each**
- **List methods for resolving conflicts**
- **List and describe constructive and destructive team roles**

Module

3

Risk Planning & Risk Management
Learning Outcomes

- **Define project risk**

- **Describe how risk planning reduces project risk**

- **Describe how to develop a Risk Management Plan (RPM)**

- **Define risk management**

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Learning Outcomes

- **Define project risk**

- **Describe how risk planning reduces risk**

- **Describe how to develop a Risk Management Plan (RMP)**

- **Define risk management**

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Module

3

Risk Planning & Risk Management

A. Why Evaluate Risk?

It is impossible to predict the future and there is unavoidable uncertainty associated with long-lasting construction projects. If we ignore uncertainty, the project plan will be flawed.

Decisions are of necessity made within the technical and cost context of their time. The technical and cost context is dynamic, so the structures we build often survive into very different times.

Why Evaluate Risk?

- **It is impossible to predict the future**

- **Uncertainty is unavoidable**

- **If ignored, project planning will be flawed**

B. Benefits of Risk Assessment

The benefits of risk assessment include:

- Increased communication within the team and among cross-functional groups, stakeholders, management, politicians, and the public.

- The risk ranking provided by workshop output helps the Project Manager know where to focus the team's efforts.

- The ability to act proactively on risk items and track the risk for which no preemptive action can be taken.

- It provides a running start into development of the risk management plan component of the project management plan.

- Project teams receive ideas on potential response strategies for major risks.

- Project Managers are better prepared for the unexpected.

Benefits of Risk Assessment

- **Improved communication.**

- **Focuses efforts.**

- **Able to be proactive to mitigate risk.**

- **Provided running start on PMP**

- **Potential response strategies are identified earlier.**

- **The Project is better prepared for unexpected.**

C. Risk Definitions:

1. Risk Management

Risk management is the act or practice of dealing with project risk. It includes planning for risk, assessing risk (identification and analyzing), developing risk response strategies, and monitoring risks during the project life.

2. Risk

Project risk is an uncertain event or condition that, if it occurs, has a positive or negative effect on at least one of the project objectives (scope, schedule, budget)

3. Threat

A project risk that has a negative effect is referred to as a threat. A project manager will proactively manage threats to the project and look for ways to reduce the probability or impact of the threat or eliminate the threat all together.

4. Opportunity

A project risk that has a positive effect is referred to as an opportunity. A project manager will proactively manage opportunities to the project and look for ways to exploit, enhance, or share the opportunity.

5. Risk Trigger

A risk may have one or more causes. Identifying the causes of risk events defines the risk trigger. A risk trigger indicates that a risk event is imminent.

D. Risk Tolerance:

There are many resources available to give guidance for risk management. Unfortunately, there is no single textbook answer for how to manage project risk. Project Managers need to rely on the organization's policies, project team involvement in risk planning, and the input from subject matter experts. Ultimately, the decisions made on how to deal with project risk will be based on the risk profile, or risk tolerance, of the Project Manager, project team, and organization.

Three common classifications used for describing risk tolerance are the risk averter (or avoider), risk neutral, or risk seeker (or taker). The method to classify these is based on the "utility," or the satisfaction received from the risk payoff.
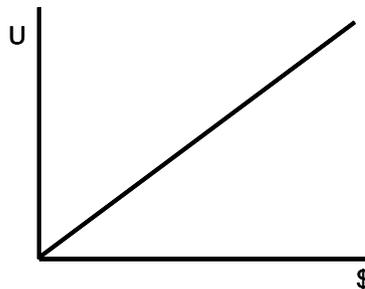
1. Risk Adverse / Averter
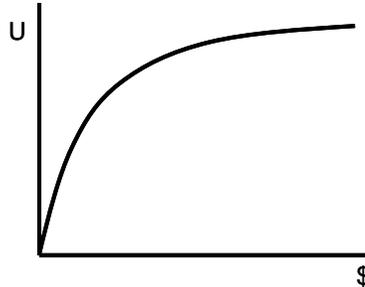
With a risk adverse or averter, the utility rises at a decreasing rate. This means when more money is at stake, the tolerance for risk diminishes. Another way to describe this is that the limit of risk tolerance is achieved at a lower dollar amount.
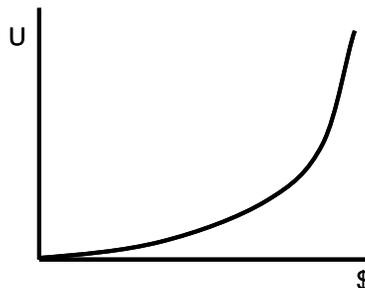
A risk adverse person will prefer a more certain outcome and demand a premium to accept risk.

2. Risk Neutral

With a risk neutral profile, the utility, or satisfaction from a risk payoff rises at a constant rate.

3. Risk Taker / Seeker

With a risk taker or risk seeker, the utility rises at an increasing rate. This means when more money is at stake, the tolerance increases. Another way to describe this is that the limit of risk tolerance is not achieved unless the dollar amount is greater.

A risk taker will prefer a more uncertain outcome and is willing to pay a penalty to take a risk.

E. INDOT Risk Policy:

During the "Plan the Work" step, the elements of risk are identified and the Risk Management Plan and Risk Register are developed. The Office of Project Management also has tools available for risk planning, such as the Risk Management Plan Template and sample risk plans.

Projects can greatly benefit from formal risk assessments. Typically, the larger the project, the greater the benefit. Also, projects with one or more of the following features can benefit from risk analysis:

- Projects that are unique or unusual

- Projects with a high degree of political interest

- Projects that have been through an abbreviated scoping process

- Projects with alternative solutions with varying scope and cost

- New alignments or bypass sections

- Capacity improvements that widen an existing highway

- Major structures

- Interchanges on multi-lane facilities

- Projects with extensive or expensive environmental or geotechnical requirements

- Projects with materials that are difficult to acquire or require special efforts

- Projects involving major reconstruction or difficult construction

- Projects with multiple stages

- Projects with major right-of-way or utility issues

These factors are important because the levels of risk, variability, and opportunity associated with each are generally higher than with routine or typical projects.

F. Risk Planning Process:

1. Review Organization Risk Policy

The first step in risk planning is to review the organization's risk policy. Depending on the cost or complexity of the project, special risk planning skills may be required from the Office of Project Management. Reviewing the INDOT Project Management Policy for Risk Assessment will help the project team determine the appropriate level of risk planning.

2. Risk Identification

Risk identification determines which risks might affect the project and documents the characteristics of the risk event. Risk identification is an iterative process because additional risks may become apparent as the project progresses through its life cycle.

Some tools a project team can use to identify and gather information about project risks are:

a. Brainstorming: The goal of brainstorming is to obtain a comprehensible list of project risks. The project team will identify the risk events and the trigger for the risk event. Risks can also be categorized by which project parameters are affected by the risk event. This is a common technique for risk information gathering.

b. Delphi Technique: The Delphi technique is a way to reach a consensus of experts. Risk experts participate anonymously as a facilitator uses a questionnaire to solicit project risks. The responses are summarized and then recirculated to the experts for further comment. Consensus is reached after a few rounds of this process. This technique helps reduce bias in the data and keeps any one person from having excessive influence on the outcome.

c. Interviewing: Interviewing experienced project team members, stakeholders, and subject matter experts (SMEs) can identify risks. Interviews are another common source of risk identification data gathering.

d. Root Cause Identification: This is a method used to further define the risk event. Think of the little 2-year old, asking "why" after each response. Eventually, the root cause, the trigger, for the risk event is identified. Developing the plan to address the risk trigger is the most effective way to respond to risk events.

e. SWOT Analysis: Strengths, weaknesses, opportunities, and threats (SWOT) technique ensures examination of the project from each of the SWOT perspectives. This increases the breadth of considered risks.

f. Assumption Analysis: Every project is developed based on a set of hypotheses, scenarios, or assumptions. Analyzing and exploring the validity of the assumptions can help identify risks due to inaccuracy, inconsistency, or incompleteness.

g. Diagramming Techniques: Risk diagramming methods such as the cause-and-effect diagram (also known as an "Ishikawa" or "fishbone" diagram) and flow charts can be used to help in risk identification and risk trigger identification.

3. Risk Register

The outputs from risk identification typically become initial entries in a document called a risk register. A sample of a risk register template is shown in Appendix A with descriptions of column headers and an example. The risk identification section of the template identifies:

- **Status:** Whether a risk is an active risk, a dormant risk, or a retired risk.

- **ID Number:** the identification for the risk

- **Date Identified and Project Phase:** When a risk was identified and what project phase (preconstruction or construction) the risk was identified in.

- **Functional Assignment:** The capital delivery functions (planning, design, ROW, environmental, construction, etc.) that are impacted by the risk.

- **Risk Event:** What the risk event is to the project with a detailed description using the SMART technique (**S**pecific, **M**easurable, **A**chievable, **R**ealistic, and **T**ime sensitive)

- **Risk Trigger:** Warning signs that indicate the risk is likely to occur or imminent. Used to determine when response strategies will be implemented.

Appendix B is the user's guide for the Risk Management Plan (RMP) and provides a complete list of the template column headers.

Once the risk has been identified, the project team can conduct further analysis (qualitative and quantitative) on the risk event.

Exercise – Risk Identification

As a team, choose one of the following projects:

1. Building a house
2. Planning a Caribbean trip

For the project, use risk-gathering techniques such as interviewing and brainstorming to identify risk events. Also identify the risk triggers for each event. Enter the information onto the risk register. Prepare a listing to present to the group.

(Time: 15 minutes)

4. Risk Considerations

a. Document the Risks

Sources of scope risk include:

- Requirements that seem likely to change
- Mandatory use of new technology
- Requirements to invent or discover new capabilities
- Unfamiliar or untried development tools or methods
- Extreme reliability or quality requirements
- External sourcing for a key subcomponent or tool
- Incomplete or poorly defined acceptance tests or criteria
- Technical complexity
- Conflicting or inconsistent specifications
- Incomplete product definition
- Very large WBS

b. Key Ideas for Identifying Scope Risks

- Clearly define all project deliverables and note challenges.
- Set limits on the project based on the value of the deliverables.
- Decompose all project work into small pieces, and identify work not well understood.

- Assign ownership for all project work and probe for reasons behind any reluctance.
- Note risk arising from expected project duration or complexity.

c. Document the Risks

Schedule risks become visible throughout the planning and scheduling processes. Here are some examples:

- Long duration activities
- Significant worst-case estimates
- High-uncertainty estimates
- Overly optimistic estimates
- All critical path (and near-critical path) activities
- Multiple critical paths
- Convergence points in the logical network
- External dependencies and interfaces
- Deadlines further out than the planning horizon
- Cross-functional and subcontracted work

d. Key Ideas for Identifying Schedule Risks

- Determine the root causes of all uncertain estimates.
- Identify all estimates not based on historical data.
- Note dependencies that pose delay risks, including all interfaces.
- Identify risky activities and schedule them early in the project.
- Ascertain risks associated with multiple critical (or near-critical) paths.
- Note risks associated with lengthy projects.

e. Document the Risks

Resource risks become visible throughout the planning and scheduling processes. Examples include:

- Activities with unknown staffing
- Understaffed activities
- Work that is outsourced
- Contract risks
- Activities requiring a unique resource

- Part-time team members
- Remote team members
- The impact of the work environment
- Budget requirements exceed the project objectives

f. Key Ideas for Identifying Resource Risks

- Identify all required skills you need for which you lack named, committed staffing
- Determine all situations in the project plan where people or other resources are overcommitted.
- Find all activities with insufficient resources.
- Identify uncertain activity effort estimates.
- Note outsourcing risks.
- Gain funding approval early for needed training, equipment purchases, and travel.
- Ascertain all expected project costs.

g. Key Ideas for Constraint Management and Risk Discovery

- Minimize differences between project plans and objectives.
- Understand and clearly document project priorities.
- Use priorities to identify project alternatives.
- Explore project opportunities.
- Identify and explicitly remove unnecessary project scope.
- Determine risks and costs of proposed project changes.
- Minimize unknown risk through brainstorming, analysis, and research.

h. Strategies for Avoiding Risks

Many of your schedule risks are consequences of decisions you made in preparing your preliminary schedule. You may be able to remove sources of schedule risk as follows:

- Reduce the number of critical paths.
- Modify the work to have fewer activity dependencies.
- Schedule the highest uncertainty activities as early as possible.
- Avoid having the same staff members work on two successive or concurrent critical (or near-critical) activities.

- Decompose lengthy activities further.
- Reschedule work to provide greater flexibility.

i. Resource risks may also be a consequence of choices you made in resource planning. Explore opportunities to avoid these risks using the following:

- Obtain names for all required project roles.
- Get explicit availability commitments from all project staff (and from their managers).
- Work to limit commitments by project staff to other projects, maintenance and support work, and other time conflicts. Explicitly document all that remain.
- Modify plans to reduce the load on fully-loaded or overcommitted resources.
- Use the best people available for the most critical activities.
- Educate team members to use more efficient or faster methods, and do it early in the project.
- Use mentoring to build teamwork and establish redundancy for critical skills.
- Upgrade or replace older equipment to make work more efficient, and do it in the beginning of the project.
- Automate manual work when possible.
- Locate and gain access to experts to cover all skill areas not available on the project team.
- Minimize dependence on a single individual or other resource for project work.
- When you use outside services, use the same suppliers that you (or others that you trust) have used successfully in the past.
- Establish contract terms with all suppliers that are consistent with project objectives.

j. Mitigation Strategies for Scope and Technical Risks

Mitigation of scope risks involves shifts in approach and potential changes to the project objective. Ideas for mitigating scope risks include:

- Explicitly specify project scope and all intermediate deliverables in measurable, unambiguous terms, including what *is not* in the deliverable. Eliminate "wants" early – make them part of scope or drop them.
- Gain acceptance for and use a clear and consistent specification change management process.
- Build models, prototypes, and simulations.
- Test with users, early and often.
- Deal with scope risks promptly.
- Obtain funding for any required outside services.
- Minimize external dependency risks.
- Consider the impact of external and environmental problems.
- Keep all plans and documents current.

k. Mitigation Strategies for Schedule Risks

Tactics for mitigating schedule risks include making additional investments in planning and revising your project approach. Some ideas to consider include:

- Use "expected" estimates when worst cases are significant.
- Schedule highest-priority work early.
- Schedule proactive notifications.
- If you must use new technology, explore how you *could* use older methods.
- Use parallel, redundant development.
- Send shipments early.
- Be conservative in estimates for training and new hardware.
- Break projects with large staffs into parallel efforts.
- Partition long projects into a sequence of shorter ones.
- Schedule project reviews.
- Reschedule work coincident with known holidays and other time conflicts.
- Track progress with rigor and discipline.

l.   Mitigation Strategies for Resource Risks

As with schedule risks, there are many tactics for resource risk mitigation. Some ideas for minimizing resource risk include:

- Avoid planned overtime.
- Build teamwork and trust on the project team.
- Use "expected" cost estimates where worst-case activity costs are high.
- Obtain firm commitment for funding and staff.
- Keep customers involved.
- Anticipate staffing gaps.
- Minimize safety and health issues.
- Encourage team members to plan for their own risks.
- Staff risky work with successful problem solvers.
- Rigorously manage outsourcing.
- Detect and address flaws in the project objective promptly.
- Rigorously track project resource use.

5. Qualitative Risk Analysis

Qualitative Risk Analysis includes methods for prioritizing the identified risks for further action, such as Quantitative Risk Analysis and Risk Response Planning. Project teams can improve performance by focusing on high-level or high-priority risks.

Qualitative Risk Analysis assesses the risk events with respect to the impact to the project objectives and the probability of occurrence. Definitions of the levels of impact and probability, as well as interviewing techniques, can help correct biases that are present in the data, as well as address the different risk profiles (tolerances) within the project team.

a. Impact/Probability Matrix

A very useful tool for Qualitative Risk Analysis is the Impact/Probability matrix. This matrix combines impact and probability values for the risk event that lead to categorizing the risk as low, medium, or high priority risks. These matrices can vary in size depending on the organization's risk policies and the nature of the project. The diagram that follows is called a 2x2 Impact/Probability matrix. The values in this matrix are "low" and "high."

2 X 2 Impact/Probability Matrix
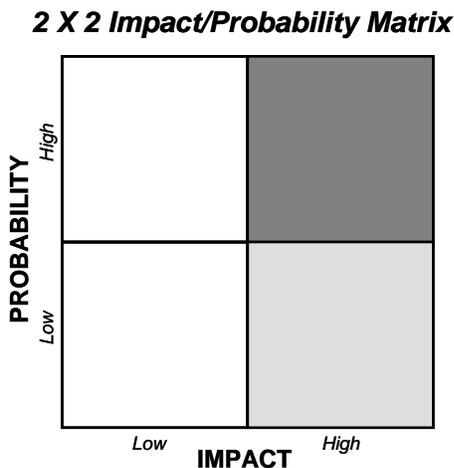
Each risk event is evaluated with respect to the impact to the project objectives. Once the impact for the risks has been assessed, the project team will evaluate the probability of the high impact risks. Risks are categorized as low risk, medium risk, or high risk. *(In a black and white matrix, these conditions are noted as shades of gray with the darker gray representing high risk and white representing low risk.)*

Typically, in a 2x2 matrix, the high risks will be further analyzed and a specific response strategy will be developed. The medium risks will be actively accepted or further analyzed, depending on the risk tolerance of the project team. The low risks will be passively accepted. Acceptance is further discussed in **Risk Response Strategy**.

Risk Management Planning

Impact/Probability Matrix

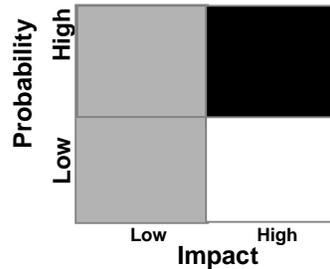- *Incorrect*: *Confusing or combining Impact & Probability*

  "It is very unlikely, therefore the impact is low"

- *Correct:* *Keep Impact & Probability independent*

  "Probability is low, but if it happens, the project will fail. Therefore, the impact is high."

Risk Management Planning
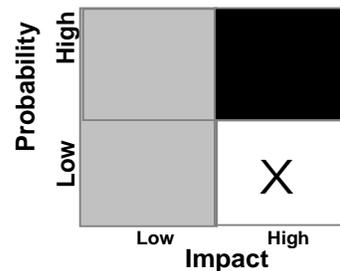
Using a 2x2 Impact/Probability Matrix

Gray: Low Risk

(Passive Acceptance – workarounds)

White: Moderate Risk (Active Acceptance contingency)

Black Area: High Risk (Risk Response Planning)

Probability — High / Low

Impact — Low / High

Risk Management Planning

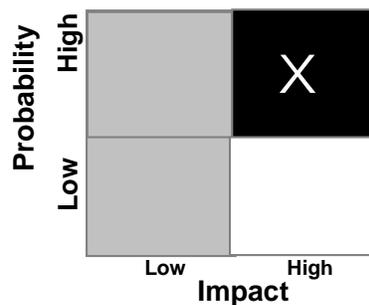## 2x2 Impact/Probability Matrix Example

Risk: Key project team member with specialized skill leaves project team before work is done.

**Impact: High
Probability: Low**

White Area: Moderate Risk

X

Probability — High / Low

Impact — Low / High

Risk Management Planning

2x2 Impact/Probability Matrix Example

Risk: Change to regulatory ordinance requires additional wetland mitigation, requiring additional ROW purchase.

Impact: High
Probability: High

Black Area: High Risk

b. Risk Impact

- High = Project objective is at risk (mandatory change to one or more of scope, schedule, and resources).
- Medium = Project objectives are okay, but significant re-planning is required.
- Low = No major plan changes; the risk is an inconvenience or it will be handled through minor overtime work.
- Very low = Less than 1 percent impact on scope, schedule, cost, or Quality
- Low = Less than 5 percent impact on scope, schedule, cost, or quality
- Moderate = Less than 10 percent impact on scope, schedule, cost, or quality
- High = Less than 20 percent impact on scope, schedule, cost, or quality
- Very high = 20 percent or more impact on scope, schedule, cost, or quality

b. Comparative Risk Rating (CRR)

Once risk events have been qualitatively assessed, the project team can prioritize the risks within each category. An easy and common method of prioritizing these risks is using a comparative risk rating method (sometimes referred to as "poor man's" rating).

Each risk event within the category is compared one-on-one with the other risk events. The project team will identify the higher priority risk event and record that comparison result. A simple matrix such as the following can be set up to compare these risk events.

Comparative Risk Rating for 4 risk events

	A	B	C	D
A	X			
B	A	X		
C	C	C	X	
D	A	B	C	X

Simply counting the number of occurrences for each risk comparison will prioritize the risks in the category. For the example, in the figure above, risk event C has 3 scored comparisons, risk event A has scored 2 comparisons, risk event B has 1 scored comparison and risk event D has none. The order of priority for these four risk events would be C-A-B-D.

Comparative risk ratings are done to the risk events that fall into the high-risk zone and medium-risk zone.

Exercise – Risk Analysis using 2x2 matrix (continuation of earlier exercise results)

Using a 2x2 impact and probability matrix, assess the risks identified in the last exercise.

- First, evaluate the impact of the risk event on the project objectives.

- Then, with the risks identified as "high" impact, assess the probability of the risk event

- Perform a comparative risk rating on the "high-high" risk events to prioritize these risk events.

(Time: 15 minutes)

2 X 2 Impact/Probability Matrix
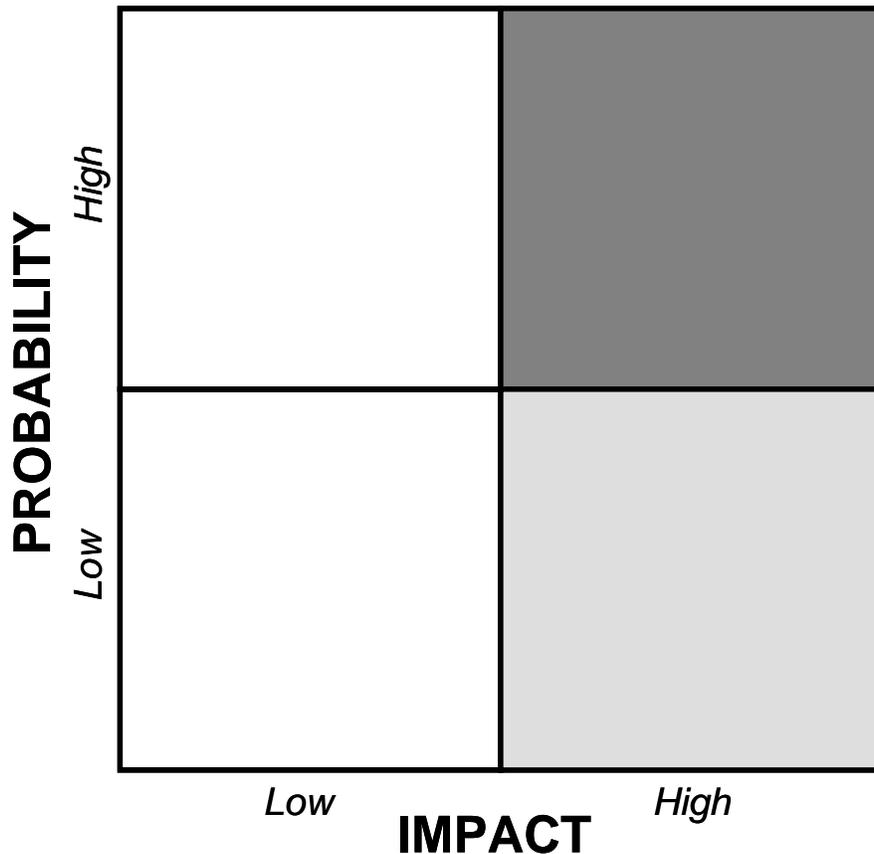
6. Quantitative Risk Analysis

Quantitative Risk Analysis is a way of numerically estimating the probability that a project will meet its time and cost objectives. Quantitative analysis is based on simultaneous evaluation of the impacts of all identified and quantified risks.

The Office of Project Management will help with the risk analysis for projects and can assist in the quantitative risk analysis using modeling techniques. Project Managers should contact the Office of Project Management during the "Initiate and align" step of the Project Management Process to plan for these risk analysis products.

Risk Management Planning

Quantitative Risk Analysis

● **The process of numerically analyzing the effect of identified risks on the project's objectives. (In particular, the project schedule and the project costs.)**

Quantitative Risk Analysis is performed on risks that have been prioritized by the Qualitative Risk Analysis process as potentially and substantially impacting the project objectives. The Quantitative Risk Analysis process analyzes those risk events and assigns a numerical value to these risk events. This process uses modeling techniques such as Monte Carlo simulations and decision-tree analysis to:

- Quantify the possible outcomes for the project and their probabilities
- Assess the probability of achieving specific project objectives
- Identify risks requiring the most attention by quantifying their relative contribution to overall project risk
- Identify realistic and achievable cost, schedule, or scope targets, given the project risks
- Determine the best management decision when some conditions or outcomes are uncertain.

Interviewing techniques are used to quantify the probability and impact of risks on project objectives. These values (typically optimistic, most likely, and pessimistic) are used to develop a probability distribution for the project components. Decision-tree analysis or modeling and simulation techniques are then used to develop the probabilities for scenarios and the rewards for logical paths.

Products of the Quantitative Risk Analysis process are:

- An updated risk register, the information for the individual risk events is updated based on this analysis

- Probabilistic analysis of success for project objectives (time and cost)

- Updated prioritization of quantified risks, the risks that pose the greatest threat or present the greatest opportunity to the project

- Trends in quantitative risk analysis. If this process and analysis is repeated during the project's life cycle, trends can become apparent leading to conclusions regarding the risk response.

Risk Management Planning

Quantitative Risk Analysis

- **Quantify possible outcomes for the project.**

- **Assess probability of achieving specific project objectives.**

- **Identify risks requiring most attention**

- **Identify realistic and achievable costs, schedule, or scope targets, given project risks.**

- **Determine best management decisions when conditions or outcomes are uncertain**

Risk Management Planning

Quantitative Risk Analysis tools

- **Interviewing (SMEs)**

- **Decision Tree Analysis**

- **Monte Carlo Simulation**

Risk Management Planning

Quantitative Risk Analysis Products

- **Updated Risk Register**

- **Probabilistic analysis for project success (time and cost)**

- **Updated priority of risk events**

- **Trends in risk analysis**

7. Monte Carlo Simulation

A Monte Carlo Simulation is a project simulation using a model that translates the uncertainties specified at the detailed level of the project into their potential impact on project objectives (time and cost). In a Monte Carlo simulation, the project model is computed many times (iterated) with the input values randomly selected based on the probability distribution for the project element or schedule activity. A probability distribution is calculated.

For a cost risk analysis, a simulation can use the project WBS or a cost breakdown as its model. For schedule risk analysis, the precedence diagramming method (PDM) is used. *(PDM is further discussed in Module 4 – Schedule Management)*

TOTAL PROJECT COSTS
Cumulative Chart
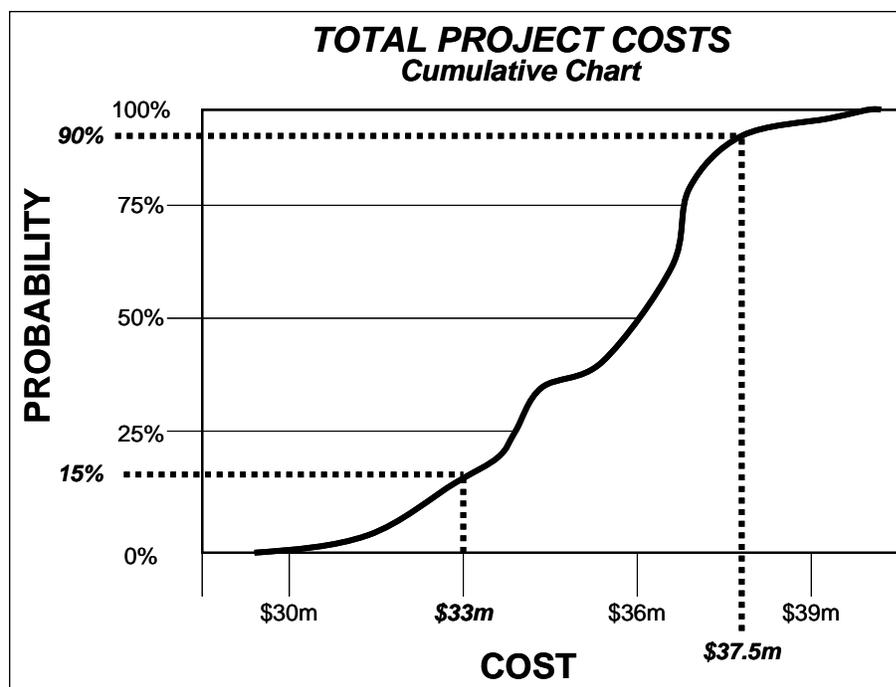
In the figure above, assume that the project has a programmed budget of $33 million dollars. Risk events are identified, qualitatively analyzed, quantitatively analyzed and tied to the project WBS. Using the Monte Carlo simulation technique, a Total Project Cost graph is generated reflecting the probability of achieving certain cost values. In the graph above, the project has a 15% probability of achieving a $33 million cost or less. Depending on the risk tolerance of the organization, this chart can be used to look for contingency values needed to meet the probability for success. In this example, assume the organization is very conservative (risk averse) and wants a 90% confidence, or probability, for project success. Based on the evaluated risk events for the project, this project needs a contingency of $4.5 million (a contingency of nearly 14%) to achieve this level of risk tolerance.

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7. Risk Response Strategy

Risk response strategy is the process of planning and developing options and actions to enhance opportunities and reduce or eliminate threats to the project objectives. This process follows the qualitative and quantitative analyses.

Planned risk responses must be:

- Proactive, not reactive

- Appropriate to the significance of the risk

- Cost effective

- Timely

- Realistic within the project context

- Agreed upon by the project team and parties involved

- Owned by a responsible person

Selection of the best response from several options is often required. Several risk response strategies are available. The strategy (or mix of strategies) most likely to be effective should be selected for each risk event.

Risk Management Planning

Risk Response Strategy

- **The process of developing options and actions to enhance opportunities and to reduce threats to the project objectives.**

Risk Management Planning

Risk Response Strategy

- **Proactive, not reactive**

- **Appropriate to significance of risk**

- **Cost effective**

- **Timely**

Risk Management Planning

Risk Response Strategy

- **Realistic within the project context**

- **Agreed upon by project team and all parties involved**

- **Owned by a responsible person**

G. Risk Response Definitions:

1. Avoidance

Risk avoidance involves changing a project objective to eliminate the threat posed by the risk event.

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Risk Management Planning

- **Avoidance – Changing a project objective to eliminate a threat posed by an adverse risk event.**

</div>

2. Transference

Risk transference requires shifting the negative impact of a threat along with the ownership of the response to a third party. Transferring the risk does not eliminate the risk. Transferring liability for a risk is most effective in dealing with financial risk exposure. Risk transference nearly always involves payment of a risk premium to the party taking on the risk. Some examples of risk transference are insurance, performance bonds, warranties, guarantees, etc.

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Risk Management Planning

- **Transference – Shifting the negative impact of a threat, along with the ownership of the response, to a third party.**

</div>

3. Mitigation

Risk mitigation implies a reduction in the probability or impact of a threat posed by the risk event to an acceptable threshold. Taking early action to reduce the probability or impact of a risk event occurring on a project is often more effective than trying to repair the damage after the risk has occurred.

Risk Management Planning

- **Mitigation – Reducing the probability or impact of an adverse risk event (threat) to an acceptable level.**

---

4. Acceptance

This strategy is adopted because it is seldom possible to eliminate all risk from a project. This strategy is used when the project team has decided not to change the Project Management Plan to address or deal with the identified risk event, or the project team is unable to identify any other suitable response strategy. Acceptance is a risk response strategy used for both threats and opportunities. This strategy can be either passive or active. Passive acceptance requires no action, leaving the project team to deal with the risk event as it occurs (workaround). Active acceptance strategies will establish a contingency reserve, including time, money, or resources, to handle known (and sometimes unknown) risks.

Risk Management Planning

- **Acceptance – The project team decides not to change project objectives to deal with risks.**

  - **Passive acceptance – no action, deal with threats as they occur (workarounds).**

  - **Active acceptance – establish a contingency reserve to handle risks.**

Risk Management Planning

Risk Response Strategy (threats)
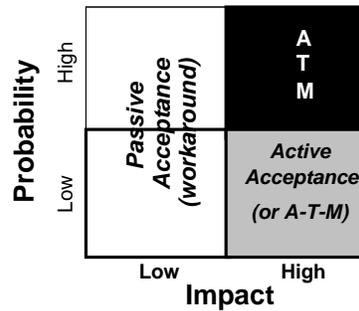
5. Exploit

This strategy may be selected for risks with positive impacts where the organization wishes to ensure that the opportunity is realized. This strategy seeks to eliminate the uncertainty associated with an opportunity by making sure it happens.

Risk Management Planning

- **Exploit – This strategy seeks to eliminate the uncertainty with an opportunity by changing a project objective to ensure it happens.**

6. Share

Sharing a positive risk involves allocating ownership to a third party who is best able to capture the opportunity for the project. One example of a risk sharing strategy is forming of partnerships or joint ventures.

> **Risk Management Planning**
>
> - **Share – Allocating ownership of the positive risk event to a third party who is best able to capture the opportunity for the project.**

7. Enhance

This strategy, similar to mitigation, increases the probability or positive impacts of an opportunity. This is done by identifying and maximizing key drivers of these positive risk events.

> **Risk Management Planning**
>
> - **Enhance – Increasing the probability or positive impact of an opportunity.**

8. Contingency Reserve

Contingency reserve is not a risk response strategy; it is an output of risk planning. When a project team chooses to actively accept a project risk event, a contingency reserve is established. This is the amount of funds, budget, or time needed above the estimate to reduce the risk of overruns of project objectives to a level acceptable to the organization.

> **Risk Management Planning**
>
> - **Contingency – Not a risk response, but an output from risk planning. Developed for actively accepted project risks. This is typically defined as time or funds.**

Module 3 Exercise – Risk Response development

Using the result from the qualitative risk analysis from the last exercise:

- Identify risk response strategies for the "high-high" risk events.

- Decide who will be the responsible person to monitor the risk event the effectiveness of the risk response.

- Decide if active acceptance of further risk response planning will be required for the "high-low" (yellow zone) risk events.

(Time: 15 minutes)

H. Risk Monitoring and Control

Throughout the project's life cycle, new risks may develop. Some risks will not occur at all and the impacts of risk may change. If the Risk Management Plan and the Risk Register are not maintained, monitored, and controlled, the effort and work done during the planning step will go to waste.

Risk monitoring and control is the process of:

- Monitoring risk and opportunity elements

- Identifying new risk and opportunity elements

- Evaluating/upgrading probability of occurrence and potential impacts

- Devising and implementing response strategies

- Evaluating and documenting the effectiveness of response actions

- Reporting to Management and Stakeholders

Risk Management Planning

Risk Monitoring and Control

- **Managing the Risk Register during the "Work the Plan" phase of the project.**

- **Recognize the probability and impact of risk events may change during the life of the project.**

- **Also recognize that additional risk events can be identified during the "Work the Plan" phase.**

Risk Management Planning

Risk Monitoring and Control

- **Assigning a responsible party (ownership) to the risk event.**

- **Track risk event status**

    o **Active or Dormant: risk is currently being monitored and analyzed.**

    o **Retired: risk event (trigger) no longer poses a threat to the project.**

Risk Management Planning

Risk Monitoring and Control

- **Risk Registers should be a standing agenda item for project team meetings.**

- **Risk reporting should be a standing reporting Item for all project progress reporting.**

Module 3 References

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A Guide to the Project Management Body of Knowledge, 3rd Edition (PMBOK Guide). Project Management Institute, Inc. 2004.

Harold Kerzner, Ph.D. *Project Management, A Systems Approach to Planning, Scheduling, and Controlling, 8th Edition.* John Wiley & Sons, Inc. 2000.

Velociteach. *The PMP Exam, 2005 Edition.* Andy Crowe, PMP. 2004.

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Module

3

Risk Planning & Risk Management

Learning Outcomes

- **Define project risk**

- **Describe how risk planning reduces project risk**

- **Describe how to develop a Risk Management Plan (RPM)**

- **Define risk management**

Module

4

Schedule Management

## Learning Outcomes

- **Define what a work breakdown structure (WBS) is and how it is developed**

- **Define the terms deliverable, activity, and milestone**

- **Define the terms logical relationship, critical path, and float**

- **Distinguish between CPM and Gantt chart schedules**

- **Describe how to update a schedule**

- **Describe how to track a schedule**

- **Understand "fast tracking"**

Schedule Management

A. Schedule Terminology & Definitions

1. Work Breakdown Structure (WBS)

A deliverable-oriented, hierarchical decomposition of the work to be executed by the project team to accomplish the team mission and create the required deliverables. The WBS defines the project scope.

```
                          ┌──────────┐
                          │   Team   │
                          │ Mission  │
                          └────┬─────┘
```
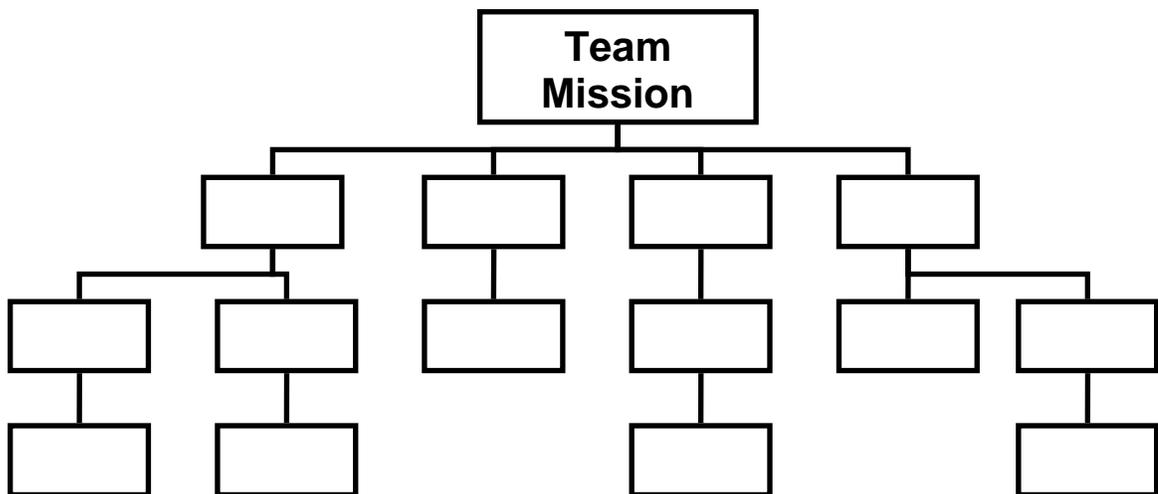
2. Deliverable

Any unique and verifiable product or result that must be produced to complete a project. Usually the lowest level of the WBS.
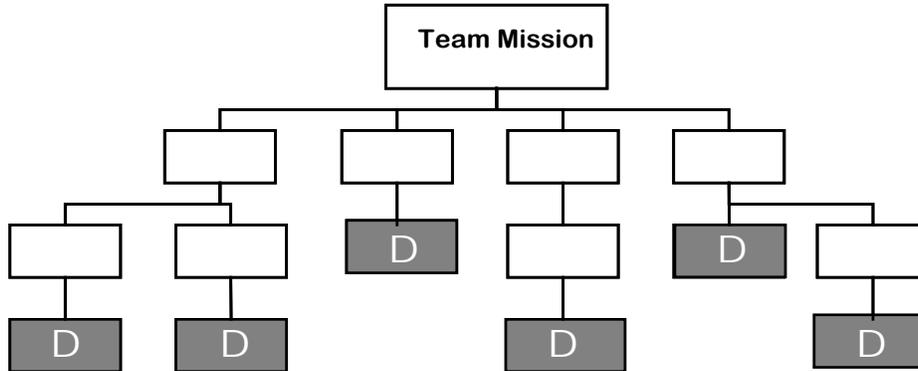
3. Scheduled Activity (task)

A component of work performed to create a deliverable.

4. Scheduled Milestone

A significant event in the project schedule, such as an event restraining future work or marking the completion of a major deliverable. A "measuring point." Milestones have zero duration and no resource assignments.
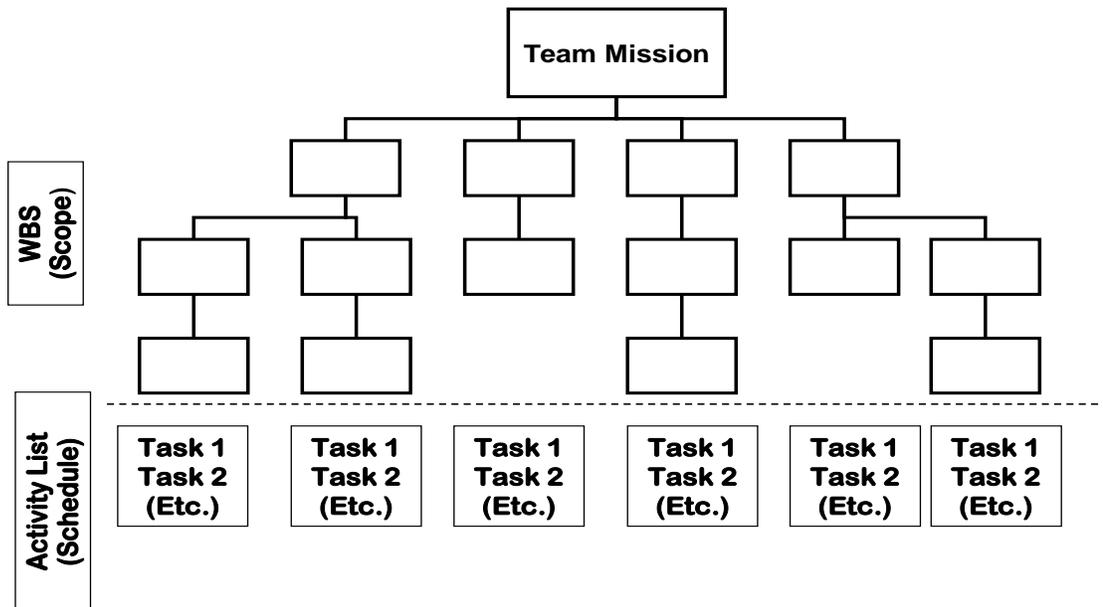
5. Logical Relationship

Logical relationship is a dependency between two project schedule activities, or between a project schedule activity and a schedule milestone. Logical relationships are generally defined as *mandatory dependencies* (or "hard logic") and *discretionary dependencies* (or "soft logic").

**Schedule Terminology & Definitions**

Logical Relationships

•**A dependency between scheduled activities, or between a scheduled activity and a schedule milestone.**

"Hard Logic" – Mandatory dependencies

"Soft Logic" – Discretionary dependencies

The four possible types of logical relationships are:

- Finish-to-Start (most common): The end of one schedule activity will constrain the start of another activity.
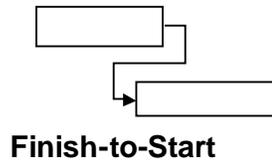
Finish-to-Start

- Finish-to-Finish: The end of one schedule activity will constrain the finish of another activity.

Finish-to-Finish

- Start-to-Start: The start of one schedule activity will constrain the start of another activity.

Start-to-Start

- Start-to-Finish (very rare, not available in some software applications): The start of one schedule activity will constrain the finish of another schedule activity.

Start-to-Finish
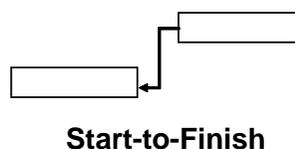
All four of these logical relationships can be modified by applying a "lead," advancing the start of the successor activity, or a "lag," postponing the start of the successor activity.

6. Precedence Diagram

A schedule network diagramming technique in which schedule activities are represented by nodes. Schedule activities are graphically linked by one or more logical relationships to show the sequence in which the activities are to be performed. Also referred to as "Activity-on-Node (AON)."
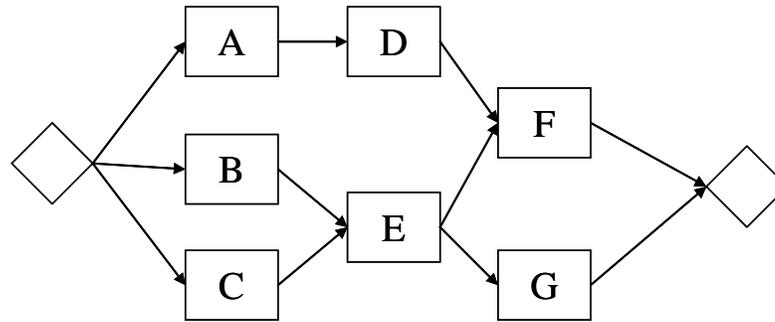
Precedence Diagram

7. Critical Path

The critical path is the sequence of schedule activities that determines the duration of the project. Some characteristics of the critical path are:

- Longest duration path through the project network
- Activities on the Critical Path are called "Critical Activities"
- Critical activities may have no float or slack
- A project can have more than one critical path
- Activities not on the Critical Path are called "Non-Critical Activities"
- To shorten the project duration or delay the project completion, the critical path must be shortened or lengthened.

8. Float (Slack)

Float, or slack, is the amount of time a scheduled activity can be delayed or extended without affecting the project (total float) end date or the next scheduled activity (free float). Float can be further defined as:

- Total Float – The total amount of time that a scheduled activity (or milestone) may be delayed or extended without delaying the project end date or violating a schedule constraint.

Activity   Total
Duration   Float
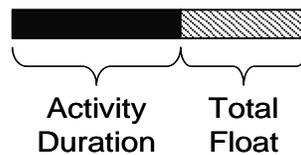
- Free Float – The amount of time that a scheduled activity (or milestone) can be delayed without delaying the start of the next activity in the network.

Activity   Free
Duration   Float
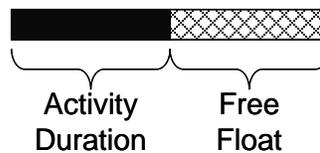
- Negative Float – The amount of time by which a critical activity (or milestone) misses a required date.

Negative   Activity
Float   Duration
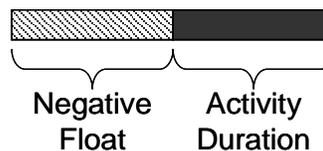
9. Critical Path Method (CPM) Scheduling

A schedule network analysis technique used to determine the amount of float on paths in the project schedule network and to determine the project duration (critical path). This is done by performing a *forward pass* through the project schedule network to determine the *early start* and *early finish* dates. Then performing a *backward pass* through the project schedule network to determine the *late start* and *late finish* dates.

Forward Pass ⟹   ⟸ **Backward Pass**

•**Early Start**   •**Late Start**
•**Early Finish**   •**Late Finish**

A → D
B
C → E
F
G

10. Gantt Chart

Also called a "bar chart." A graphic display of schedule-related information. Schedule activities or WBS components are listed at the left of the chart and dates are shown across the top of the chart. Schedule activities are shown as a date-paced horizontal bar. This is the most common form of communication for a schedule. This is a report from the project management or project scheduling programs.

Task #	Task Name	Duration
1	Generic Project	50d
2	Start	0d
3	Task A	20d
4	Task B	16d
5	Task C	25d
6	Task D	10d
7	Task E	20d
8	Task F	7d
9	Task G	14d
10	Task H	10d
11	Task J	15d
12	Finish	0d

B. Schedule Tracking

Once the project team has committed to and endorsed a project schedule, a Project Manager needs to baseline the project schedule. This project performance baseline represents a "snapshot" of the approved project scope (WBS) and project schedule. Evaluating actual schedule dates to the project performance baseline will help the project team evaluate schedule and cost performance.

A Project Manager needs to track the schedule activities and record when these schedule activities actually started and completed. This will help identify where the project is currently at and what potential changes or delays are approaching.

1. Tracking Schedule "Actuals"

a. Actual Start

This is the date that the work on the deliverable or schedule activity actually started. In the project schedule software applications, this field is called "Actual Start."

Schedule Tracking

Actual Start – This is the date that work on the scheduled activity actually started. In project management software applications, this field is called "Actual Start."

---

b. Actual Finish

This is the date that the work on the deliverable or schedule activity actually finished. In project schedule software applications, this field is called "Actual Finish."

Schedule Tracking

***Actual Finish** – This is the date that the work on the scheduled activity actually finished. In project management software applications, this field is called "Actual Finish."*

---

c. Percent Complete

Percent Complete is a function of time. The formula for this value is defined as *"Elapsed Duration/Activity Duration x 100%."*

Schedule Tracking

***Percent Complete** – This is a function of time. The formula for this value is*

Elapsed Duration / Total Duration x 100%

---

d. Base Cost Percent Complete

The key to accurately calculating project progress is having an accurate estimate of how much of the deliverable (or work) is complete, expressed in a percentage (%). There are several methods to choose from, depending upon the type of work performed.

Schedule Tracking

Base Cost % Complete – This is the percent of the deliverable that has been completed. There are several ways to estimate this based on the deliverable.

A project performance baseline must be defined in the project management program before this value can be entered.

---

e. Units Produced Method

This is the ratio of the units produced to the total specified at completion. Units must be nearly identical. Some examples would be:

- Drilling 10 holes, completed 4 holes, % complete would be 40%

- Paving 5 lane miles, completed 4 lane miles, % complete would be 80%

Schedule Tracking

Base Cost % Complete

Units Produced Method – This is the ratio of units produced to the total specified at completion. Units must be nearly identical.

Example:
Drilling 10 holes, 4 complete – 40% complete

---

f. Interim Milestone Method (Agreement Method)

Establish the percent of the total that is represented by each milestone, based on experience or an agreement with the project team members on percent complete of various stages of the process/deliverable. Some examples would be:

- Geometric design complete = 30%
- Detailed Plans = 60%
- Contract Documents = 90%

or

- Data Collection = 10%
- Draft Report = 70%
- Revised Draft = 90%
- Published final = 100%

Schedule Tracking

Interim Milestone (Agreement) Method – Establish the percent of the total that is to be represented by each milestone.

Example:
Deliverable: Traffic Signal Design
- **_Data Collected – 10% complete_**
- **_Preliminary Design – 60% complete_**
- **_Final Design – 90% complete_**
- **_PS&E – 100% complete_**

g. 50/50 Method

The 50/50 method is best used when an accurate estimate is nearly impossible and when durations are relatively short (less than the reporting frequency). This method is a good method for higher-level Earned Value Methods (EVM) and when there are several processes (or deliverables) to be evaluated. The more tasks or deliverables evaluated, the more accurate the EVM. 50% complete is assumed when the task or deliverable has started. 100% complete is assumed when the task/deliverable is finished.

h. 0/100 Method

The 0/100 method is best used when a task or deliverable has no value unless it is completed and when durations are relatively short (less than the reporting frequency). This method is also a good method for higher-level EVM and when there are several processes (or deliverables) to be evaluated. 0% complete is assumed until a task or deliverable is complete. 100% complete is assumed when the task/deliverable is finished.

Schedule Tracking

50/50 Method – 50% complete assumed when scheduled activity actual starts. 100% complete when scheduled activity is actually completed.

0/100 Method – 0% complete assumed when scheduled activity actual starts. 100% complete when scheduled activity is actually completed.

---

i. Proportional Relationship Method

This method is used when the completion of a measurable amount of one work package indicates the completion of another task that cannot be easily measured. This method works well for the "on-going" or hammock tasks within the project schedule. An example of this method would be:

- 40% of the project is complete, so 40% of the project management task is complete.

Schedule Tracking

***Proportional Relationship Method** – This is used when the completion of a measurable amount of one work package indicates the completion of another scheduled activity that cannot be easily measured. Use for "hammock" tasks.*

Example:
Project is 45% complete, Project Management hammock task is 45% complete

---

C. Schedule Recovery / Schedule Compression

Schedule compression is a technique used to shorten the project duration without reducing the project scope. There are two methods used to compress, or recover a schedule.

Schedule Recovery / Schedule Compression

Schedule Compression

A technique used to shorten a project duration without reducing the project scope.

There are two methods of schedule compression:

- ***Schedule Crashing***
- ***Schedule Fast Tracking***

---

1. Schedule Crashing

Schedule crashing is a compression technique in which schedule activity durations are modified, working-day definitions are modified, or resource requirements are modified. These modifications are analyzed to determine how to obtain the greatest amount of compression for the least incremental cost (Triple Constraints Theory). Typically, crashing a project schedule will increase project costs, and sometimes crashing a project schedule does not produce a viable alternative. Some examples of crashing are:

- Shorten schedule activity durations
- Assigning additional resources
- Working overtime / working on non-working days
- Changing project or resource calendars

Schedule Recovery / Schedule Compression

Schedule Crashing

A compression technique in which scheduled activity durations are modified, working-day definitions are modified, or resource requirements are modified.

Typically will increase costs.

Activities must be "resource dependant"

---

2. Schedule Fast Tracking

Fast tracking is a compression technique in which activities that would normally be completed in sequence are performed in parallel. Fast tracking does not change the resource requirements, but modifies the logical relationships between schedule activities. This approach can require work to be performed without complete detailed information. Typically, fast tracking a project schedule will increase project risk, which may have an impact on project costs (Triple Constraints Theory).

Schedule Recovery / Schedule Compression

Schedule Fast Tracking

A compression technique in which activities that would be normally done in sequence are performed in parallel.

Fast tracking does not change resource requirements, but modifies the logical relationships.

Typically, fast tracking will increase project risk.

Cannot fast track "hard logic"

---

3. "What-If" Scenario Analysis

This is the analysis of the question "<u>What if</u> the situation represented by scenario 'X' happens?" Using the schedule model, the effects of different compression techniques can be analyzed with regards to project costs and the amount of schedule time recovered. The outcome from "what-if" analysis can be used to assess the feasibility of the project schedule under certain adverse conditions. This can be further used for risk planning, contingency planning, and response planning. Monte Carlo Analysis is a common "what-if" technique used.

Schedule Recovery / Schedule Compression

What-if Scenario Analysis

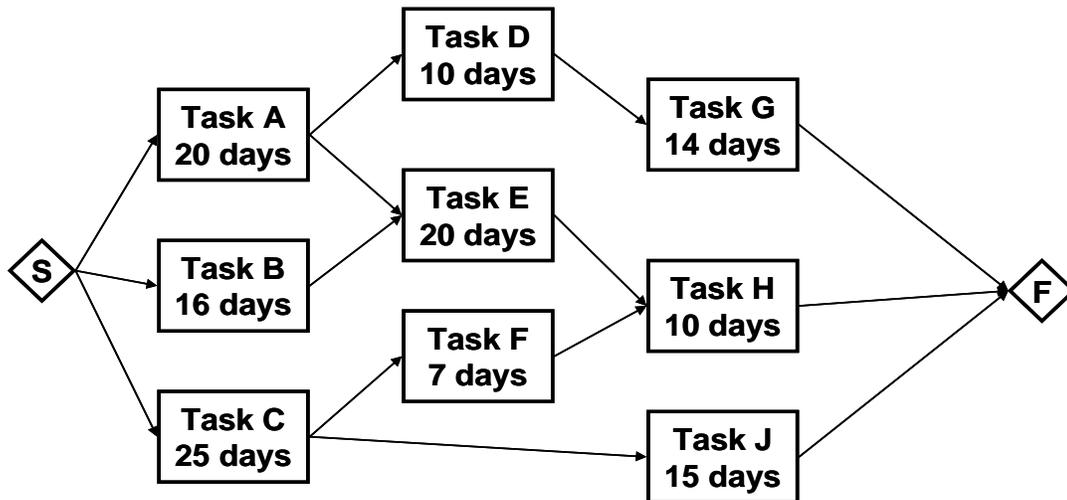***Asking "what-if" for each situation and how it affects the project model.***

Outcomes can evaluate the effects to project objectives.

Also used for risk planning.

---

4. Project Development Plans

See Appendix C

Module 4 Exercise

1. Identify the paths through schedule network and determine the critical path and project duration.

_____

_____

_____

2. The project customer is requesting this project be completed in 45 days. Is schedule compression required? If so, what methods would be used to compress the project schedule?

_____

_____

_____

3. Using the revised project schedule from #2 as the baseline plan, the duration of Task E is delayed to 24 days due to a key resource being unavailable for the first 4 days. Does this impact the project schedule and project end date? If so, what methods would be used to recover the remaining project schedule (assume everything else to date is completed or in progress)?

_____

_____

_____

Module

4

Schedule Management

Learning Outcomes

- **Define what a work breakdown structure (WBS) is and how it is developed**

- **Define the terms deliverable, activity, and milestone**

- **Define the terms logical relationship, critical path, and float**

- **Distinguish between CPM and Gantt chart schedules**

- **Describe how to update a schedule**

- **Describe how to track a schedule**

- **Understand "fast tracking"**

Resource Planning

Learning Outcomes

- **Define resource planning**

- **Define Resource estimating**

- **Explain the use of a resource histogram and its use in resource planning**

- **Define resource leveling**

- **Explain resource conflict and balancing**

Module

5

Resource Planning

Estimating schedule activity resources involves determining what resources (persons, equipment, materials), what quantity of each resource will be used, and when each resource will be available to perform project activities.

Resource Planning

**Estimating Schedule Activity
Resource Requirements**

- *Determining what resources will be required (labor, equipment, material)*

- *What quantity for each resource will be required.*

- *When resources are available to perform project activities.*

A. Resource Estimating

Estimating the level of effort or quantity of resource can be challenging, especially when a Project Manager is estimating the level of effort for a labor resource (person).

There are several tools and techniques available to the Project Manager and to the project team for estimating resources for project activities.

1. Expert Judgment

Any group or person with specialized knowledge can provide estimates for specific activities.

2. Bottom-up Estimating

Decomposing the activity into smaller, more detailed sub tasks and evaluating the resource requirements for these activities. The resource needs of each lower, more detailed piece of work are estimated, and these estimates are then aggregated into a total quantity for the schedule activity.

3. Three-point Estimating

Similar to estimating schedule activity duration, optimistic, pessimistic, and most likely estimate values are identified. This method will allow for risk contingency to be planned for the resource assignment and the schedule activity.


Resource Planning

Resource Estimating Techniques

- *__Expert Judgment__ – Any group or person with specialized knowledge.*

- *__Bottom-Up Estimating__ – Decompose activities into smaller work components.*

- *__Three-Point Estimating__ – Optimistic, pessimistic and most likely values are determined to calculate estimate.*

B. Resource Histogram

A resource histogram is a bar chart showing the amount of time that a resource is scheduled to work over a series of time periods. Resource availability may be depicted as a line for comparison purposes.

Resource Histogram
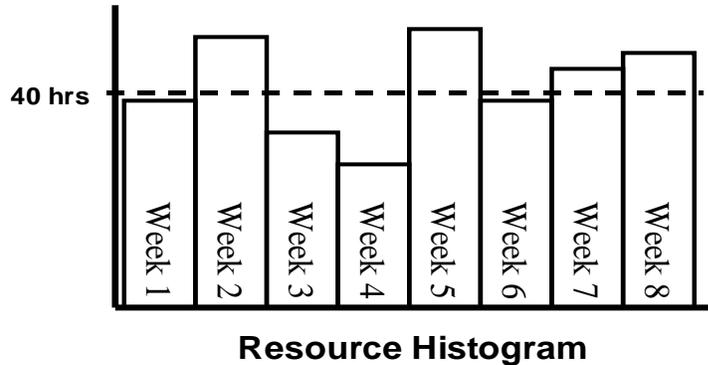
C. Resource Conflict and Balancing

As discussed earlier, one of the primary sources of conflict on a project is the availability of resources, especially critical or specialized resources that must be shared with different projects. A Project Manager must be able to identify when a resource is needed. Using the resource histogram, and comparing the assigned work to the resource's availability (calendar), a Project Manager can validate the schedule activity.

1. Resource and Project Calendars

Resource calendars and project calendars identify the periods of work or when work is allowed. Project calendars affect all activities. Resource calendars only affect a specific resource or a category of resources.

Resource Planning

Resource Conflict and Balancing

- *__Project calendar__ – defines the workable time periods for the project.*

- *__Resource calendar__ – defines the workable time periods for the specific resource.*

- *Conflicts in resource availability and schedule activity dates must be resolved to ensure the project will be completed according to accepted project objectives.*

---

2. Resource Leveling

Resource leveling is a schedule network analysis technique that is applied to a schedule model that has been already analyzed by the critical path method. Resource leveling is used to verify the project schedule is realistic. Scheduled start dates and scheduled finish dates can be modified to reflect resource availability. Resource leveling is also performed to ensure that capable resources are available for critical activities and to address situations when critical resources must be shared. Resource leveling can also help identify resources that may be underutilized, allowing a Project Manager to use this available pool of resources to deliver scheduled activities on the scheduled dates if other critical resources are not available.

Resource Planning

Resource Leveling

- *Schedule network analysis technique applied to a schedule model that has a critical path identified.*

- *Schedule start and finish dates can be modified to reflect resource availability.*

- *Identifies under-allocated resources*

There are different methods for resource leveling. A Project Manager must be able to identify how resolving a resource conflict can impact project objectives. The following methods can be used and the effects to time and cost analyzed.

```
            Resource Planning


    Resource Leveling

    • Different methods for resource leveling

    • Project Manager analyzes effects on
      project objectives (time and cost) for
      resolving resource conflict.
```
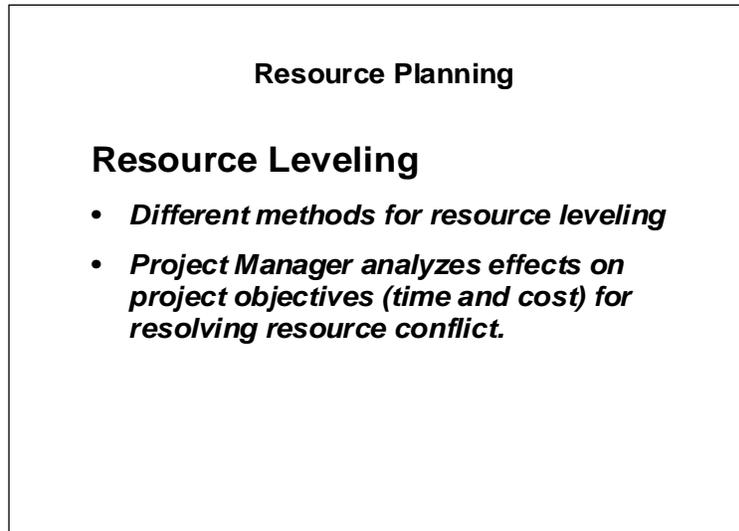
a. <u>Do nothing</u>. This method is recognizing that the resource requirements are an estimate and that a tolerable limit can be set for accepting an over allocation of the resource.

- Time (schedule) impact – None.
- Cost (budget) impact – None.

```
          Resource Leveling Methods


    Do Nothing if over-allocation is
        within acceptable limits

    • Schedule/Time Impact – None

    • Resource/Cost Impact – None
```
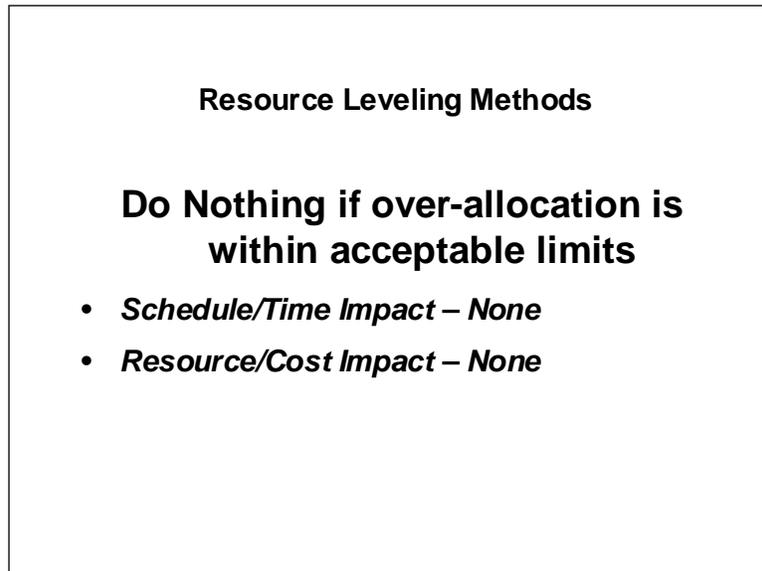
b. <u>Delay non-critical path tasks within available float</u>.

- Time (schedule) impact – None.

- Cost (budget) impact – None (except for inflation effects)

Resource Leveling Methods

Delay non-critical tasks within available float

- ***Schedule/Time Impact – None***

- ***Resource/Cost Impact – None (except for inflation effects)***

---

c. <u>Extend non-critical path task durations within available float</u> <u>(keeping total effort constant and decreasing the rate at which the</u> <u>resource is used)</u>.

- Time (schedule) impact – None.
- Cost (budget) impact – None (except for inflation effects).

Resource Leveling Methods

Extend non-critical task durations within the available float

- *Schedule/Time Impact – None*
- *Resource/Cost Impact – None (except for inflation effects)*

---

d. <u>Add or substitute resources of equal or greater capability for the over-allocated resource</u>.

- Time (schedule) impact – May need to consider learning curve for new resources.

- Cost (budget) impact – Substitute resource may have higher cost.

Resource Leveling Methods

Add or substitute resource of equal or greater capability

- *Schedule/Time Impact – May need to consider learning curve for new resource.*

- *Resource/Cost Impact – Cost impact if substitute resource has higher costs*

---

e. <u>Delay critical path tasks</u>.

- Time (schedule) impact – Project schedule delay impact equal to delay value.

- Cost (budget) impact – Costs associated with project extension and possible inflation costs.

Resource Leveling Methods

Delay critical path tasks

- *Schedule/Time Impact – Schedule impact equal to the delay*

- *Resource/Cost Impact – Cost impact due to project time extension and inflation costs*

---

f. Extend the durations of critical path tasks (while keeping the total effort constant and decreasing the rate at which the resource is used).

- Time (schedule) impact – Project schedule delay impact equal to extension value.

- Cost (budget) impact – Costs associated with project extension and possible inflation costs.

Resource Leveling Methods

Extend critical path task durations

- *Schedule/Time Impact – Schedule impact equal to the delay*

- *Resource/Cost Impact – Cost impact due to project time extension and inflation costs*

---

g. Authorize the use of overtime for tasks that are on the critical path.

- Time (schedule) impact – Could shorten the schedule (schedule crashing).

- Cost (budget) impact – Cost impact due to higher resource cost if resources incur overtime cost. Also, introduces potential inefficiencies.

Resource Leveling Methods

Authorize Overtime

- ***Schedule/Time Impact – Could shorten schedule (schedule crashing)***

- ***Resource/Cost Impact – Cost impact due to premium cost rates***

---

h. <u>Split the task into two or more non-sequential pieces</u>.

- Time (schedule) impact – Schedule impact if part of task extends outside of float.

- Cost (budget) impact – Cost impact due to possible project extension, inflation costs, and inefficiencies in splitting the task.

Resource Leveling Methods

Split the task into non-sequential pieces

- *Schedule/Time Impact – Schedule impact if part of task extends outside of float (soft logic)*

- *Resource/Cost Impact – Cost impact due to project time extension and inflation costs and inefficiencies in splitting the task*

---

i. Modify the Scope.

- Time (schedule) impact – Could possibly shorten the schedule due to less work or quality of work being accomplished.

- Cost (budget) impact – Could go either way. In the short run, the costs should be less due to less work being accomplished; however the long run costs may be increased

---

Resource Leveling Methods

Modify the scope

- *Schedule/Time Impact – Could shorten schedule due to less work or quality of work being accomplished*

- *Resource/Cost Impact – Could go either way. In the short term, costs could be less due to less work, but long term costs may increase*

Module 5 References

Project Management Institute. *A Guide to the Project Management Body of Knowledge, 3*^{*rd*} *Edition (PMBOK Guide).* Project Management Institute, Inc. 2004.

Exercise Gantt

Task #	Task Name	Duration
1	Generic Project	50d
2	Start	0d
3	Task A	20d
4	Task B	16d
5	Task C	25d
6	Task D	10d
7	Task E	20d
8	Task F	7d
9	Task G	14d
10	Task H	10d
11	Task J	15d
12	Finish	0d

Using the Gantt chart above (Gantt chart report from scheduling exercise earlier), develop a resource histogram for this project. (Use the blank histogram below.)

Assume that a "Design Engineer" is the required resource for each activity. Each activity will only require one "Design Engineer" to complete the task.

Resource Histogram

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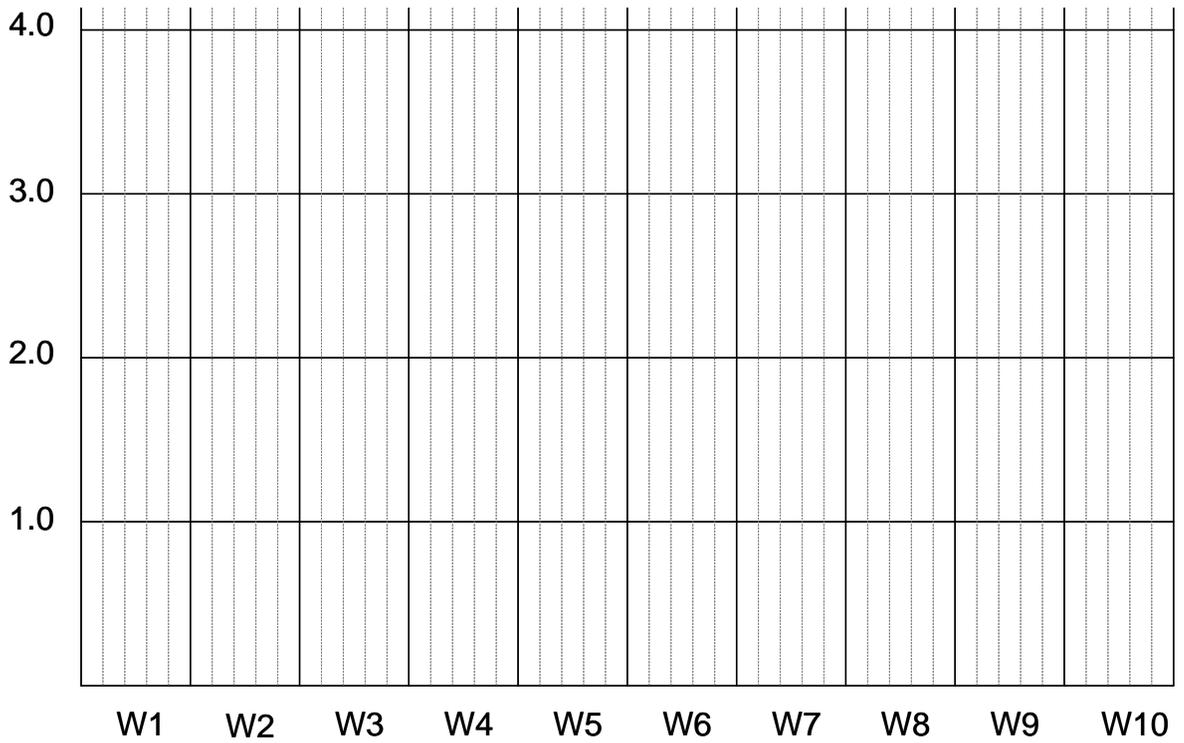Using the three charts on the previous pages, answer the following questions:

1. How many Design Engineers needed at any one time?

    _____

    _____

    _____

    _____

2. Only three Design Engineers are available. How would you resolve this resource conflict?

    _____

    _____

    _____

    _____

3. Was there an impact to the project end date?

Complete the resource histogram for question number 2 above.

Resource Histogram

4.0									
3.0									
2.0									
1.0									
	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10

Module

5

Resource Planning

Learning Outcomes

- **Define resource planning**

- **Define Resource estimating**

- **Explain the use of a resource histogram and its use in resource planning**

- **Define resource leveling**

- **Explain resource conflict and balancing**