Chapter One

Software Project Management

Introduction

- The job pattern of an IT company engaged in software development can be seen split in two parts:
- Software Creation
- Software Project Management
- **What is Project?**

✓ A project is well-defined task, which is a collection of several operations done in order to achieve a goal (for example, software development and delivery).

✓ A project is "a temporary endeavor undertaken to create a unique product, service, or result" (PMBOK® Guide, Fourth Edition, 2008, p. 5)

What is Project Management?

- **Project management** is "the application of knowledge, skills, tools, and techniques to project activities in order to meet project requirements" (PMI*, Project Management Body of Knowledge (PMBOK® Guide), 2000, p. 6)

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Characteristics of Project

- **A Project can be characterized as:**
- Every project may has a unique and distinct goal.
- Project is not routine activity or day-to-day operations.
- Project comes with a start time and end time.
- Project ends when its goal is achieved hence it is a temporary phase in the lifetime of an organization.
- Project needs adequate resources in terms of time, manpower, finance, material and knowledge-bank.

Software Project

- A **Software Project** is the complete procedure of software development from requirement gathering to testing and maintenance, carried out according to the execution methodologies, in a specified period of time to achieve intended software product.

Importance of software project management.

- Software is said to be an **intangible product**.
- Software development is a kind of all new stream in world business and there's very little experience in building software products.
- Most software products are tailor made to fit client's requirements. The most important is that the underlying technology changes and advances so frequently and rapidly that experience of one product may not be applied to the other one.

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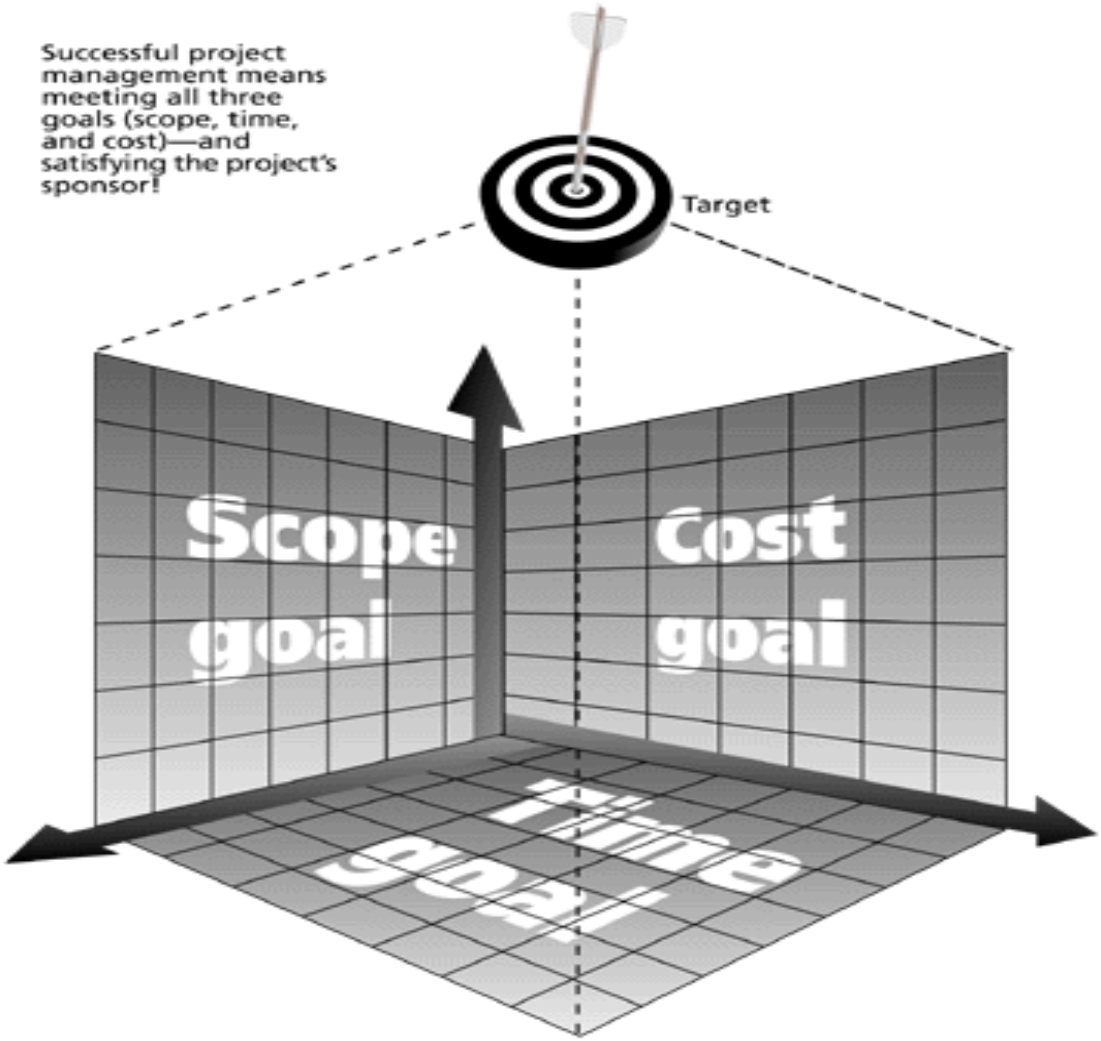
- All such business and environmental constraints bring risk in software development hence it is essential to manage software projects efficiently. **Blow** triple constraints for software projects

- It is an essential part of software organization to deliver quality product, keeping the cost within client's budget constrain and deliver the project as per scheduled.

Figure 1-1 The Triple Constraint of Project Management

Successful project management means meeting all three goals (scope, time, and cost) – and satisfying the project's sponsor!

The fourth constraint: quality



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- There are **several factors**, both **internal and external**, which may impact this triple constrain triangle. Any of three factor can severely impact the other two.
- Therefore, software project management is essential to **incorporate user requirements** along with budget and time constraints.

Project Success

- There are several ways to define project success:
  - The project met scope, time, and cost goals
  - The project satisfied the customer/sponsor
  - The results of the project met its main objective, such as making or saving a certain amount of money, providing a good return on investment, or simply making the sponsors happy

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1. Executive support
2. User involvement
3. Experienced project manager
4. Clear business objectives
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6. Standard software infrastructure
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- **Managing People**
- Act as project leader
- Liaison with stakeholders
- Managing human resources
- Setting up reporting hierarchy etc.

- **Managing Project**

- Defining and setting up project scope
- Managing project management activities
- Monitoring progress and performance
- Risk analysis at every phase
- Take necessary step to avoid or come out of problems
- Act as project spokesperson

Problems with Software Projects

- poor estimates and plans;
- lack of quality standards and measures;
- lack of guidance about making organizational decisions;
- lack of techniques to make progress visible;
- poor role definition - who does what?
- incorrect success criteria.

Project Stakeholders

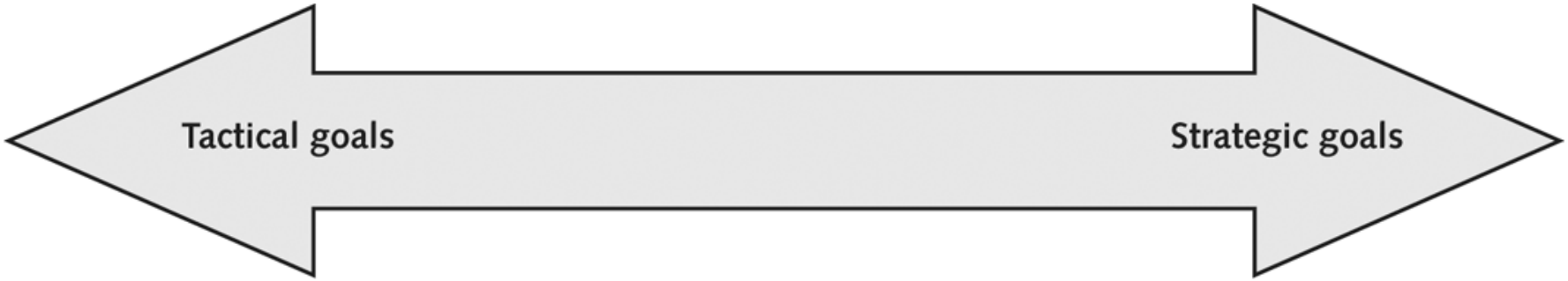
- ✓ **Stakeholders** are the people involved in or affected by project activities
- ✓ Stakeholders include:
  - The project sponsor
  - The project manager
  - The project team
  - Support staff
  - Customers
  - Users
  - Suppliers
  - Opponents to the project

Project Portfolio Management

- **Portfolio:** is a group of programs (investments)
- **Project Portfolio Management:** is grouping and managing groups and programs as a portfolio of investments that contribute to the entire enterprise's success.
- As part of **project portfolio management,** organizations group and manage projects and programs as a portfolio of investments that contribute to the entire enterprise's success

- Portfolio managers help their organizations make wise investment decisions by helping to select and analyze projects from a strategic perspective

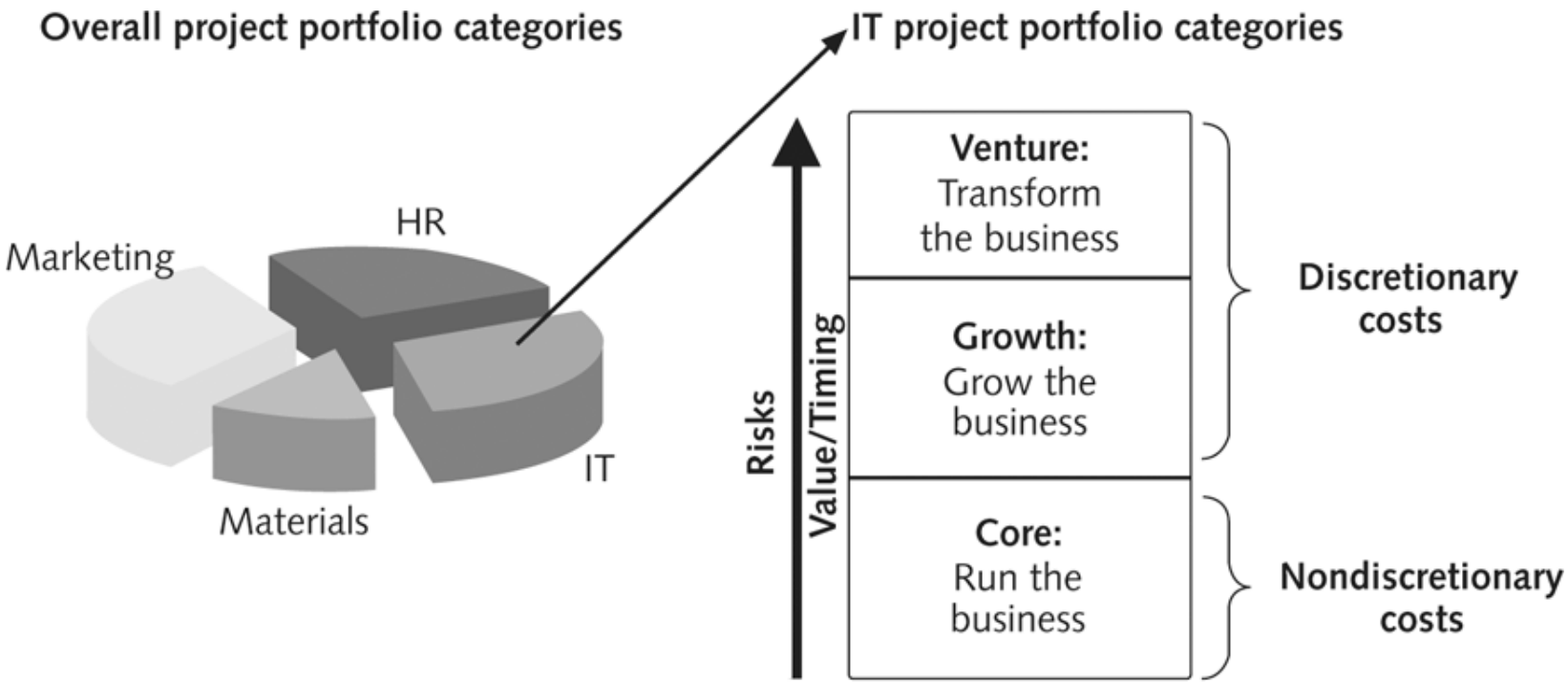
Project Management Compared to Project Portfolio Management



Project management
- Are we carrying out projects well?
- Are projects on time and on budget?
- Do project stakeholders know what they should be doing?

Project portfolio management
- Are we working on the right projects?
- Are we investing in the right areas?
- Do we have the right resources to be competitive?

Sample Project Portfolio Approach



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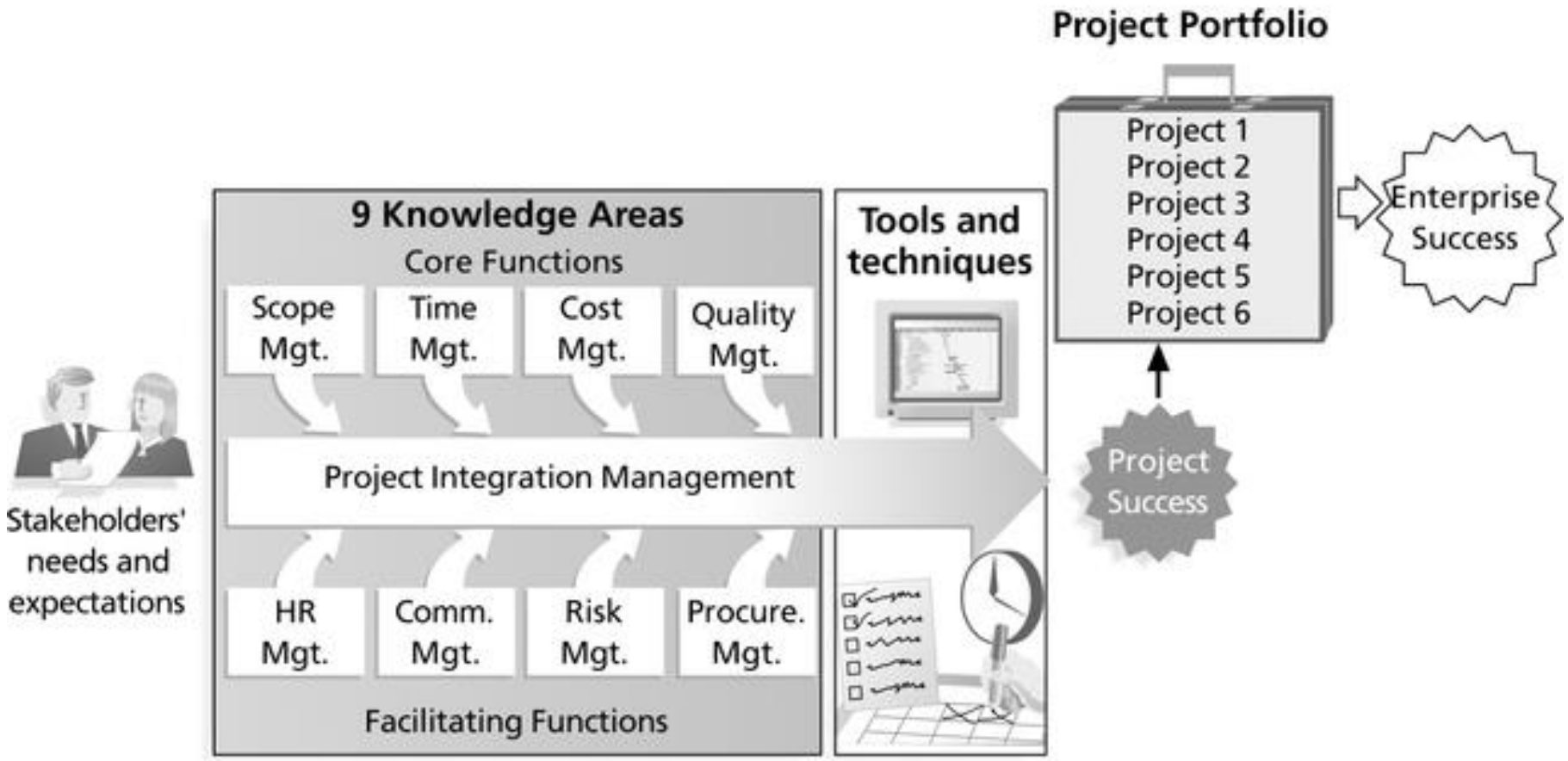

Figure 1-2. Project Management Framework

9 Project Management Knowledge Areas

- Knowledge areas describe the key competencies that project managers must develop
  - 4 core knowledge areas lead to specific project objectives (scope, time, cost, and quality)
  - 4 facilitating knowledge areas are the means through which the project objectives are achieved (human resources, communication, risk, and procurement management)
  - 1 knowledge area (project integration management) affects and is affected by all of the other knowledge areas

Feasibility Study

✓**What is a Feasibility Study in Project Management?**

- It determines whether the project is likely to succeed in the first place.
- It is typically conducted before any initial steps are taken with a project, including planning. It is one of — if not the— most important factors in determining whether the project can move forward.
- The study identifies the project market (if applicable); highlights the project's key goals; maps out potential roadblocks and offers alternative solutions; and factors in time, budget, legal, and manpower requirements to determine whether the project is not only possible but advantageous for the company to undertake.

Key points of a feasibility study

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- **Technical capability:** Does the organization have the technical resources to undertake the project?
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- **Operational feasibility:** Does the project, in its proposed scope, meet the organization's needs by solving problems and/or taking advantage of identified opportunities?
- **Time:** Can the project be completed in a reasonable timeline?

Cost-Benefit Analysis

- A cost-benefit analysis (CBA) is a process that is used to estimate the costs and benefits of decisions in order to find the most cost-effective alternative.
- A CBA is a versatile method that is often used for the business, project and public policy decisions.
- **In project management,** a cost-benefit analysis is used to evaluate the cost versus the benefits in your project proposal and business case. It begins with a list, as so many processes do.

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- A formal CBA lists all project expenses and tangible benefits, then calculates the return on investment (ROI), internal rate of return (IRR), net present value (NPV), and payback period.
- **required rate of return/IRR —** the minimum acceptable rate of return on an investment
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- Then, the difference between the costs and the benefits from taking action is calculated.
- A general rule of thumb is the costs should be less than 50% of the benefits, and the payback period shouldn't **exceed a year.**
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- An effective CBA evaluates the following costs and benefits:

✓ **Costs**

- **Direct costs:** These are all the costs that are directly related to the manufacturing of the product. Such as materials, equipment, labor, etc.
- **Indirect costs:** Other expenses that are not directly related to the product such as rent, utilities, or transportation costs.
- **Intangible costs:** Any other costs that can't be quantified, such as the brand damage if the market doesn't respond positively to the product.
- **Opportunity costs:** The loss of opportunities that occurs when a decision is made instead of another. For example, you could have chosen to manufacture a product that could have been more profitable than the one you chose to make.
- **Costs of potential risks:** Any project is susceptible to a variety of risks. You should always consider that you might have unexpected costs at some point.

Cont'd

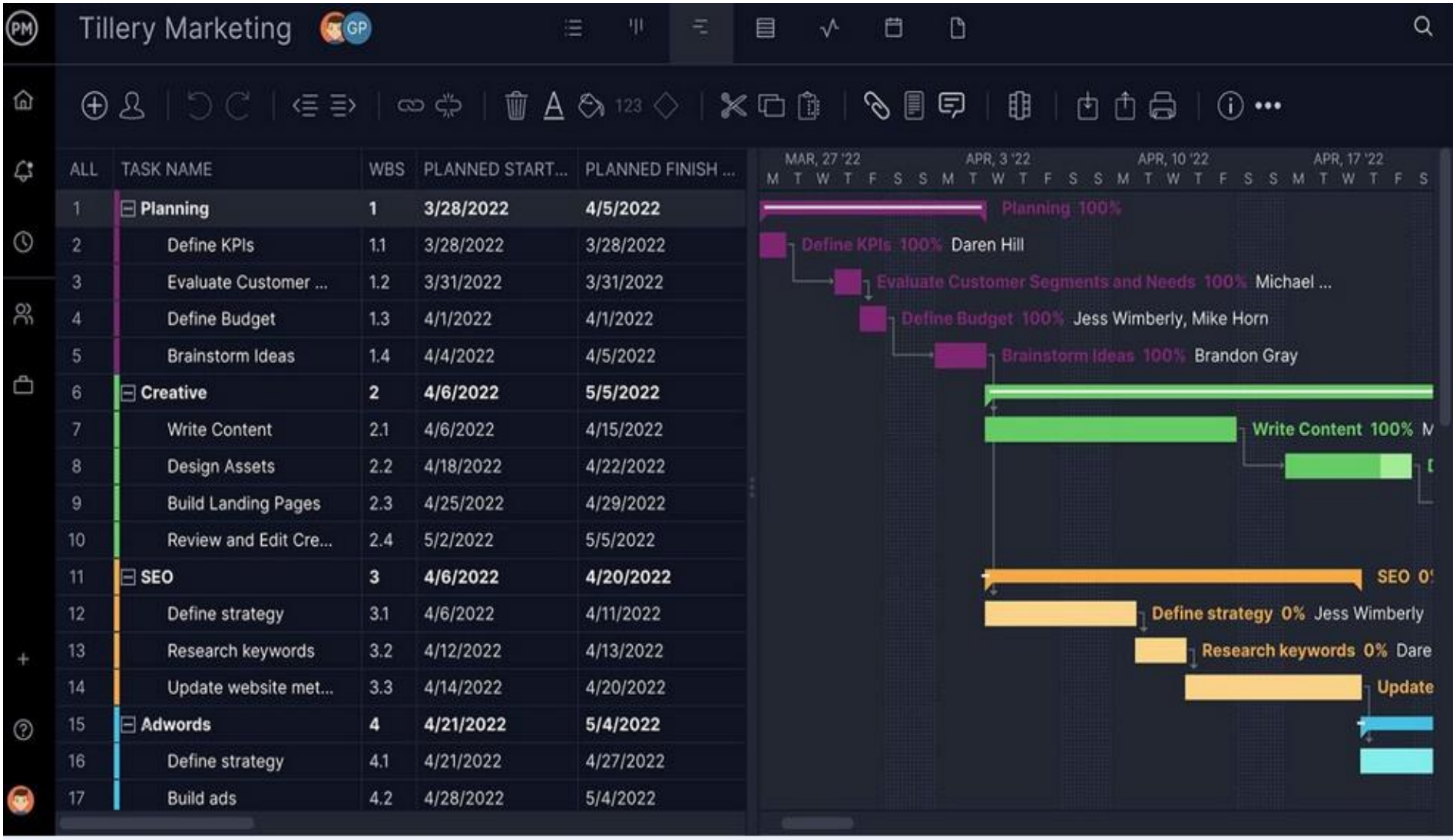
✓Benefits

- **Direct Benefits:** The measurable benefits in monetary value that you get from the project. In this case, the revenue, sales and profit obtained from your product.
- **Indirect Benefits:** Benefits that you can perceive but not necessarily measure such as increased brand awareness.
- **Total benefits:** costs of a project or decision and subtracting that amount from the total projected benefits of the project or decision. (Sometimes, this value is represented as a ratio.)
- **Net benefits:** is determined by summing all benefits and subtracting the sum of all costs of a project.
- Net benefit can be useful in ranking projects with similar B/C ratios.

Planning

- ✓ Our online Gantt charts have features to plan your projects and organize your tasks, so they lead to a successful final deliverable.
- ✓ If things change, and they will, the Gantt is easy to edit, so you can pivot quickly.

Example…


Tillery Marketing
GP
ALL
TASK NAME
WBS
PLANNED START...
PLANNED FINISH ...
1 Planning 1 3/28/2022 4/5/2022
2 Define KPIs 1.1 3/28/2022 3/28/2022
3 Evaluate Customer ... 1.2 3/31/2022 3/31/2022
4 Define Budget 1.3 4/1/2022 4/1/2022
5 Brainstorm Ideas 1.4 4/4/2022 4/5/2022
6 Creative 2 4/6/2022 5/5/2022
7 Write Content 2.1 4/6/2022 4/15/2022
8 Design Assets 2.2 4/18/2022 4/22/2022
9 Build Landing Pages 2.3 4/25/2022 4/29/2022
10 Review and Edit Cre... 2.4 5/2/2022 5/5/2022
11 SEO 3 4/6/2022 4/20/2022
12 Define strategy 3.1 4/6/2022 4/11/2022
13 Research keywords 3.2 4/12/2022 4/13/2022
14 Update website met... 3.3 4/14/2022 4/20/2022
15 Adwords 4 4/21/2022 5/4/2022
16 Define strategy 4.1 4/21/2022 4/27/2022
17 Build ads 4.2 4/28/2022 5/4/2022
MAR, 27 '22
APR, 3 '22
APR, 10 '22
APR, 17 '22
Planning 100%
Define KPIs 100% Daren Hill
Evaluate Customer Segments and Needs 100% Michael ...
Define Budget 100% Jess Wimberly, Mike Horn
Brainstorm Ideas 100% Brandon Gray
Write Content 100%
Define strategy 0% Jess Wimberly
Research keywords 0%
Update

The phases of a project management life cycle

- Regardless of what kind of project you're planning, every project goes through the same stages.
- Although each project will require its own set of unique processes and tasks, they all follow a similar framework.
- There's always a **beginning**, a **middle**, and an **end**. This is called the project management life cycle.

Cont'd

- The project management life cycle provides predictability and gives the project manager a way to tackle tasks in distinct phases.
- In this section, we'll explain what you need to know about each phase.

The initiation phase

- The initiation phase is the first phase of the entire project management life cycle. The goal of this phase is to define the project, develop a business case for it, and get it approved. During this time, the project manager may do any of the following:
- Perform a feasibility study
- Create a project charter
- Identify key stakeholders
- Select project management tools

The planning phase

- The planning phase is critical to creating a project roadmap the entire team can follow. This is where all of the details and goals are outlined in order to meet the requirements laid out by the organization.
- During this phase, project managers will typically:

- Create a project plan
- Develop a resource plan
- Define goals and performance measures
- Communicate roles and responsibilities to team members
- Build out workflows
- Anticipate risks and create contingency plans

The execution phase

- his stage is where the bulk of the project happens. Deliverables are built to make sure the project is meeting requirements. This is where most of the time, money, and people are pulled into the project.
- a kickoff meeting is held to mark the official start of the execution phase. A kickoff meeting agenda might look something like this
- **Introductions:** Who's who?
- **Project background:** Why are you doing this project? What are the goals?
- **Project scope:** What kind of work is involved?

Cont'd

- **Project plan:** What does the roadmap look like?
- **Roles:** Who will be responsible for which elements of the project?
- **Communication:** What kind of communication channels will be used? What kind of meetings or status reports should your team expect?
- **Tools:** Which tools will be used to complete the project, and how will they be used?
- **Next steps:** What are the immediate action items that need to be completed?
- **Q&A:** Open the floor for any questions

The controlling and monitoring phase

- This phase happens in tandem with the execution phase. As the project moves forward, the project manager must make sure all moving parts are seamlessly headed in the right direction. If adjustments to the project plan need to be made due to unforeseen circumstances or a change in direction, they may happen here.

Cont'd

- During the controlling and monitoring phase, project managers may have to do any of the following:
- Manage resources
- Monitor project performance
- Risk management
- Perform status meetings and reports
- Update project schedule
- Modify project plans
- At the end of this phase, all the agreed project deliverables should be completed and accepted by the customer.

Project closure Phase

- The closing phase is a critical step in the project management life cycle. It signals the official end of the project and provides a period for reflection, wrap-up, and organization of materials.

✓ Project managers can:

- Take inventory of all deliverables
- Tie up any loose ends
- Hand the project off to the client or the team that will be managing the project's day-to-day operations

cont'd

- Perform a post-mortem to discuss and document any learnings from the project
- Organize all project documents in a centralized location
- Communicate the success of the project to stakeholders and executives
- Celebrate project completion and acknowledge team members

Project Management Tools and Techniques

- Project management tools and techniques assist project managers and their teams in various aspects of project management
- Some specific ones include
  - Project Charter, scope statement, and WBS (work breakdown structure) (scope)
  - Gantt charts, network diagrams, critical path analysis, critical chain scheduling (time)
  - Cost estimates and earned value management (cost)

Sample Gantt Chart

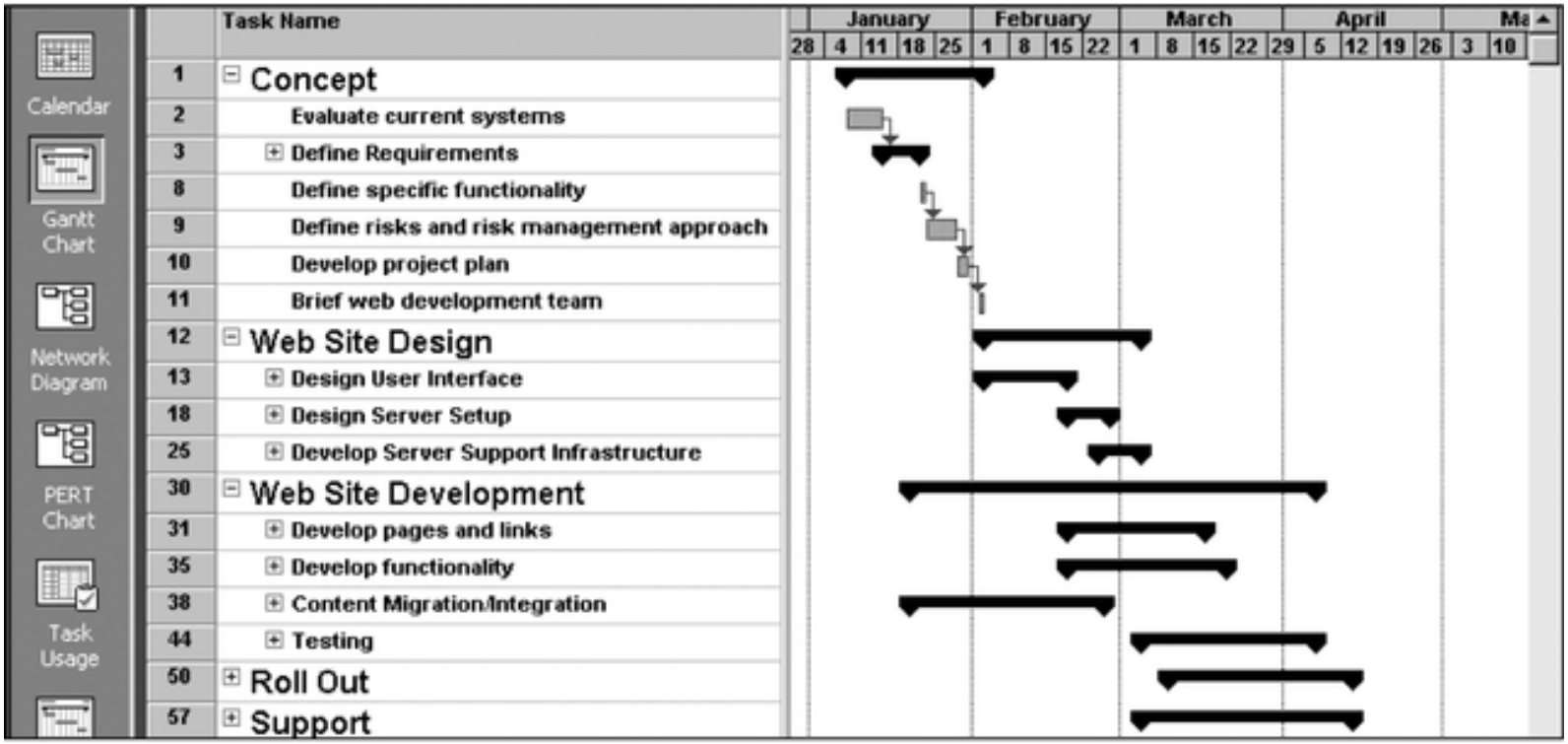


Figure 1-3. Sample Gantt Chart in Microsoft Project 2002

The WBS is on the left, and each task's start and finish date are shown on the right using a calendar timescale. Early Gantt Charts, first used in 1917, were drawn by hand.

Sample Network Diagram

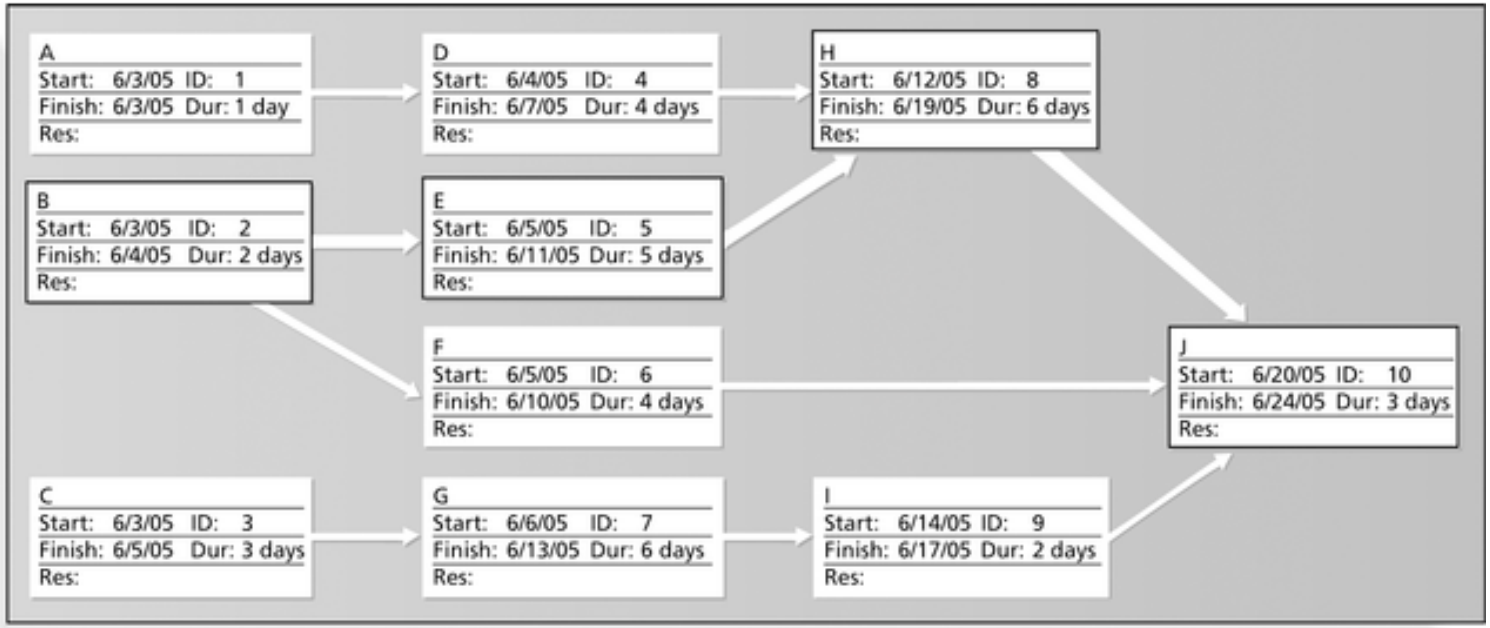


Figure 1-4. Sample Network Diagram in Microsoft Project 2002

Each box is a project task from the WBS. Arrows show dependencies between tasks. The bolded tasks are on the critical path. If any tasks on the critical path take longer than planned, the whole project will slip <u>unless</u> something is done. Network diagrams were first used in 1958 on the Navy Polaris project, before project management software was available.

Sample Enterprise Project Management Tool

Company ABC Project Portfolio				
Project Name	**Scope**	**Schedule**	**Budget**	**Links**
Active Projects				
Project 1	○	●	●	
Project 2	●	●	●	
Project 3	○	○	○	
Project 4	○	●	●	
Approved Projects				
Project 10	○	○	○	
Project 11	○	○	○	
Project 12	○	○	○	
Project 13	○	○	○	
Project 14	○	○	○	
Opportunities				
Project 100				
Project 200				
○	White = going well			
●	Gray = some problems			
●	Black = major problems			

Figure 1-5. Sample Enterprise Project Management Tool

In recent years, organizations have been taking advantage of software to help manage their projects throughout the enterprise.

THANK YOU

Chapter One

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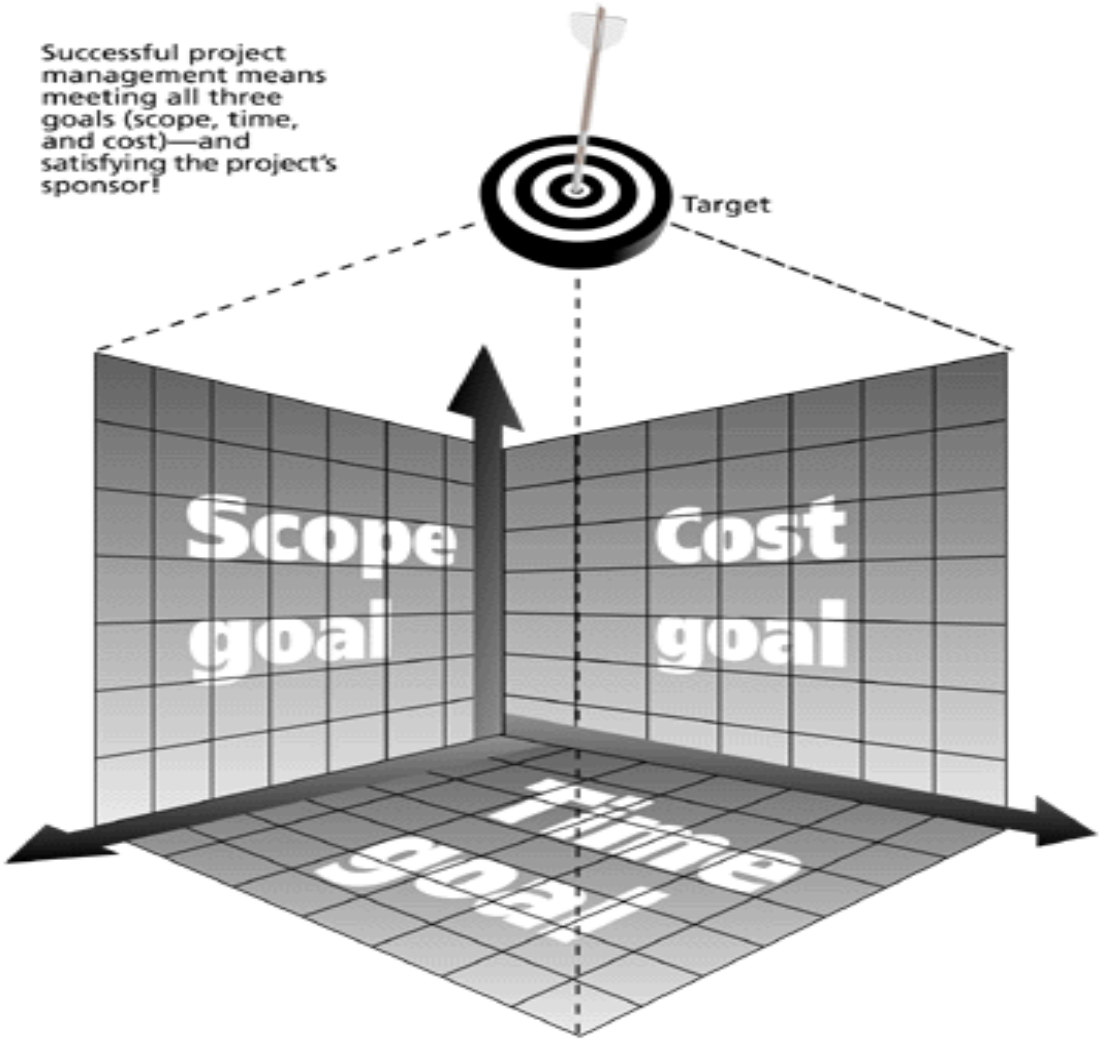

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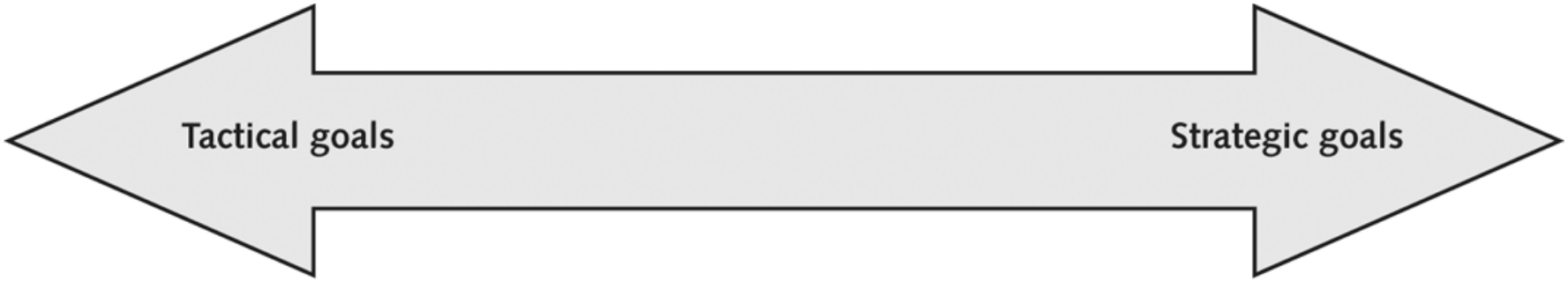

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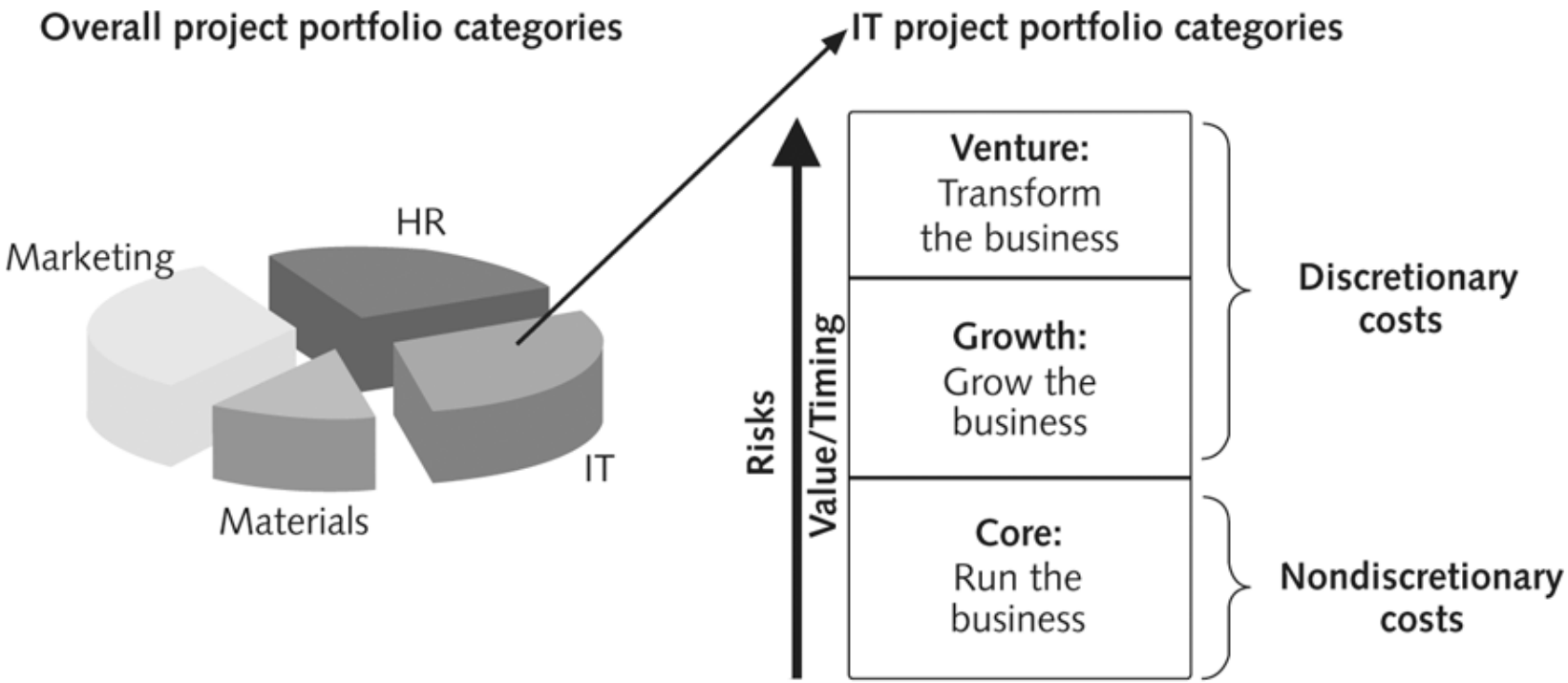

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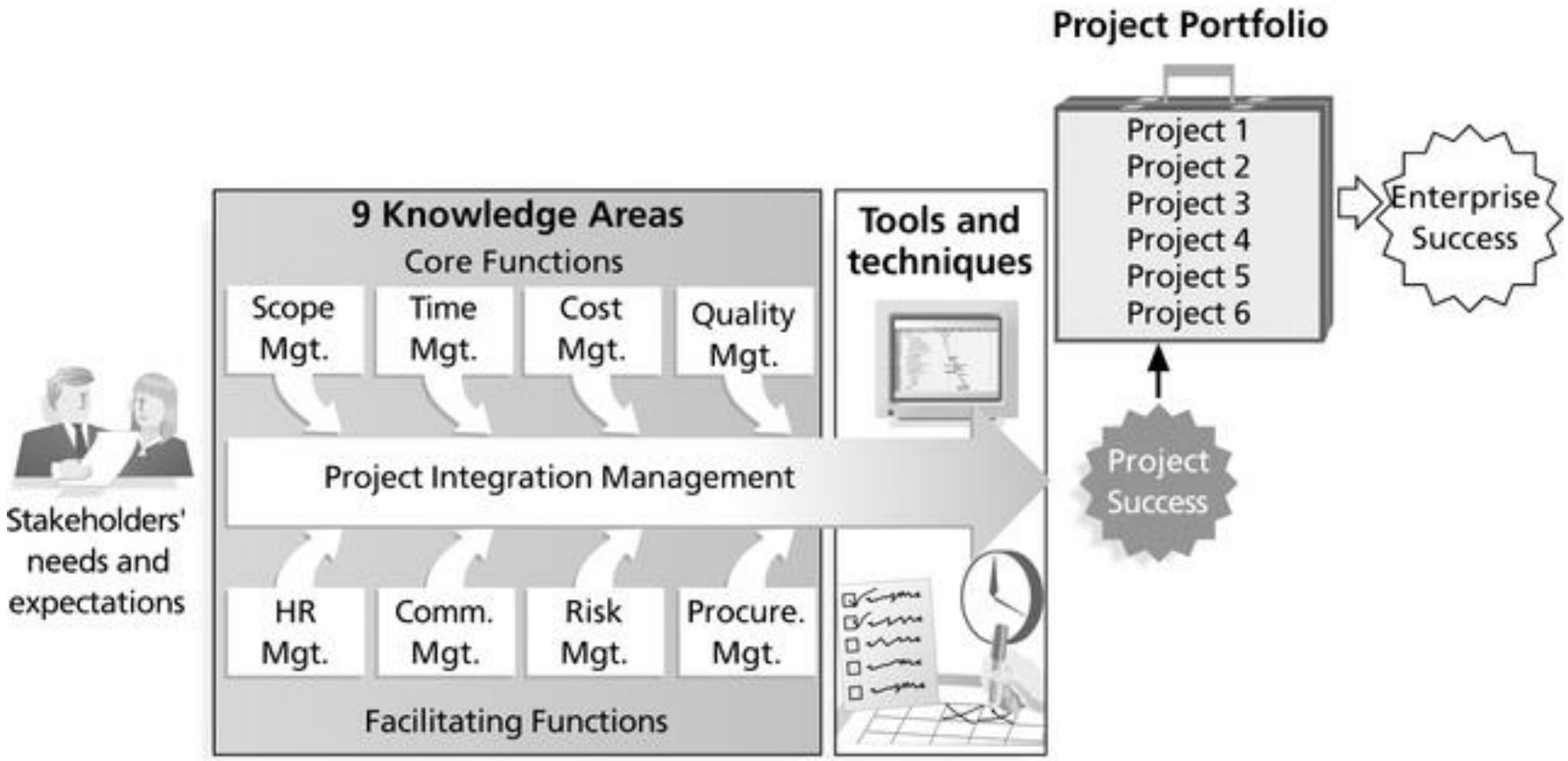

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- **Intangible costs:** Any other costs that can't be quantified, such as the brand damage if the market doesn't respond positively to the product.
- **Opportunity costs:** The loss of opportunities that occurs when a decision is made instead of another. For example, you could have chosen to manufacture a product that could have been more profitable than the one you chose to make.
- **Costs of potential risks:** Any project is susceptible to a variety of risks. You should always consider that you might have unexpected costs at some point.

Cont'd

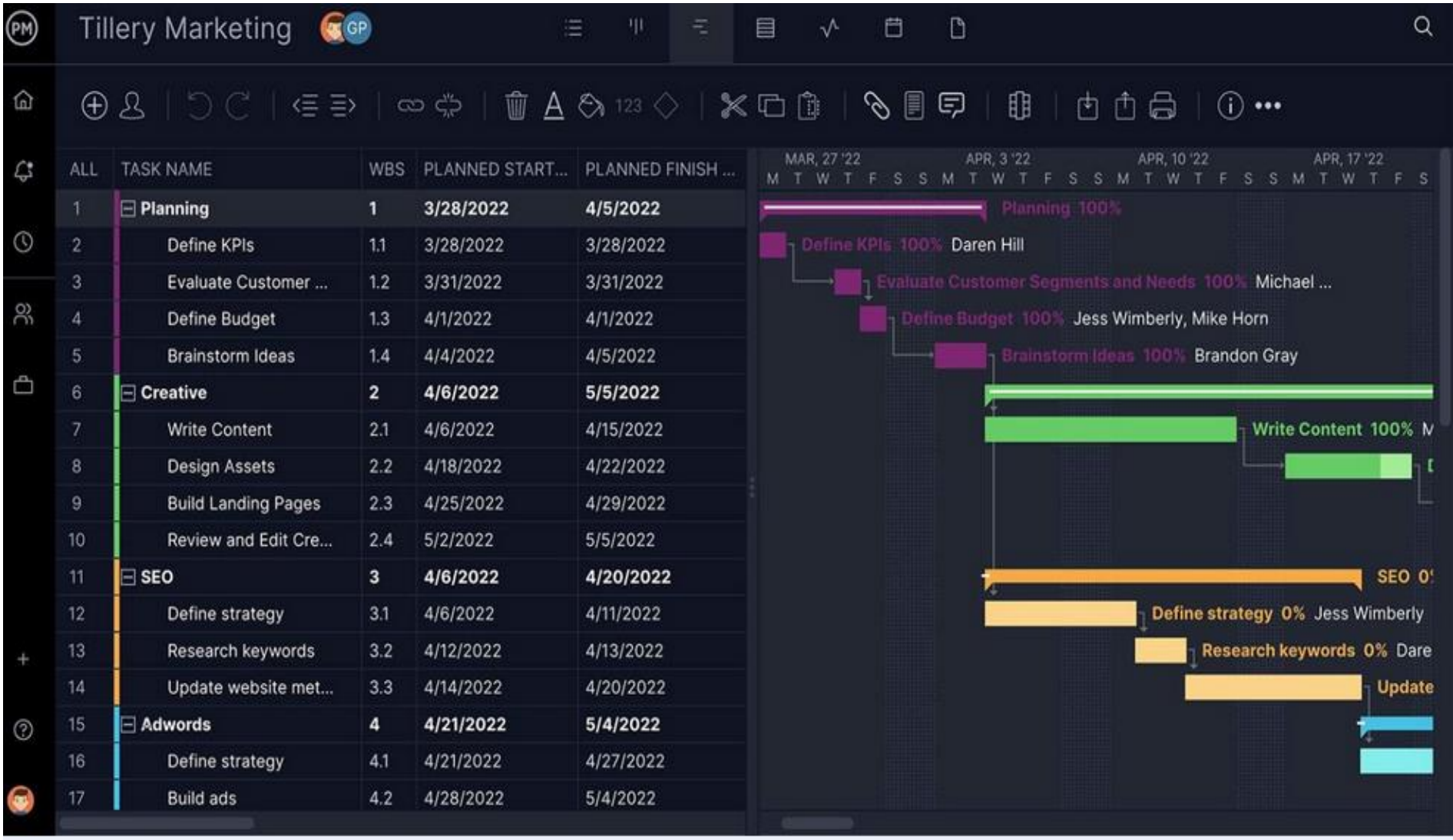
✓Benefits

- **Direct Benefits:** The measurable benefits in monetary value that you get from the project. In this case, the revenue, sales and profit obtained from your product.
- **Indirect Benefits:** Benefits that you can perceive but not necessarily measure such as increased brand awareness.
- **Total benefits:** costs of a project or decision and subtracting that amount from the total projected benefits of the project or decision. (Sometimes, this value is represented as a ratio.)
- **Net benefits:** is determined by summing all benefits and subtracting the sum of all costs of a project.
- Net benefit can be useful in ranking projects with similar B/C ratios.

Planning

- ✓ Our online Gantt charts have features to plan your projects and organize your tasks, so they lead to a successful final deliverable.
- ✓ If things change, and they will, the Gantt is easy to edit, so you can pivot quickly.

Example…


Tillery Marketing
GP
ALL
TASK NAME
WBS
PLANNED START...
PLANNED FINISH ...
1 Planning 1 3/28/2022 4/5/2022
2 Define KPIs 1.1 3/28/2022 3/28/2022
3 Evaluate Customer ... 1.2 3/31/2022 3/31/2022
4 Define Budget 1.3 4/1/2022 4/1/2022
5 Brainstorm Ideas 1.4 4/4/2022 4/5/2022
6 Creative 2 4/6/2022 5/5/2022
7 Write Content 2.1 4/6/2022 4/15/2022
8 Design Assets 2.2 4/18/2022 4/22/2022
9 Build Landing Pages 2.3 4/25/2022 4/29/2022
10 Review and Edit Cre... 2.4 5/2/2022 5/5/2022
11 SEO 3 4/6/2022 4/20/2022
12 Define strategy 3.1 4/6/2022 4/11/2022
13 Research keywords 3.2 4/12/2022 4/13/2022
14 Update website met... 3.3 4/14/2022 4/20/2022
15 Adwords 4 4/21/2022 5/4/2022
16 Define strategy 4.1 4/21/2022 4/27/2022
17 Build ads 4.2 4/28/2022 5/4/2022
MAR, 27 '22
APR, 3 '22
APR, 10 '22
APR, 17 '22
Planning 100%
Define KPIs 100% Daren Hill
Evaluate Customer Segments and Needs 100% Michael ...
Define Budget 100% Jess Wimberly, Mike Horn
Brainstorm Ideas 100% Brandon Gray
Write Content 100%
Define strategy 0% Jess Wimberly
Research keywords 0%
Update

The phases of a project management life cycle

- Regardless of what kind of project you're planning, every project goes through the same stages.
- Although each project will require its own set of unique processes and tasks, they all follow a similar framework.
- There's always a **beginning**, a **middle**, and an **end**. This is called the project management life cycle.

Cont'd

- The project management life cycle provides predictability and gives the project manager a way to tackle tasks in distinct phases.
- In this section, we'll explain what you need to know about each phase.

The initiation phase

- The initiation phase is the first phase of the entire project management life cycle. The goal of this phase is to define the project, develop a business case for it, and get it approved. During this time, the project manager may do any of the following:
- Perform a feasibility study
- Create a project charter
- Identify key stakeholders
- Select project management tools

The planning phase

- The planning phase is critical to creating a project roadmap the entire team can follow. This is where all of the details and goals are outlined in order to meet the requirements laid out by the organization.
- During this phase, project managers will typically:

- Create a project plan
- Develop a resource plan
- Define goals and performance measures
- Communicate roles and responsibilities to team members
- Build out workflows
- Anticipate risks and create contingency plans

The execution phase

- his stage is where the bulk of the project happens. Deliverables are built to make sure the project is meeting requirements. This is where most of the time, money, and people are pulled into the project.
- a kickoff meeting is held to mark the official start of the execution phase. A kickoff meeting agenda might look something like this
- **Introductions:** Who's who?
- **Project background:** Why are you doing this project? What are the goals?
- **Project scope:** What kind of work is involved?

Cont'd

- **Project plan:** What does the roadmap look like?
- **Roles:** Who will be responsible for which elements of the project?
- **Communication:** What kind of communication channels will be used? What kind of meetings or status reports should your team expect?
- **Tools:** Which tools will be used to complete the project, and how will they be used?
- **Next steps:** What are the immediate action items that need to be completed?
- **Q&A:** Open the floor for any questions

The controlling and monitoring phase

- This phase happens in tandem with the execution phase. As the project moves forward, the project manager must make sure all moving parts are seamlessly headed in the right direction. If adjustments to the project plan need to be made due to unforeseen circumstances or a change in direction, they may happen here.

Cont'd

- During the controlling and monitoring phase, project managers may have to do any of the following:
- Manage resources
- Monitor project performance
- Risk management
- Perform status meetings and reports
- Update project schedule
- Modify project plans
- At the end of this phase, all the agreed project deliverables should be completed and accepted by the customer.

Project closure Phase

- The closing phase is a critical step in the project management life cycle. It signals the official end of the project and provides a period for reflection, wrap-up, and organization of materials.

✓ Project managers can:

- Take inventory of all deliverables
- Tie up any loose ends
- Hand the project off to the client or the team that will be managing the project's day-to-day operations

cont'd

- Perform a post-mortem to discuss and document any learnings from the project
- Organize all project documents in a centralized location
- Communicate the success of the project to stakeholders and executives
- Celebrate project completion and acknowledge team members

Project Management Tools and Techniques

- Project management tools and techniques assist project managers and their teams in various aspects of project management
- Some specific ones include
  - Project Charter, scope statement, and WBS (work breakdown structure) (scope)
  - Gantt charts, network diagrams, critical path analysis, critical chain scheduling (time)
  - Cost estimates and earned value management (cost)

Sample Gantt Chart

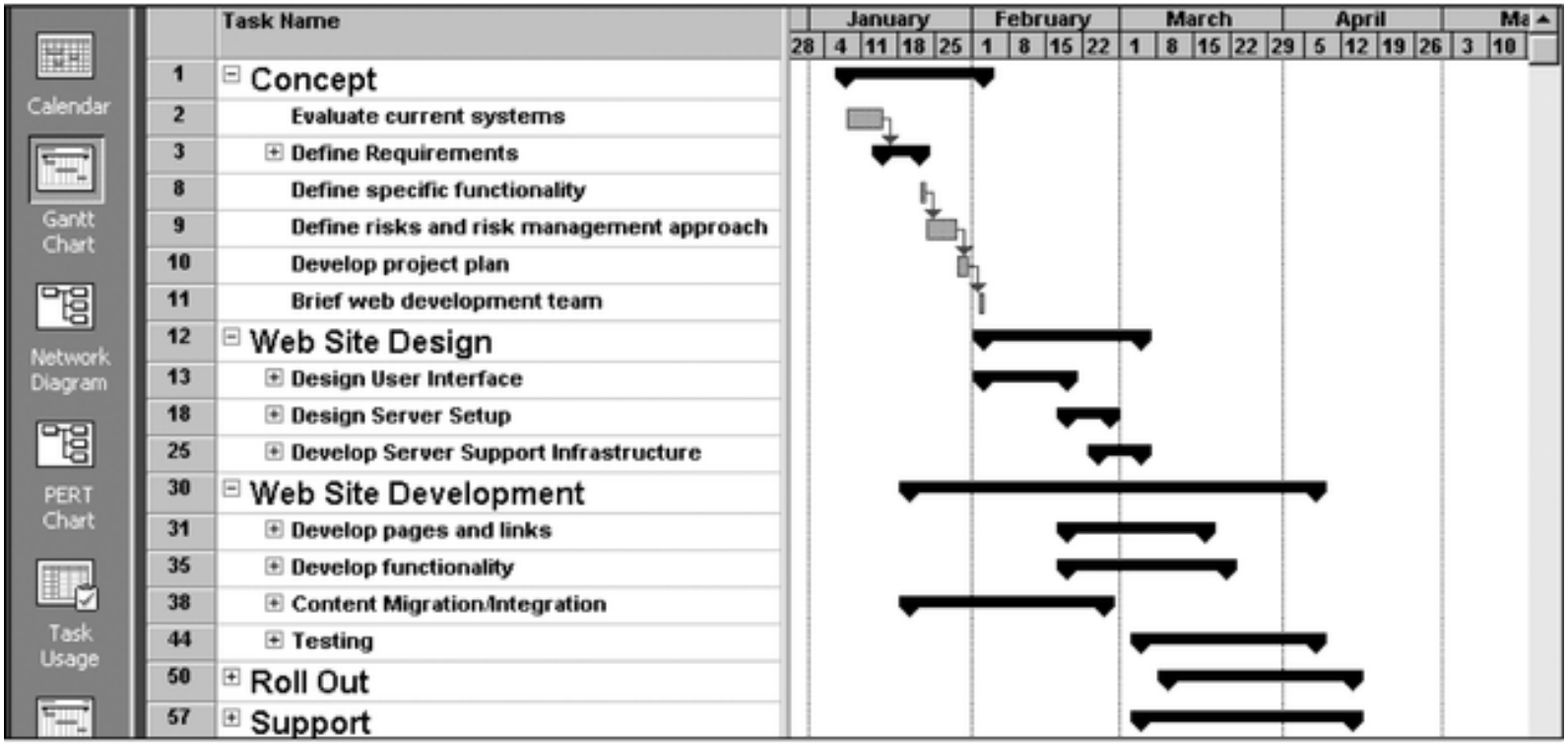


Figure 1-3. Sample Gantt Chart in Microsoft Project 2002

The WBS is on the left, and each task's start and finish date are shown on the right using a calendar timescale. Early Gantt Charts, first used in 1917, were drawn by hand.

Sample Network Diagram

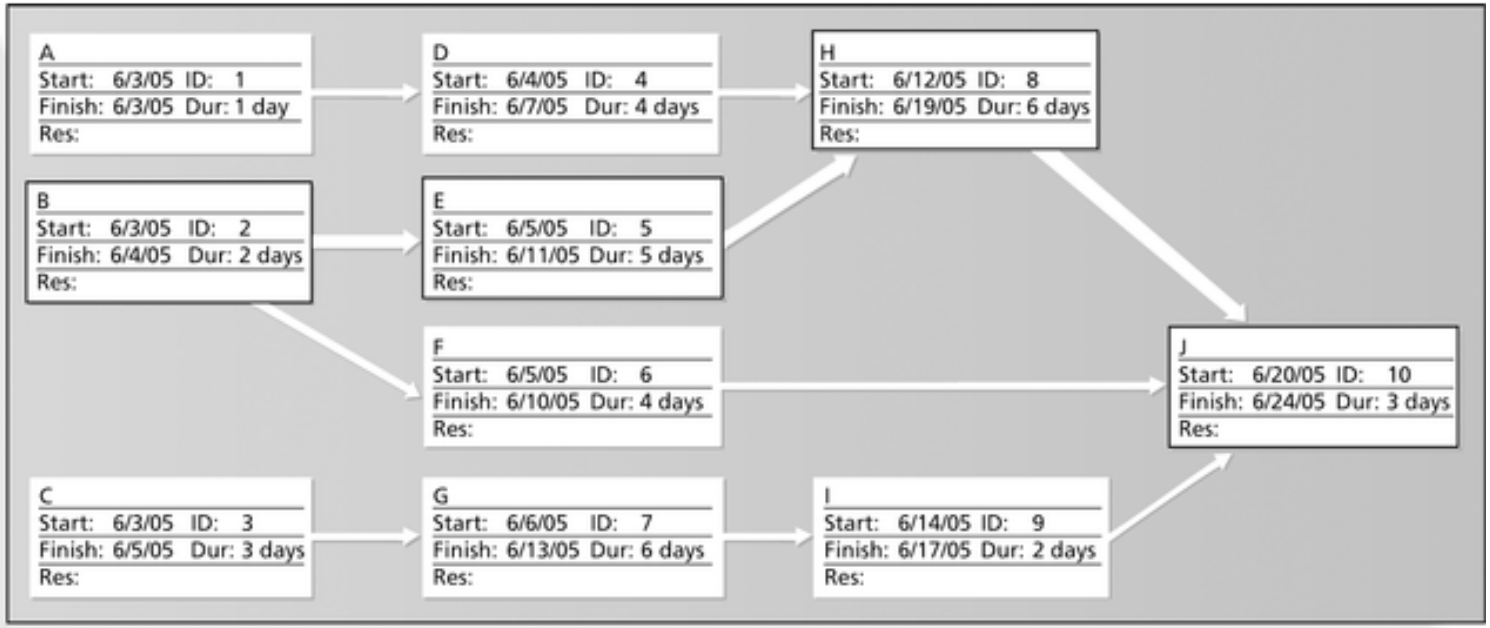


Figure 1-4. Sample Network Diagram in Microsoft Project 2002

Each box is a project task from the WBS. Arrows show dependencies between tasks. The bolded tasks are on the critical path. If any tasks on the critical path take longer than planned, the whole project will slip <u>unless</u> something is done. Network diagrams were first used in 1958 on the Navy Polaris project, before project management software was available.

Sample Enterprise Project Management Tool

Company ABC Project Portfolio				
Project Name	**Scope**	**Schedule**	**Budget**	**Links**
Active Projects				
Project 1	○	●	●	
Project 2	●	●	●	
Project 3	○	○	○	
Project 4	○	●	●	
Approved Projects				
Project 10	○	○	○	
Project 11	○	○	○	
Project 12	○	○	○	
Project 13	○	○	○	
Project 14	○	○	○	
Opportunities				
Project 100				
Project 200				
○	White = going well			
●	Gray = some problems			
●	Black = major problems			

Figure 1-5. Sample Enterprise Project Management Tool

In recent years, organizations have been taking advantage of software to help manage their projects throughout the enterprise.

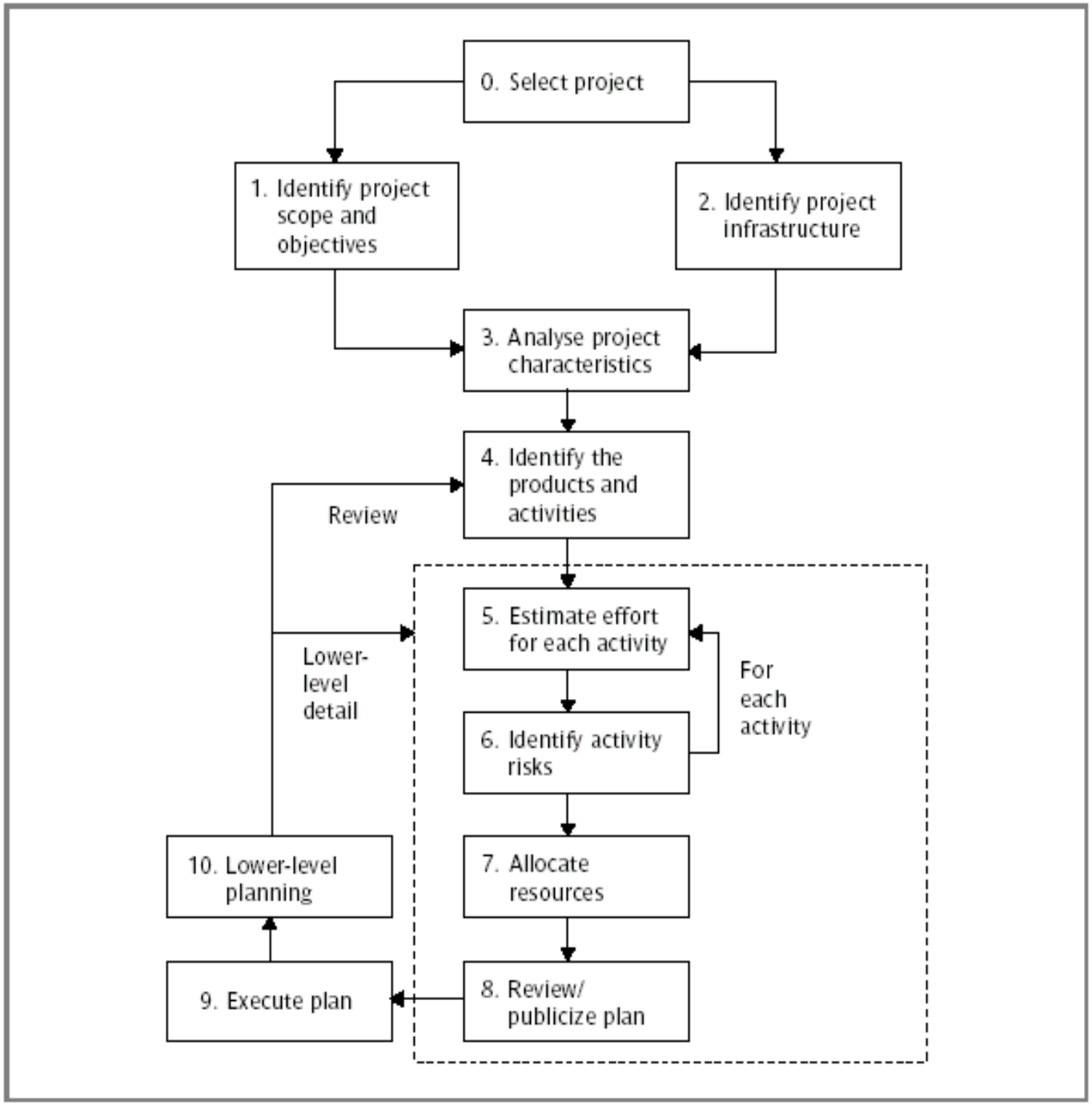
THANK YOU

Continuity of chapter - 2

Step Wise Project planning

Introduction to Step Wise Project Planning

- A framework of basic **steps in project planning**
- The framework described is called the Step Wise method to help to distinguish it from other methods such as PRINCE2.
- PRINCE2 is a set of project management standards that were originally sponsored by what is now the Office of Government Commerce (OGC) for use on British government ICT and business change projects.
- PRINCE stands for PRojects IN Controlled Environments.



An overview of Step Wise Project planning

Step	Activities within step
0	Select project
1	Identify project scope and objectives
1.1	Identify objectives and measures of effectiveness in meeting them
1.2	Establish a project authority
1.3	Identify stakeholders
1.4	Modify objectives in the light of stakeholder analysis
1.5	Establish methods of communication with all parties
2	Identify project infrastructure
2.1	Establish relationship between project and strategic planning
2.2	Identify installation standards and procedures
2.3	Identify project team organization

3 Analyse project characteristics

3.1 Distinguish the project as either objective- or product-driven

3.2 Analyse other project characteristics

3.3 Identify high-level project risks

3.4 Take into account user requirements concerning implementation

3.5 Select general life-cycle approach

3.6 Review overall resource estimates

4 Identify project products and activities

4.1 Identify and describe project products (including quality criteria)

4.2 Document generic product flows

4.3 Recognize product instances

4.4 Produce ideal activity network

4.5 Modify ideal to take into account need for stages and checkpoints

5 Estimate effort for each activity

5.1 Carry out bottom-up estimates

5.2 Revise plan to create controllable activities

6 Identify activity risks

6.1 Identify and quantify activity-based risks

6.2 Plan risk reduction and contingency measures where appropriate

6.3 Adjust plans and estimates to take account of risks

7 Allocate resources

7.1 Identify and allocate resources

7.2 Revise plans and estimates to take account of resource constraints

8 Review/publicize plan

8.1 Review quality aspects of project plan

8.2 Document plans and obtain agreement

9/10 Execute plan/lower levels of planning

This may require the reiteration of the planning process at a lower level

Step 1: Identify Project Scope and Objectives

- Steps 1, 2 and 3 are longer-term planning, broad in outline

- 1.1 Identify objectives and *practical* measures of effectiveness in meeting them

  - vision document helps find the objectives
  - measuring effectiveness can be in terms of *software quality*...

Software Quality

- *product operation quality factors:*
  - correctness - fulfils user objectives / meet specifications
  - reliability - failure rate / degree of accuracy
  - efficiency - computer resources required
  - integrity - safekeeping of data
  - usability - effort required to learn and use
- *product revision quality factors:*
  - maintainability - effort required to locate and fix errors
  - testability - effort required to test / scope, precision of test
  - flexibility - effort required to modify
- *product transition quality factors:*
  - portability - effort required to switch hardware/OS
  - reusability - of components in other applications
  - interoperability - effort required to couple to another system

Step 1: Identify Project Scope and Objectives

- 1.2 Establish a project authority
  - a single person or group with unity of purpose
  - to avoid being pulled in different directions

- 1.3 Stakeholder analysis - identify all stakeholders in the project and their interests &
- 1.4 Modify objectives in light of the stakeholder analysis
  - again, can look to the vision document

- 1.5 Establish methods of communication with all parties
  - including external authorities/providers
  - might lead to making a *communications plan*

Step 2: Identify Project Infrastructure

- 2.1 Identify relationship between the project and strategic planning
  - a strategic business or it plan needs to document:
  - order of projects
  - hardware & software standards to be met

- 2.2 Identify installation standards and procedures
  - making sure that all changes are documented, approved and reviewed
  - specifying which measure of quality are to be used and when

- 2.3 Identify project team organisation
  - can you choose, or is it pre-specified?
  - either way, what impact will team and sub-team structure have?

Step 3: Analyse Project Characteristics

- 3.1 Distinguish the project as either objective- or product-driven
  - objective driven will give you more freedom but often there is a specified product you have to build to form a solution
- 3.2 Analyse other project characteristics (including quality-based ones)
  - essentially considering non-functional requirements:
    - safety critical?
    - sensitive data?
    - speed/space requirements?

Step 3: Analyse Project Characteristics

- 3.3 Identify high level project risks
  - as discussed in the Iteration Planning lecture
  - don't forget aspects such as resistance to change

- 3.4 Take into account user requirements concerning implementation
  - some organisations (such as government) might require use of the waterfall method

Step 3: Analyse Project Characteristics

- if 3.4 allows a choice, then figure what's best based upon:
  - staff available
  - time available
  - distribution of resources

3.5 Select development methodology and lifecycle approach

- 3.6 Review overall resource estimates
  - and if need be revise cost estimates, team organisation and risks

Step 4: Identify Project Products and Activities

- more detailed planning of individual activities

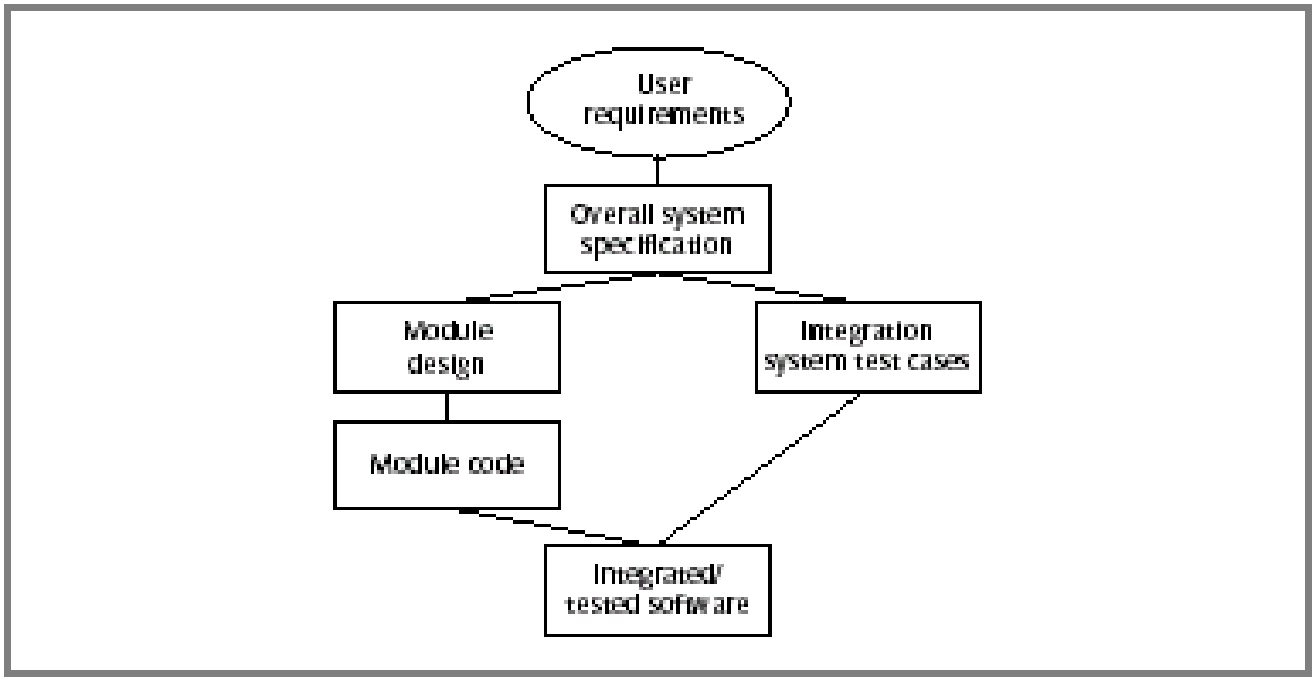
- 4.1 Identify and describe project products
  - activities should produce tangible products:
    - *deliverables* - to be hand over to the client at the end of the project
      - also includes technical products:
        - training manual, operating instructions
    - *intermediates* - used in the process of creating deliverables
      - also includes planning and quality products:
        - uml documentation, test cases

Products

- products can be composite - made up of several smaller (sub) products
- each should be documented by a *product description* (PRINCE2):
  - name
  - purpose
  - derivation (if it modifies an existing product)
  - composition
  - form
  - relevant standards
  - quality criteria (for acceptance)

Step 4: Identify Project Products and Activities

- 4.2 Document generic product flows
  - some products cannot be created until other products exist
  - these relationships can be captured in a *product flow diagram:*



A fragment of a Product Flow Diagram (PFD) for a software development task

Step 4: Identify Project Products and Activities

- 4.3 Recognise product instances
  - spot when the same PFD fragment relates to many instances of a type product
  - that might allow you to
    - re-use the plans for the activities which produce it
    - assign team members to undertake groups of activities with similar pfd

Step 4: Identify Project Products and Activities

- 4.4 Produce ideal activity network

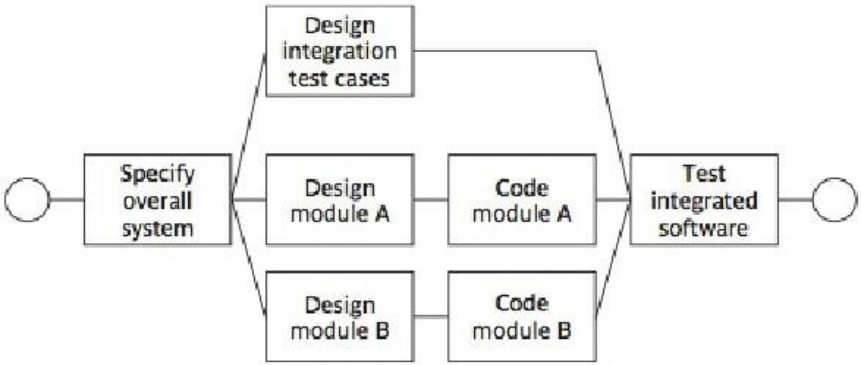


fig3.5 Ch 3 *Software Project Management*

- 'ideal' because resource constraints are not taken into account

Step 4: Identify Project Products and Activities

- 4.5 Modify the ideal to take into account need for stages and checkpoints
  - sequencing activities in 4.4 encourages a plan which will minimise the project time
  - it assumes that a dependent activity can start as soon as the preceeding ones have completed
  - in reality we will want to divide the project into stages and introduce *checkpoint activities*...

Checkpoint Activities & Milestones

- checking that products are compatible
- just after a checkpoint is a good place to add a *milestone:*
  - a dummy activity with no duration
  - indicates the start or end of a group of activities
  - can represent the completion of an important stage of a project
  - so useful for ensuring that overall monitoring of the project (such as by the project authority) takes place regularly at appropriate points

Step 5: Estimate effort for each activity

- 5.1 Carry out bottom-up estimates
  - staff, time, effort (staff x time), other resources needed

- 5.2 Revise plan to create controllable activities
  - long activities (say 12 weeks) make a project difficult to control
    - after 6 weeks are we 50% complete?
    - can be hard to tell
  - better to break down into smaller subtasks
  - conversely, some very short, connected activities might be better bundled together, with a simple checklist
  - roughly aim for activities to match the length of the reporting period
    - if you have progress meetings every 2 weeks, try to identify activities which take two weeks

Step 6: Identify activity risks

- 6.1 Identify and quantify activity-based risks
  - look at the assumptions in the plan, such as:
    - time required
    - availability of staff/resources
  - these generate uncertainty
    - simple way to handle:
      - create a most likely estimate for time/effort
      - create a second estimate with a safety margin such that the target has a 95% chance of being met
  - look at the damage that could be caused by a risk
    - pick out the most important ones

Step 6: Identify activity risks

- 6.2 Plan risk reduction and contingency measures where appropriate
  - reduce where possible
  - otherwise specify a *contingency plan*
    - for example: contract temporary developer if team member becomes unavailable through illness

- 6.3 Adjust overall plans and estimates to take account of risks
  - including adding new activities - such as training and practice - if need be

Step 7: Allocate Resources

- 7.1 Identify and allocate resources
  - what type of staff is needed for activity?
  - who is (provisionally) available when required?

- 7.2 Revise plans and estimates to take into account resource constraints
  - where there is conflict establish an order of priority
  - note effects upon project duration
  - a *GANNT* chart can help resolve conflict and maximise productivity...

GANNT Chart

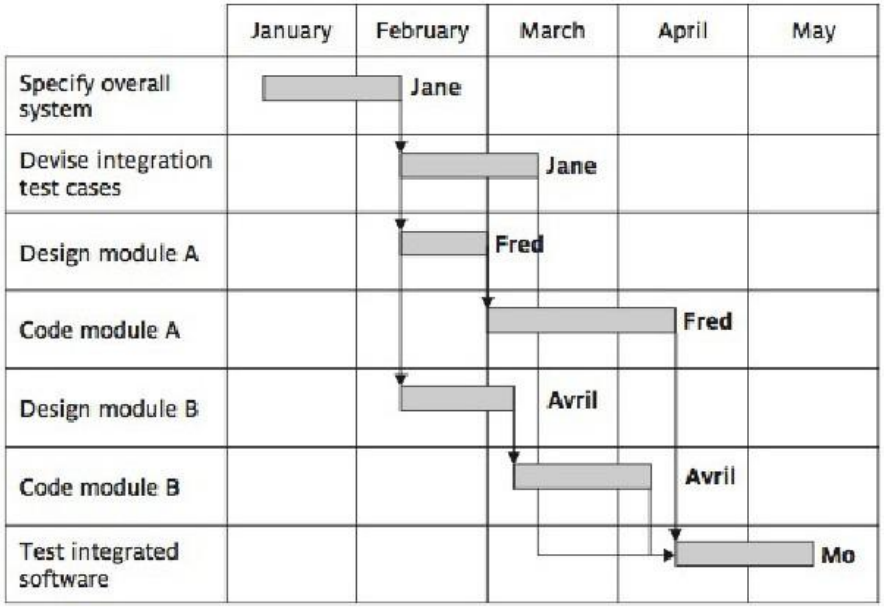


fig3.6 Ch 3 *Software Project Management (5th Edition, 2009) Hughes & Cotterell*

Step 8: Review/Publicise plan

- 8.1 Review quality aspects of the project plan
  - sometimes undertaking one activity can reveal that an earlier activity was not properly completed:
    - will have to be reworked
    - will require effort and resources
    - can lead to loss of control of project
  - need to be sure that a completed task is truly completed
    - need *quality criteria* for each task
      - tick off when complete
        - the list from step 1.1 will help form these

Step 8: Review/Publicise plan

- 8.2 Document plans and obtain agreement
  - make sure everyone understands and agrees
  - specify this task in a *communications plan* if need be (as mentioned in step 1.5)

Steps 9 and 10: Execute Plan / Lower Levels of Planning

- during the project draw up plans for activities in greater detail as they become due
  - detail has to wait as more information becomes available
  - especially if you are using an iterative development approach
  - maintain provisional plans for more important later tasks
  - planning in great detail too soon could be a waste of time

To conclude

- planning a project properly is almost a project in itself
  - the Step Wise method is one good approach
- documenting the plan is important:
  - the activities
  - the products
  - the schedule
  - the measures of quality
  - the lines of communication
  - the procedures/standards which must be met
- this is a vast topic and wider reading for those interested is recommended

References

- Hughes, B., and Cotterell, M. (1999) *Software Project Management*, 2nd edition, McGraw-Hill.
- PMBOK, 6TH Edition
- Pfleeger, S.L. (1998) *Software Engineering: Theory and Practice*, Prentice Hall.

Next … Project Scope Management

Chapter - 3

Project Time Management

LEARNING OBJECTIVES

After reading this chapter, you will be able to:

- Understand the importance of project schedules and good project time management
- Define activities as the basis for developing project schedules
- Describe how project managers use network diagrams and dependencies to assist in activity sequencing
- Understand the relationship between estimating resources and project schedules
- Explain how various tools and techniques help project managers perform activity duration estimating
- Use a Gantt chart for planning and tracking schedule information, find the critical path for a project, and describe how critical chain scheduling and the Program Evaluation and Review Technique (PERT) affect schedule development
- Discuss how reality checks and discipline are involved in controlling and managing changes to the project schedule
- Describe how project management software can assist in project time management and review words of caution before using this software

Project Scheduling

- Project Scheduling in a project refers to **roadmap of all activities** to be done with specified order and within time slot allotted to each activity.
- Project managers tend to define various tasks, and project milestones and arrange them keeping various factors in mind.
- They look for **tasks lie in critical path in the schedule**, which are necessary to complete in specific manner (because of task interdependency) and strictly within the time allocated.
- Arrangement of tasks which lies **out** of critical path are **less likely to impact** over all schedule of the project.

Cont'd

✓ **For scheduling a project, it is necessary to -**

- Break down the project tasks into smaller, manageable form
- Find out various tasks and correlate them
- Estimate time frame required for each task
- Divide time into work-units
- Assign adequate number of work-units for each task
- Calculate total time required for the project from start to finish

Importance of Project Schedules

- Managers often cite delivering projects on time as one of their biggest challenges
- Average time overrun from 1995 CHAOS report was 222%; improved to 163% in 2001 study
- Time has the least amount of flexibility; it passes no matter what
- Schedule issues are the main reason for conflicts on projects, especially during the second half of projects

Project Time Management Processes

- Recall the triple constraint of project management balancing scope, time, and cost goals and note the order of these items.
- Ideally, the project team and key stakeholders first define the project scope, then the time or schedule for the project, and then the project cost.
- There are **six** main processes involved in project time management:

Cont'd

1. ***Defining activities*** involves identifying the specific activities that the project team members and stakeholders must perform to produce the project deliverables. An **activity** or **task** is an element of work normally found on the work breakdown structure (WBS) that has an expected duration, a cost, and resource requirements. The main outputs of this process are an activity list,
activity attributes, and milestone list.
2. ***Sequencing activities*** involves identifying and documenting the relationships between project activities. The main outputs of this process include project schedule network diagrams and project document updates.

Cont'd

3. Estimating activity resources involves estimating how many **resources** people, equipment, and materials a project team should use to perform project activities. The main outputs of this process are activity resource requirements, a resource breakdown structure, and project document updates.

4. ***Estimating activity durations*** involves estimating the number of work periods that are needed to complete individual activities. Outputs include activity duration estimates and project document updates.

Cont'd

5. ***Developing the schedule*** involves analyzing activity sequences, activity resource estimates, and activity duration estimates to create the project schedule. Outputs include a project schedule, a schedule baseline, schedule data, and project document updates.

6. *Controlling the schedule* involves controlling and managing changes to the project schedule. Outputs include work performance measurements, organizational process assets updates, change requests, project management plan updates, and project document updates.

Defining Activities

- An activity or task is an element of work normally found on the work breakdown structure (WBS) that has an expected duration, a cost, and resource requirements
- Activity definition involves developing a more detailed WBS and supporting explanations to understand all the work to be done so you can develop realistic cost and duration estimates
- Project schedules grow out of the basic documents that initiate a project:
- Project charter includes the start and end dates and budget information
- Scope statement and WBS help define what will be done

Activity Sequencing

- Involves reviewing activities and determining dependencies

- **Mandatory dependencies:** inherent in the nature of the work being performed on a project, sometimes referred to as hard logic
  - Example: write code, then test code
- **Discretionary dependencies:** defined by the project team., sometimes referred to as soft logic and should be used with care since they may limit later scheduling options
  - Example: good practice to get sign-offs *before* performing the work
- **External dependencies:** involve relationships between project and non-project activities
  - Example: tasks dependent of delivery of hardware from an outside vendor
  - **You *must* determine dependencies in order to use critical path analysis**

Project Network Diagrams

- Project network diagrams are the preferred technique for showing activity sequencing
- A project network diagram is a schematic display of the logical relationships among, or sequencing of, project activities

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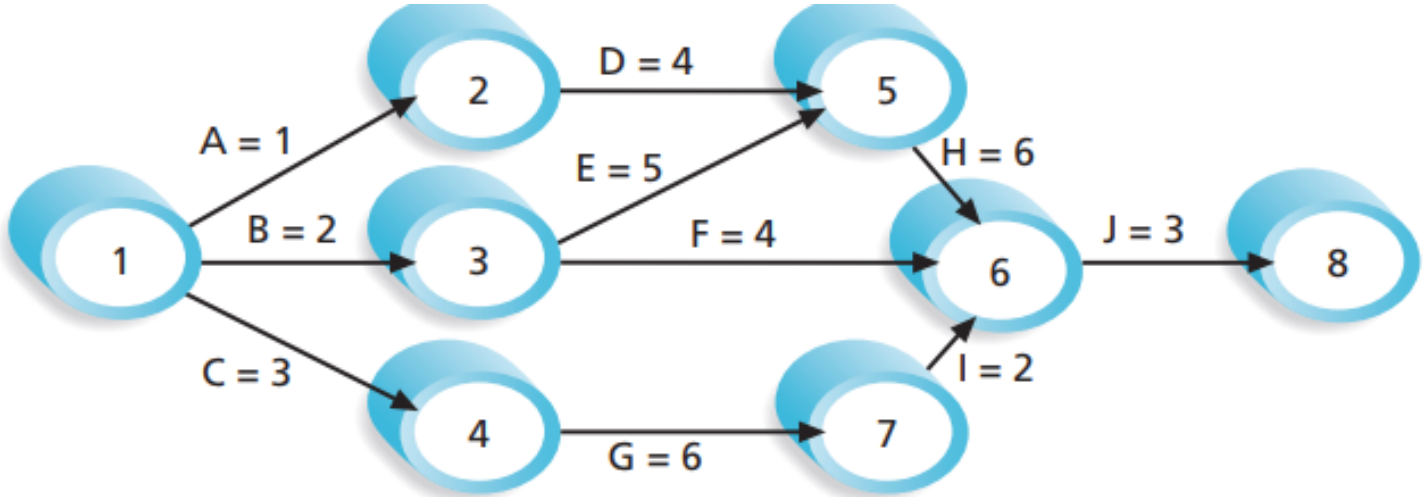


Note: Assume all durations are in days; A=1 means Activity A has a duration of 1 day.

FIGURE 6-2 Activity-on-arrow (AOA) network diagram for Project X

Cont'd

- The format of this network diagram uses the **activity-on-arrow (AOA)** approach or the **arrow diagramming method (ADM)** a network diagramming technique in which activities are represented by **arrows** and connected at points called nodes to illustrate the sequence of activities.
- Can only show finish-to-start dependencies.
- A **node** is simply the starting and ending point of an activity.
- The first node signifies the start of a project, and the last node represents the end of a project.

Process for Creating AOA Diagrams

1. Find all of the activities that start at node 1. Draw their finish nodes and draw arrows between node 1 and those finish nodes. Put the activity letter or name and duration estimate on the associated arrow.
2. Continuing drawing the network diagram, working from left to right. Look for bursts and merges. A **burst** occurs when a single node is followed by two or more activities. A **merge** occurs when two or more nodes precede a single node.
3. Continue drawing the project network diagram until all activities that have dependencies are included in the diagram.
4. As a rule of thumb, all arrowheads should face toward the right, and no arrows should cross in an AOA network diagram.

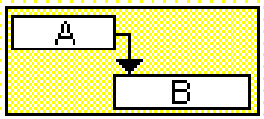
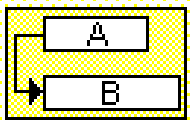
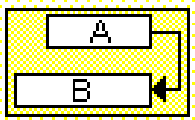
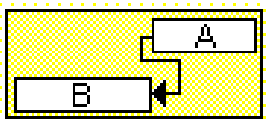
Precedence Diagramming Method (PDM)

- Activities are represented by boxes.
- Arrows show relationships between activities.
- More popular than ADM method and used by project management software.
- Better at showing different types of dependencies.

Figure 6-3 illustrates the types of dependencies that can occur among project activities. After you determine the reason for a dependency between activities (mandatory,

Task dependencies

The nature of the dependencies between linked tasks. You link tasks by defining a dependency between their finish and start dates. For example, the "Contact caterers" task must finish before the start of the "Determine menus" task. There are four kinds of task dependencies in Microsoft Project:

Task dependency	Example	Description
Finish-to-start (FS)		Task (B) cannot start until task (A) finishes.
Start-to-start (SS)		Task (B) cannot start until task (A) starts.
Finish-to-finish (FF)		Task (B) cannot finish until task (A) finishes.
Start-to-finish (SF)		Task (B) cannot finish until task (A) starts.

Cont'd

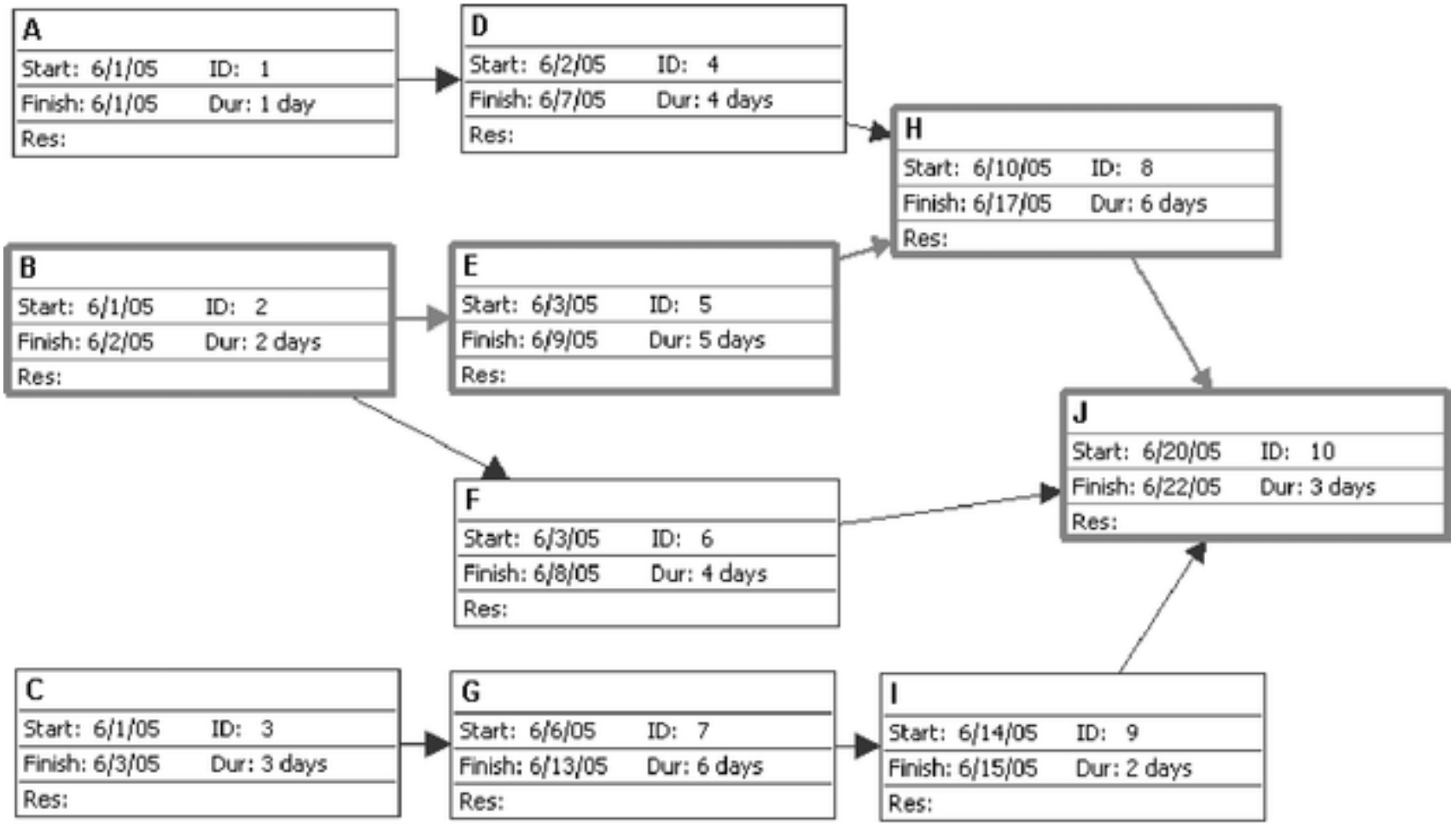
- The **four types of dependencies** or relationships between activities include:

- **Finish-to-start dependency:** a relationship where the "from" activity or predecessor must finish before the "to" activity or successor can start. For example, you cannot provide user training until after software, or a new system, has been installed. Finish-to-start is the most common type of relationship, or dependency, and AOA network diagrams use only finish-to-start dependencies.
- **Start-to-start dependency:** a relationship in which the "from" activity cannot start until the "to" activity or successor is started. For example, on several information technology projects, a group of activities all start simultaneously, such as the many tasks that occur when a new system goes live.

Cont'd

- **Finish-to-finish dependency:** a relationship where the "from" activity must be finished before the "to" activity can be finished. One task cannot finish before another finishes. For example, quality control efforts cannot finish before production finishes, although the two activities can be performed at the same time.
- **Start-to-finish dependency:** a relationship where the "from" activity must start before the "to" activity can be finished. This type of relationship is rarely used, but it is appropriate in some cases. For example, an organization might strive to stock raw materials just in time for the manufacturing process to begin. A delay in the manufacturing process starting should delay completion of stocking the raw materials. Another example would be a babysitter who wants to finish watching a young child but is dependent on the parent arriving. The parent must show up or "start" before the babysitter can finish his or her oversight.

Figure 6-4. Sample PDM Network Diagram



Activity Resource Estimating

- Before estimating activity durations, you must have a good idea of the quantity and type of resources that will be assigned to each activity.
  - **resources** are people, equipment, and materials
- Consider important issues in estimating resources
  - How difficult will it be to do specific activities on this project?
  - Anything unique about the project?
  - What is the organization's history in doing similar activities?
  - Are the required resources available? Level of experience for each person? Can the organization acquire more resources?
- A **resource breakdown structure** is a hierarchical structure that identifies the project's resources by category and type.

Estimating Activity Durations

- **Duration** includes the actual amount of time worked on an activity *plus* the elapsed time.
- **Effort** is the number of workdays or work hours required to complete a task.
- Effort does not normally equal duration.
- People doing the work should help create estimates, and an expert should review them.

Cont'd

- Instead of providing activity estimates as a discrete number, such as four weeks, it's often helpful to create a **three-point estimate**
  - an estimate that includes an **optimistic**, **most likely**, and **pessimistic** estimate, such as three weeks for the optimistic, four weeks for the most likely, and five weeks for the pessimistic estimate

Cont'd

- The **optimistic** estimate is based on a **best-case scenario**, while
- the **pessimistic** estimate is based on a **worst-case scenario**.
- The **most likely** estimate, as it sounds, is an estimate based on a most likely or **expected** scenario.
- Three-point estimates are needed for PERT and Monte Carlo simulations

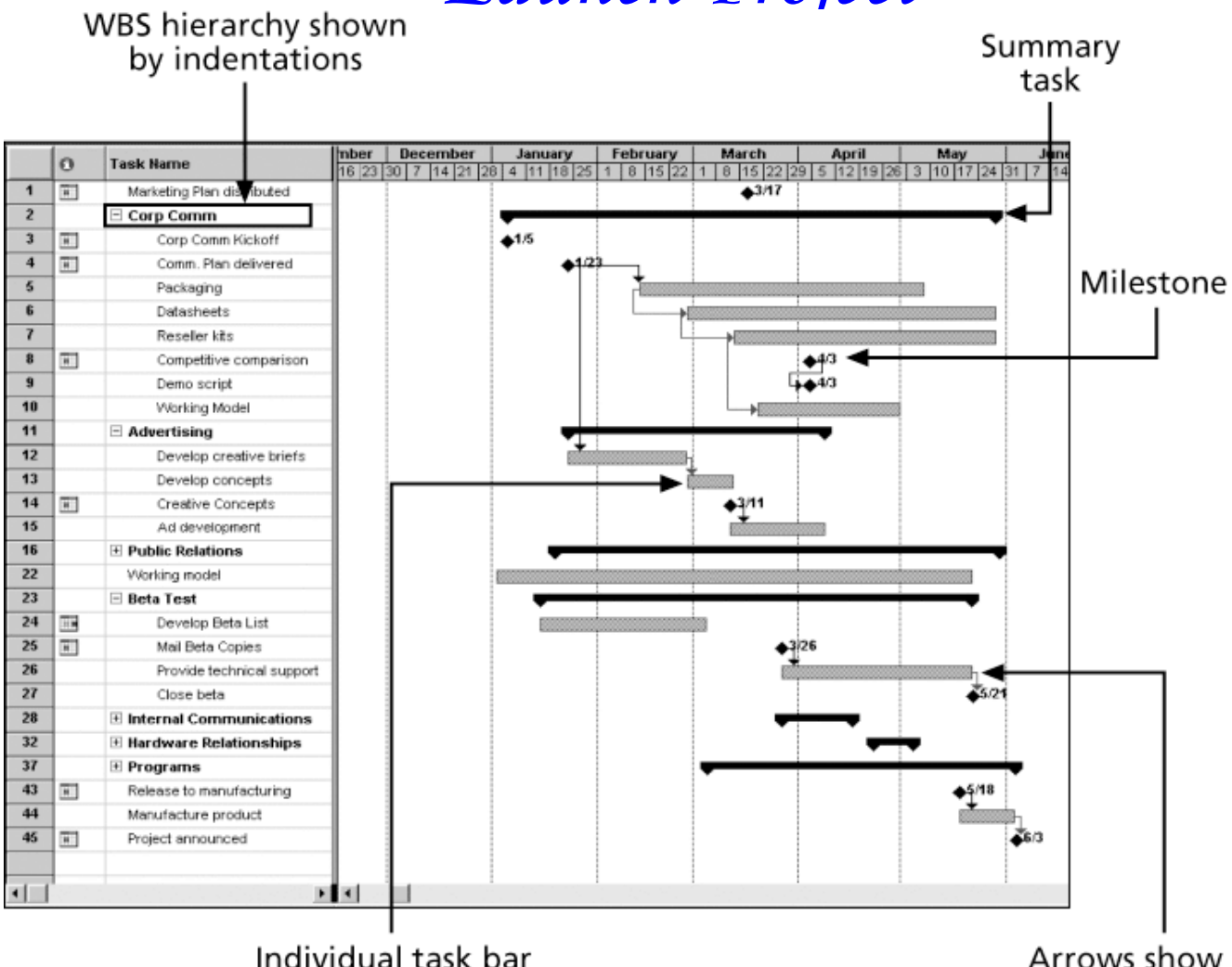
Developing the Schedule

- Uses results of the other time management processes to determine the start and end date of the project
- Ultimate goal is to create a <u>realistic</u> project schedule that provides a basis for monitoring project progress for the time dimension of the project
- **Important tools and techniques**:
  - Gantt charts
  - Critical path analysis
  - Critical chain scheduling
  - PERT analysis

Gantt charts

- **Gantt charts** provide a standard format for displaying project schedule information by listing project activities and their corresponding start and finish dates in a calendar format
- Symbols include:
  - A black diamond: a milestones
  - Thick black bars: summary tasks
  - Lighter horizontal bars: durations of tasks
  - Arrows: dependencies between tasks

Figure 6-6. Gantt Chart for Software Launch Project



Adding Milestones to Gantt Charts

- Many people like to focus on meeting milestones, especially for large projects
- Milestones emphasize important events or accomplishments on projects
- Normally create milestone by entering tasks with a zero duration, or you can mark any task as a milestone

Cont'd

- To make milestones meaningful, some people use the SMART criteria to help define them.
  - The **SMART criteria** are guidelines suggesting that milestones should be:
    Specific
  - **M**easurable
  - **A**ssignable
  - **R**ealistic
  - **T**ime-framed

Cont'd

- For example, **distributing a marketing plan** is specific, measurable, and assignable if everyone knows what should be in the marketing plan, how it should be distributed, how many copies should be distributed and to whom, and who is responsible for the actual delivery.
- Distributing the marketing plan is realistic and able to be time-framed **if it is an achievable event and scheduled at an appropriate time.**

Best Practice

- Schedule risk is inherent in the development of complex systems. Luc Richard, the founder of www.projectmangler.com, suggests that project managers can reduce schedule risk through project milestones, a best practice that involves identifying and tracking significant points or achievements in the project. The five key points of using project milestones include the following:
  1. Define milestones early in the project and include them in the Gantt chart to provide a visual guide
  2. Keep milestones small and frequent
  3. The set of milestones must be all-encompassing
  4. Each milestone must be binary, meaning it is either complete or incomplete.
  5. Carefully monitor the critical path

Figure 6-7 shows a Tracking Gantt chart

- **Tracking Gantt chart** a Gantt chart that compares planned and actual project schedule information.
- The planned schedule dates for activities are called the **baseline dates**, and the entire approved planned schedule is called the **schedule baseline**.
- The Tracking Gantt chart includes columns (hidden in Figure 6-7) labeled Start and Finish to represent actual start and finish dates for each task, as well as columns labeled Baseline Start and Baseline Finish to represent planned start and finish dates for each task. In this example, the project is completed, but several tasks missed their planned start and finish dates

Figure 6-7 shows a Tracking Gantt chart

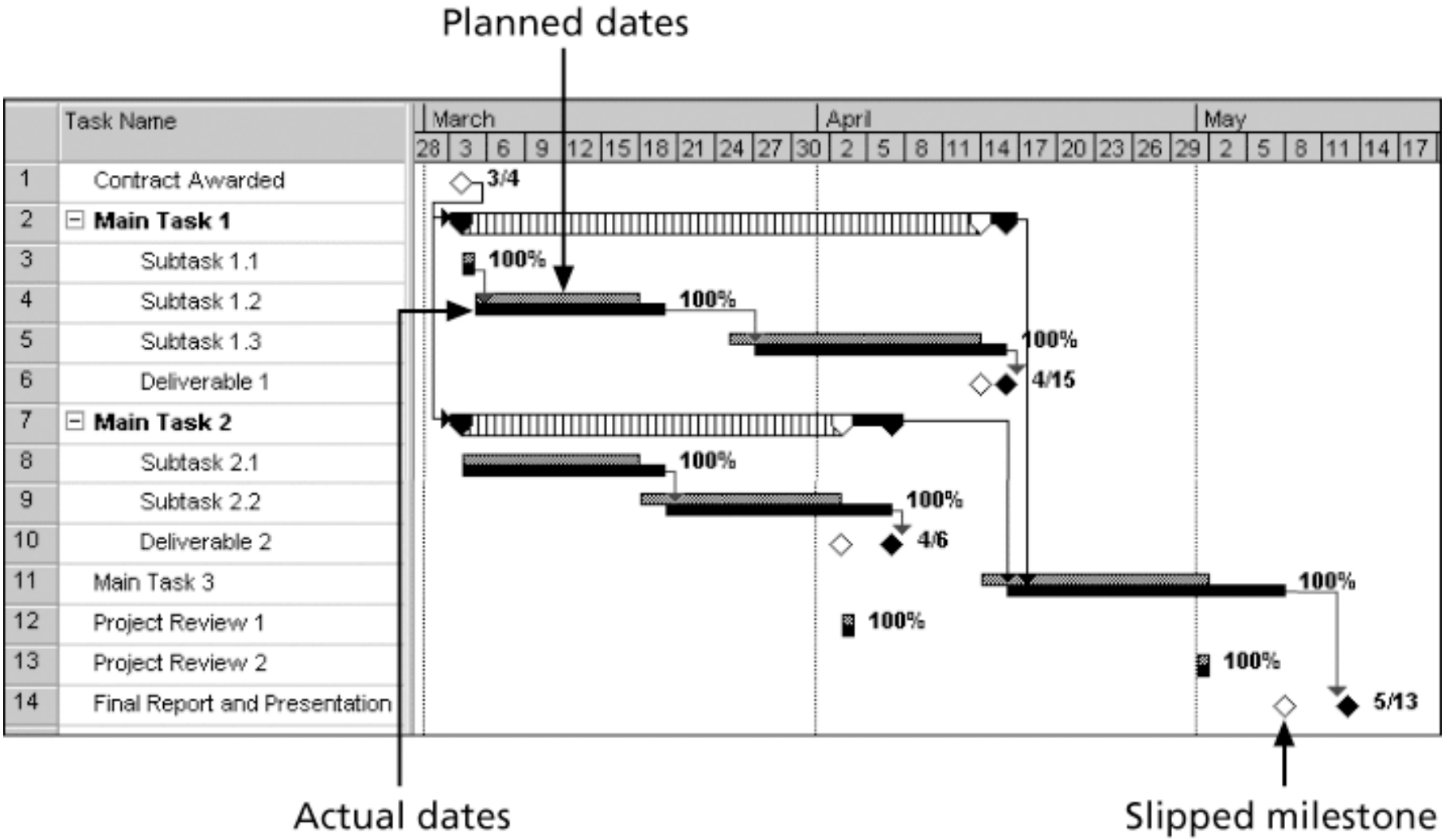


Figure 6-7 shows a Tracking Gantt chart

- Notice that the Gantt chart in Figure 6-7 often shows two horizontal bars for tasks. The top horizontal bar represents the planned or baseline duration for each task. The bar below it represents the actual duration. Subtasks 1.2 and 1.3 illustrate this type of display.
- A white diamond on the Tracking Gantt chart represents a **slipped milestone**. A slipped milestone means the milestone activity was actually completed later than originally planned. For example, the last task provides an example of a slipped milestone since the final report and presentation were completed later than planned. Percentages to the right of the horizontal bars display the percentage of work completed for each task. For example, 100 percent means the task is finished, 50 percent means the task is still in progress and is 50 percent completed.

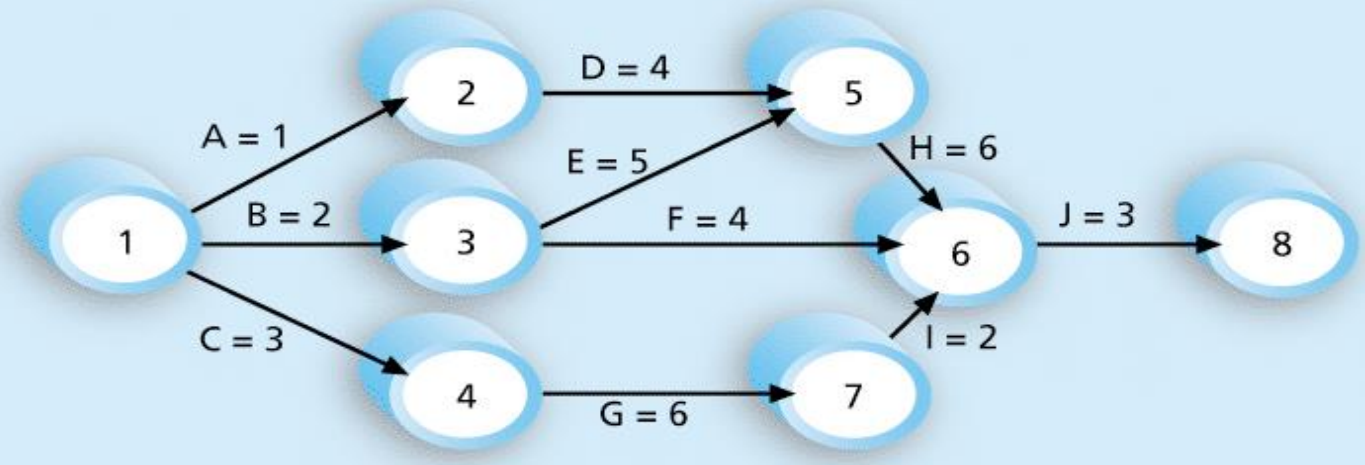
Critical Path Method (CPM)

- **CPM** is a network diagramming technique used to predict total project duration
- A **critical path** for a project is the series of activities that determines the ***earliest time*** by which the project can be completed
- The critical path is the ***longest path*** through the network diagram and has the least amount of slack or float
- **Slack** or **float** is the amount of time an activity may be delayed without delaying a succeeding activity or the project finish date

Calculating the Critical Path

- First develop a good network diagram
- Add the duration estimates for all activities on each path through the network diagram
- The **longest path is the critical path**
- If one or more of the activities on the critical path takes longer than planned, the whole project schedule will slip *unless* the project manager takes corrective action

Figure 6-8. Determining the Critical Path for Project X



Note: Assume all durations are in days.

Path 1:	A-D-H-J	Length = 1+4+6+3 = 14 days
Path 2:	B-E-H-J	Length = 2+5+6+3 = 16 days
Path 3:	B-F-J	Length = 2+4+3 = 9 days
Path 4:	C-G-I-J	Length = 3+6+2+3 = 14 days

Since the critical path is the longest path through the network diagram, Path 2, B-E-H-J, is the critical path for Project X.

Using Critical Path Analysis to Make Schedule Trade-offs

- **Free slack** or **free float** is the amount of time an activity can be delayed without delaying the early start of any immediately following activities
- **Total slack** or **total float** is the amount of time an activity may be delayed from its early start without delaying the planned project finish date
- A **forward pass** through the network diagram determines the early start and finish dates
- A **backward pass** determines the late start and finish dates

Scheduling with activity time

Activity	Immediate predecessors	Completion Time (week)
A	-	5
B	-	6
C	A	4
D	A	3
E	A	1
F	E	4
G	D,F	14
H	B,C	12
I	G,H	2
	Total ……	51

This information indicates that the total time required to complete activities is 51 weeks. However, we can see from the network that several of the activities can be conducted simultaneously (A and B, for example).

Earliest start & earliest finish time

- We are interested in the longest path through the network, i.e., the critical path.

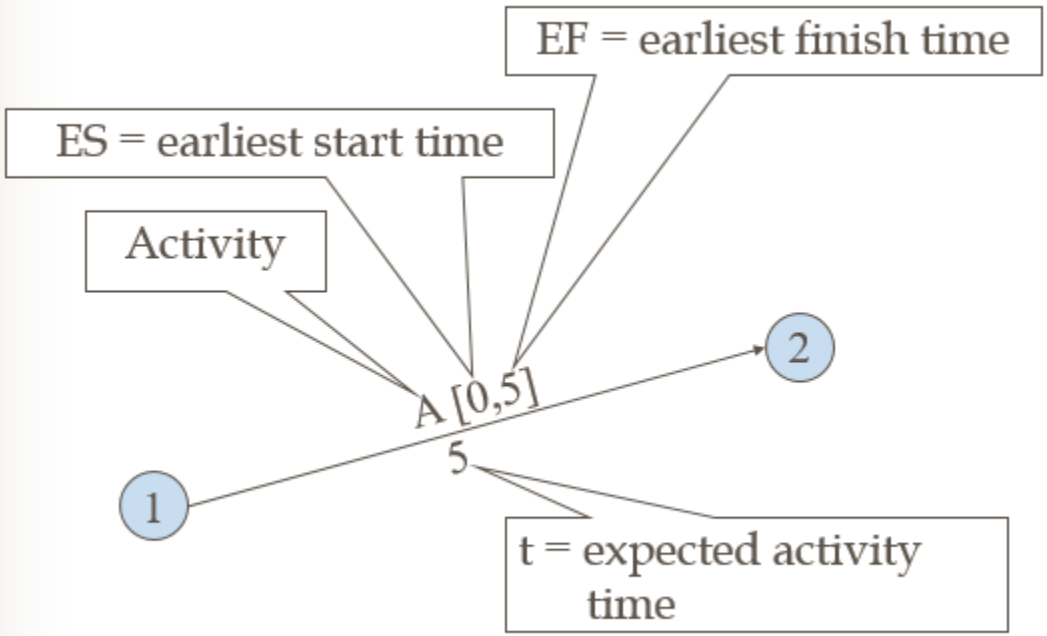
- Starting at the network's origin (node 1) and using a starting time of 0, we compute an ***earliest start*** (ES) and ***earliest finish*** (EF) time for each activity in the network.

- The expression EF = ES + t can be used to find the earliest finish time for a given activity.

  For example, for activity A, ES = 0 and t = 5; thus the earliest finish time for activity A is

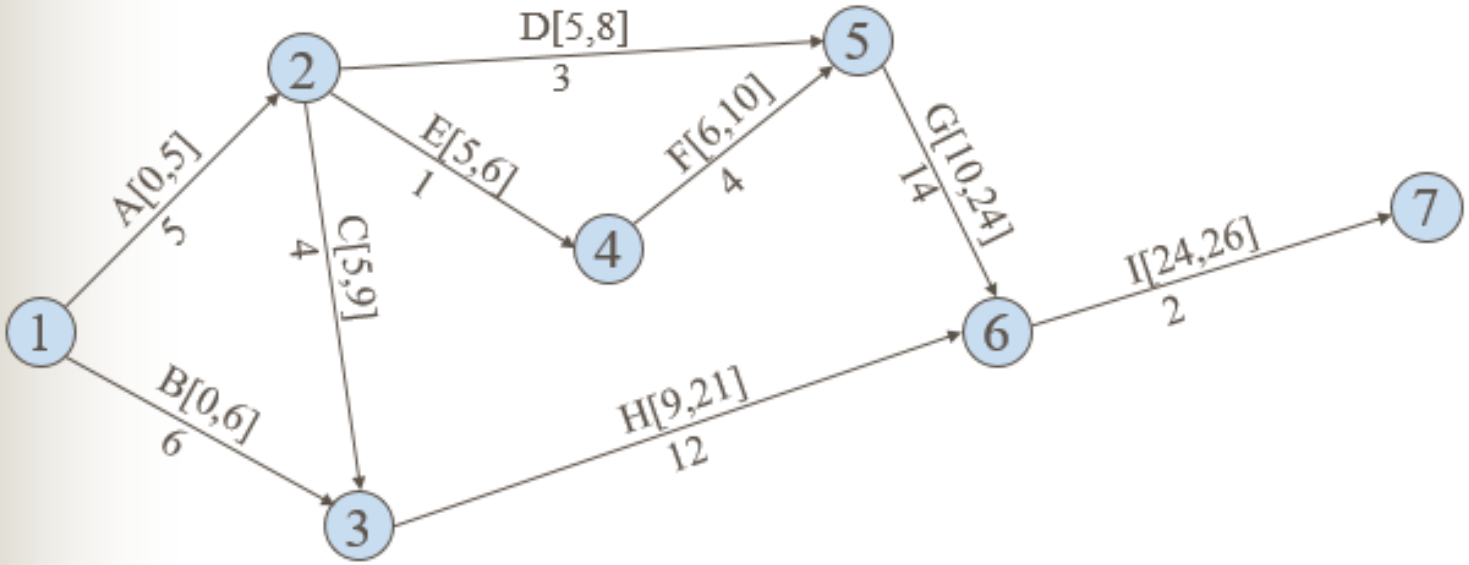
$$EF = 0 + 5 = 5$$

Cont'd


EF = earliest finish time
ES = earliest start time
Activity
2
A [0,5]
5
1
t = expected activity time

Cont'd

Network with ES & EF time

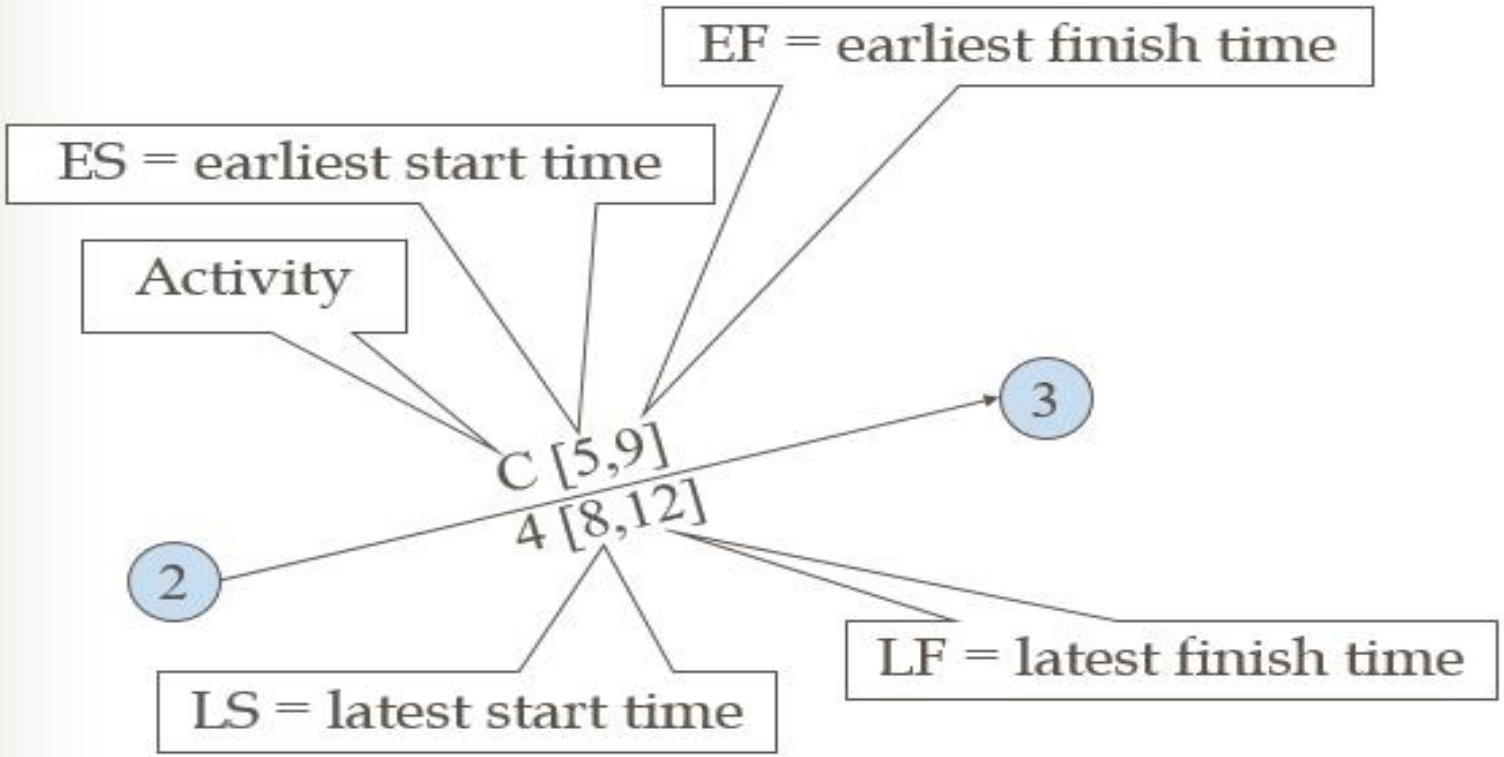


Earliest start time rule:

The earliest start time for an activity leaving a particular node is equal to the **largest** of the earliest finish times for all activities entering the node.

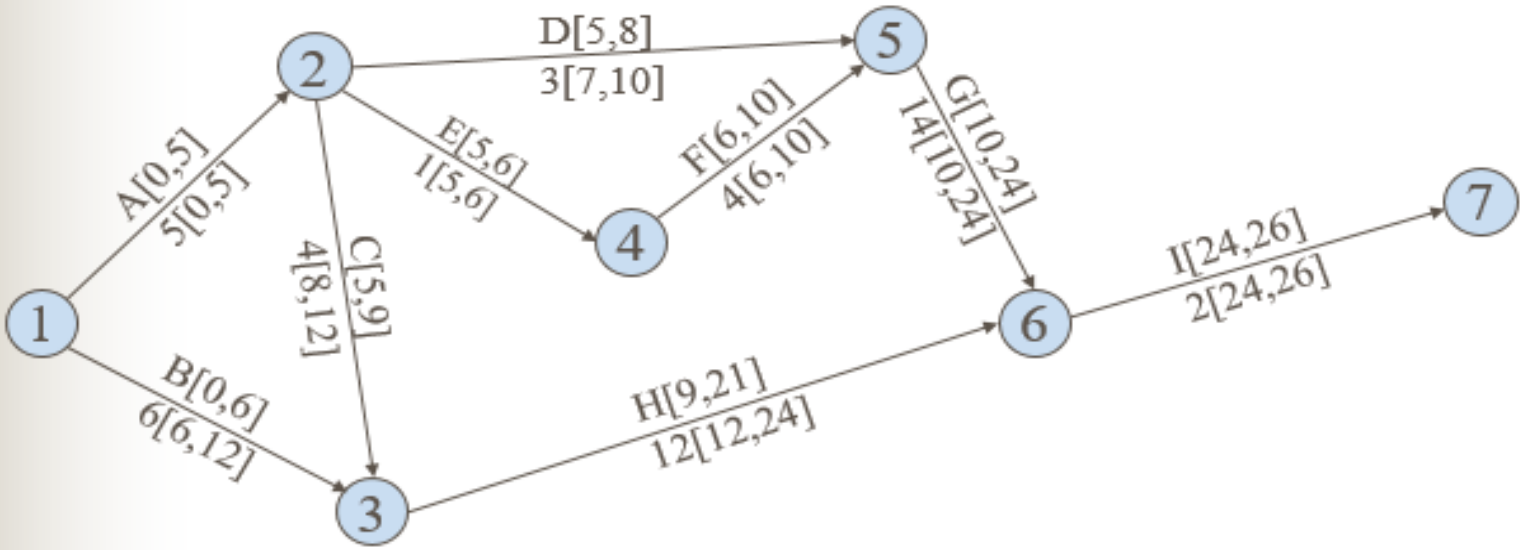
Cont'd

Activity, duration, ES, EF, LS, LF



Cont'd

Network with LS & LF time



<u>Latest finish time rule</u>:

The latest finish time for an activity entering a particular node is equal to the **smallest** of the latest start times for all activities leaving the node.

Latest start & latest finish time

- To find the critical path we need a backward pass calculation.
- Starting at the completion point (node 7) and using a ***latest finish*** time (LF) of 26 for activity I, we trace back through the network computing a ***latest start*** (LS) and latest finish time for each activity
- The expression **LS = LF – t** can be used to calculate latest start time for each activity. For example, for activity I, LF = 26 and t = 2, thus the latest start time for activity I is

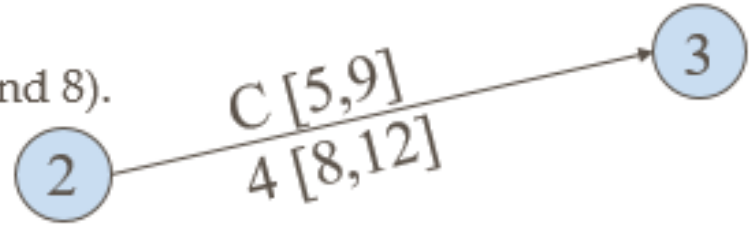
$$LS = 26 - 2 = 24$$

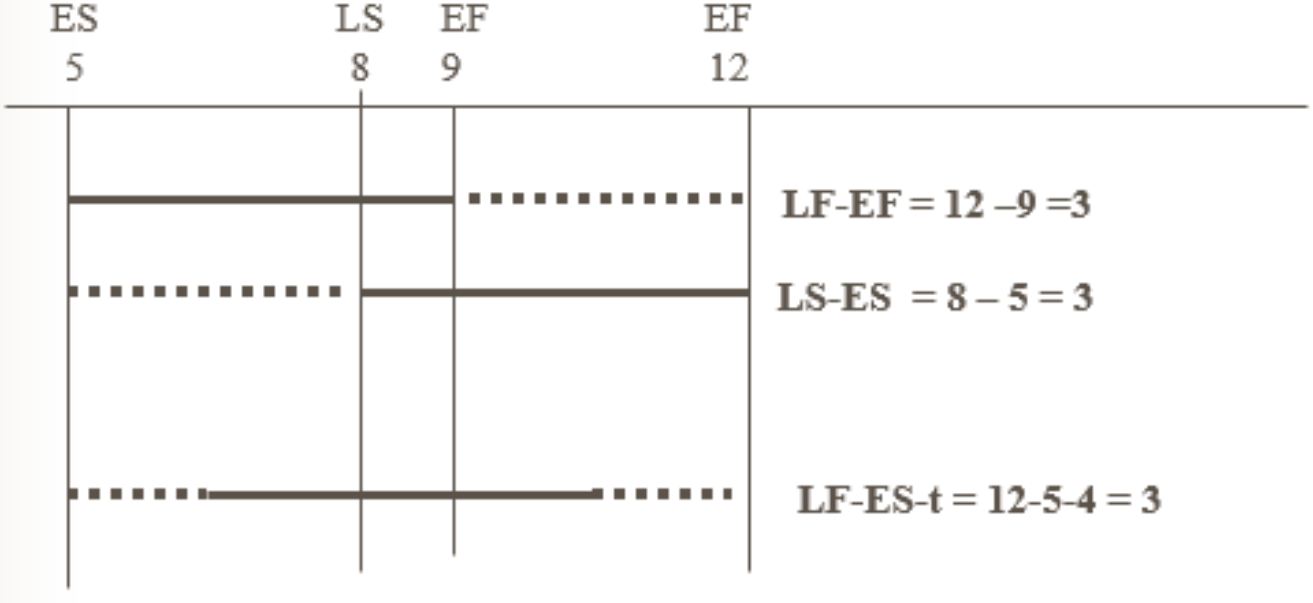
Slack or Free Time or Float

Slack is the length of time an activity can be delayed without affecting the completion date for the entire project.

For example, slack for C = 3 weeks, i.e Activity C can be delayed up to 3 weeks

(start anywhere between weeks 5 and 8).





Activity schedule for our example

Activity	Earliest start (ES)	Latest start (LS)	Earliest finish (EF)	Latest finish (LF)	Slack (LS-ES)	Critical path
A	0	0	5	5	0	Yes
B	0	6	6	12	6	
C	5	8	9	12	3	
D	5	7	8	10	2	
E	5	5	6	6	0	Yes
F	6	6	10	10	0	Yes
G	10	10	24	24	0	Yes
H	9	12	21	24	3	
I	24	24	26	26	0	Yes

IMPORTANT QUESTIONS

- **What is the total time to complete the project?**
  - 26 weeks if the individual activities are completed on schedule.

- **What are the scheduled start and completion times for each activity?**
  - ES, EF, LS, LF are given for each activity.

- **What activities are *critical* and must be completed as scheduled in order to keep the project on time?**
  - Critical path activities: A, E, F, G, and I.

- **How long can *non-critical* activities be delayed before they cause a delay in the project's completion time**
  - Slack time available for all activities are given.

Figure 6-9. Calculating Early and Late Start and Finish Dates

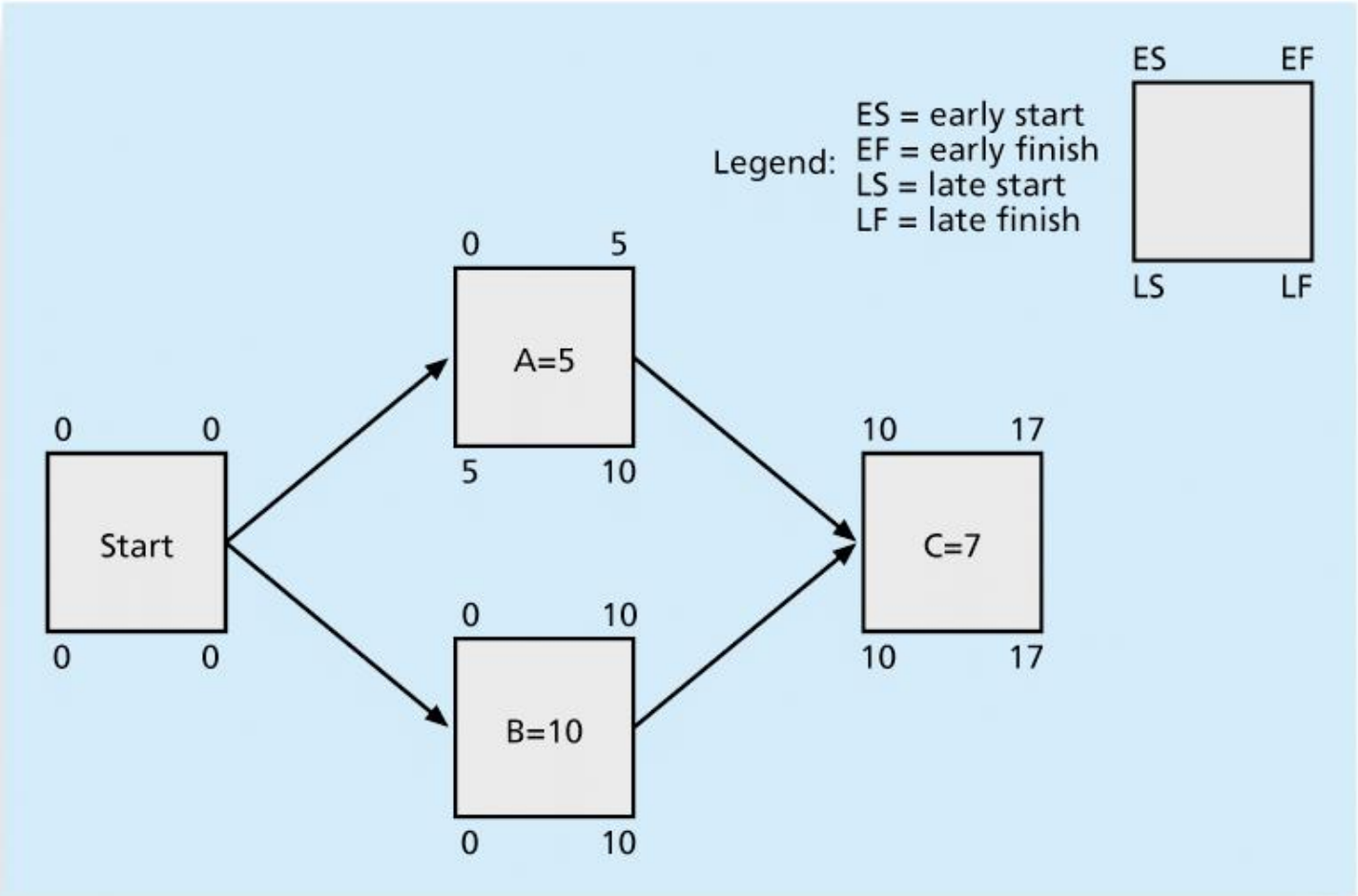
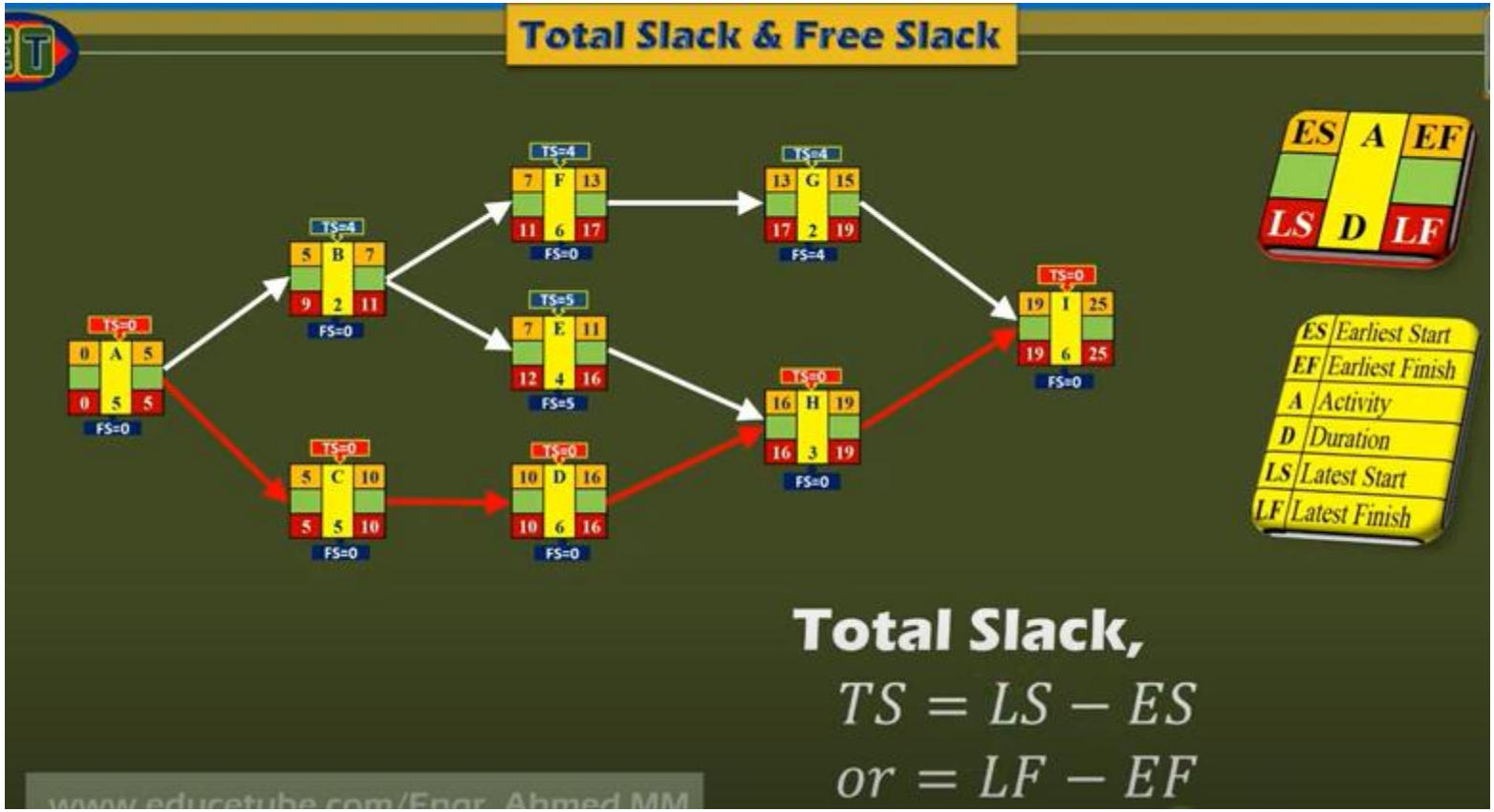


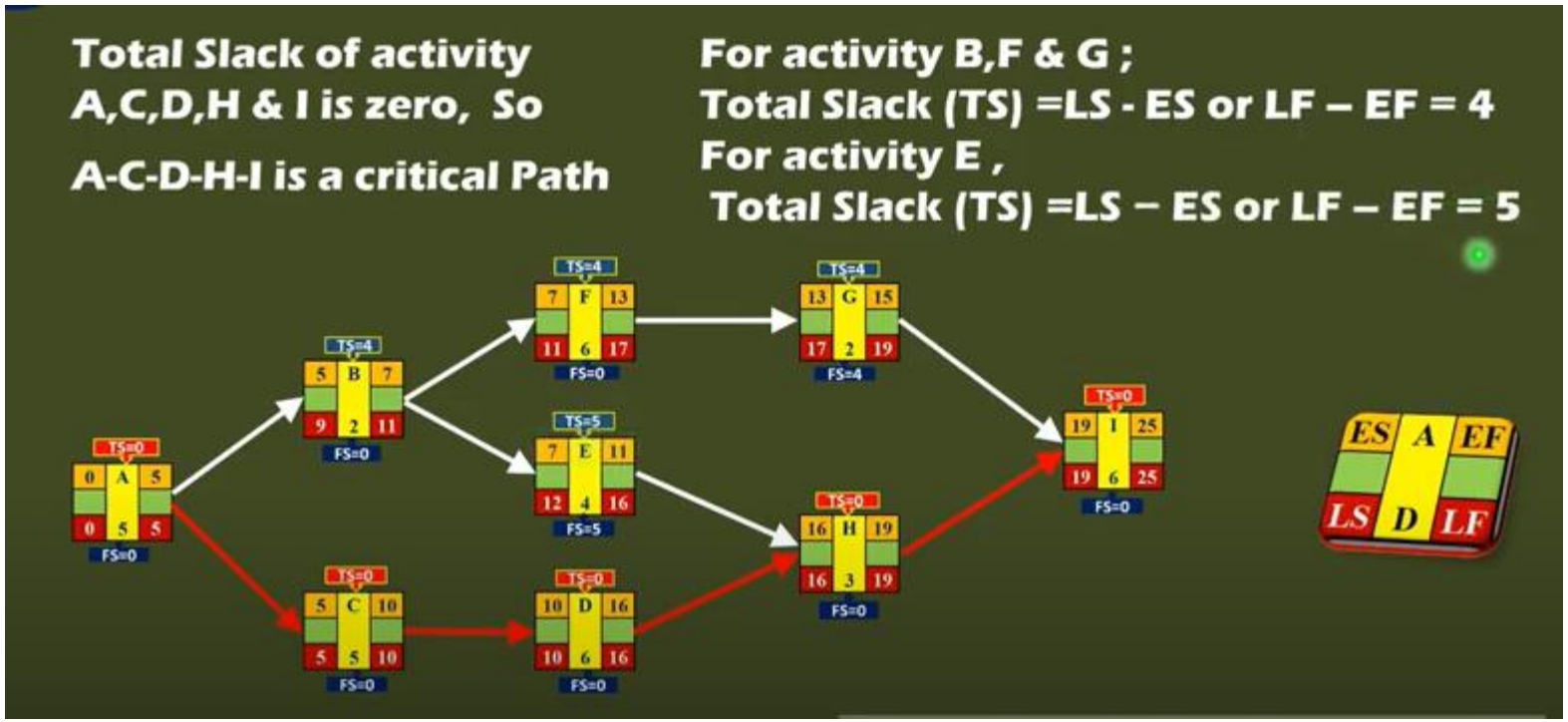
Table 6-1. Free and Total Float or Slack for Project X

Task Name	Start	Finish	Late Start	Late Finish	Free Slack	Total Slack
A	8/3/09	8/3/09	8/5/09	8/5/09	0d	2d
B	8/3/09	8/4/09	8/3/09	8/4/09	0d	0d
C	8/3/09	8/5/09	8/5/09	8/7/09	0d	2d
D	8/4/09	8/7/09	8/6/09	8/11/09	2d	2d
E	8/5/09	8/11/09	8/5/09	8/11/09	0d	0d
F	8/5/09	8/10/09	8/14/09	8/17/09	7d	7d
G	8/6/09	8/13/09	8/10/09	8/17/09	0d	2d
H	8/12/09	8/19/09	8/12/09	8/19/09	0d	0d
I	8/14/09	8/17/09	8/18/09	8/19/09	2d	2d
J	8/20/09	8/24/09	8/20/09	8/24/09	0d	0d

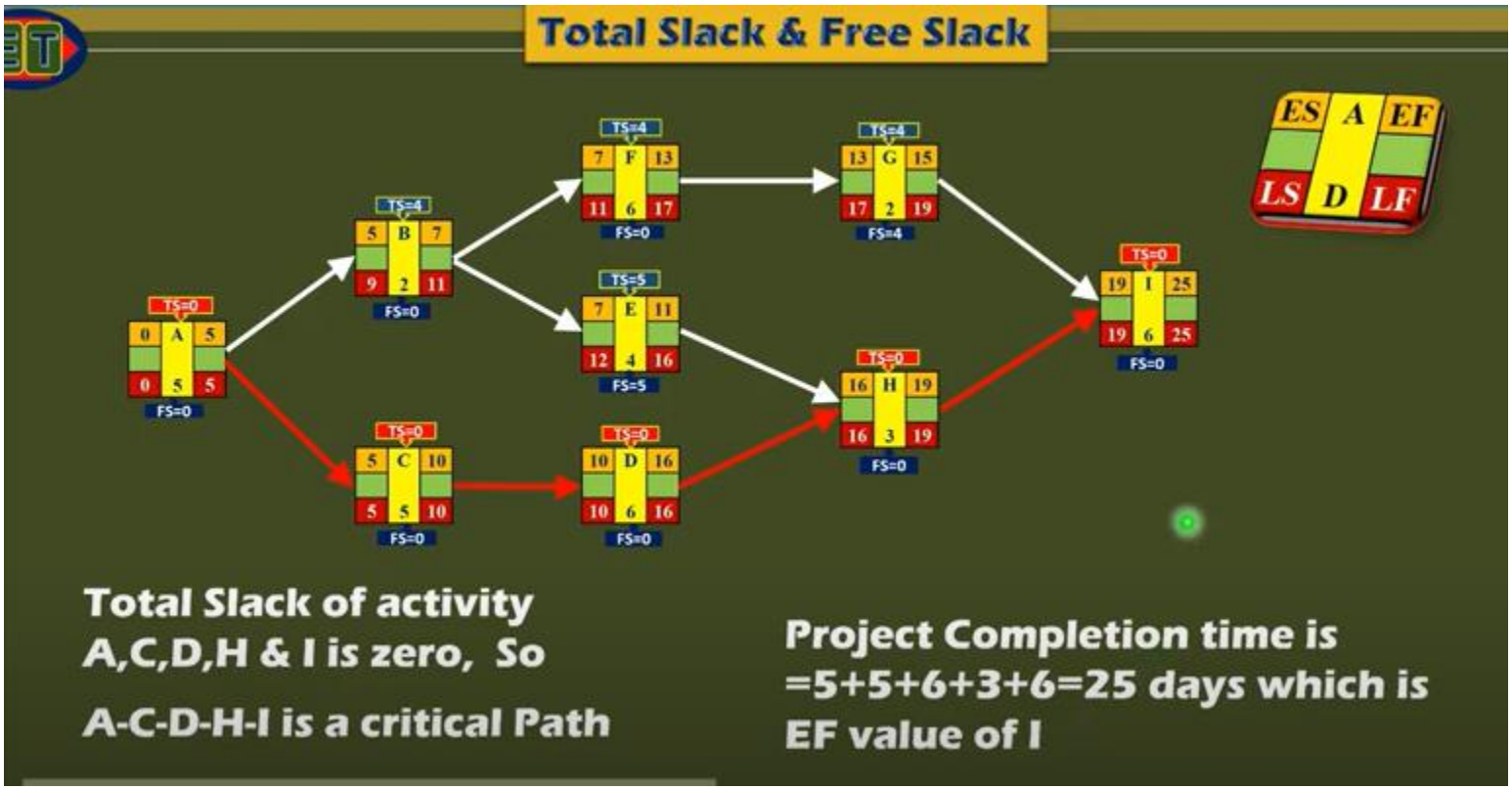
Additional example to calculate free slack and total slack



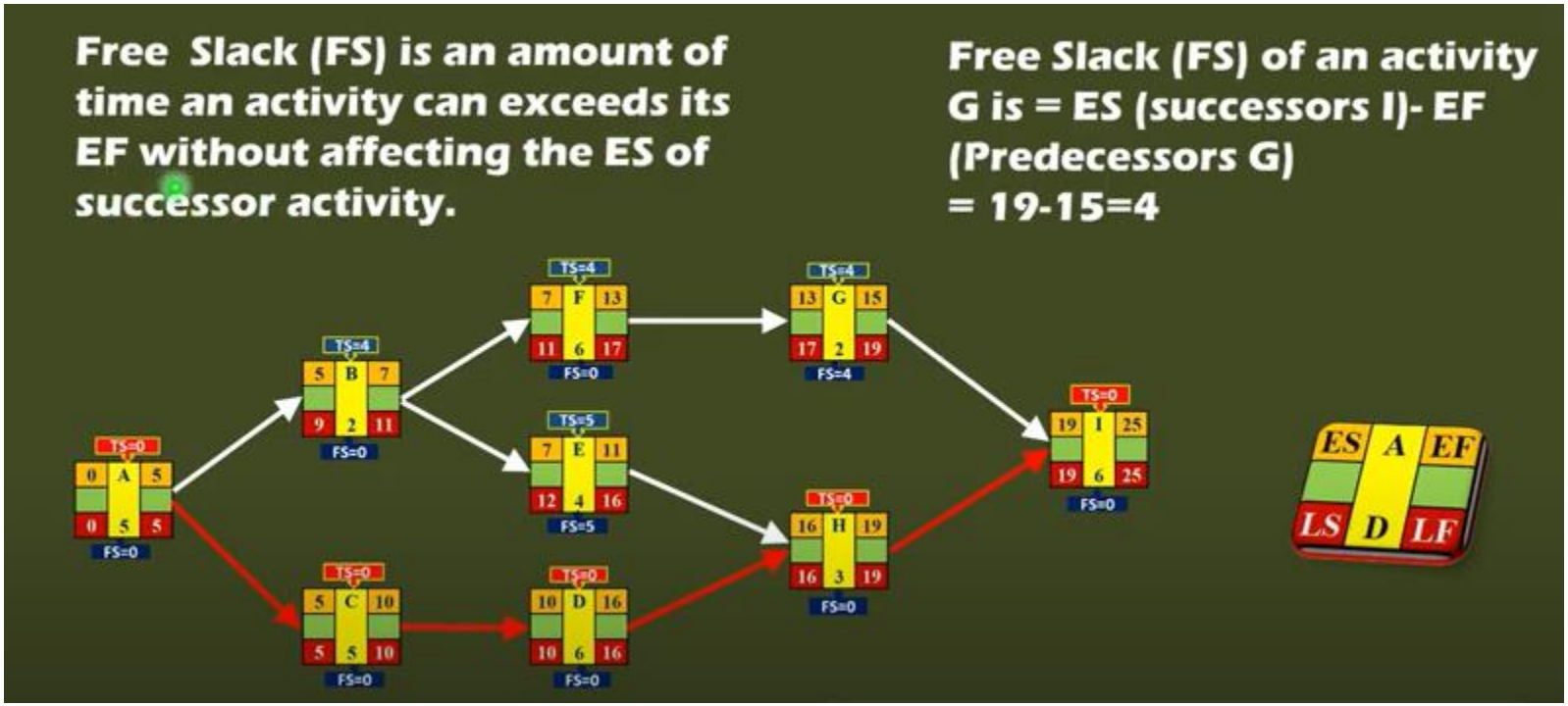
Additional example to calculate free slack and total slack



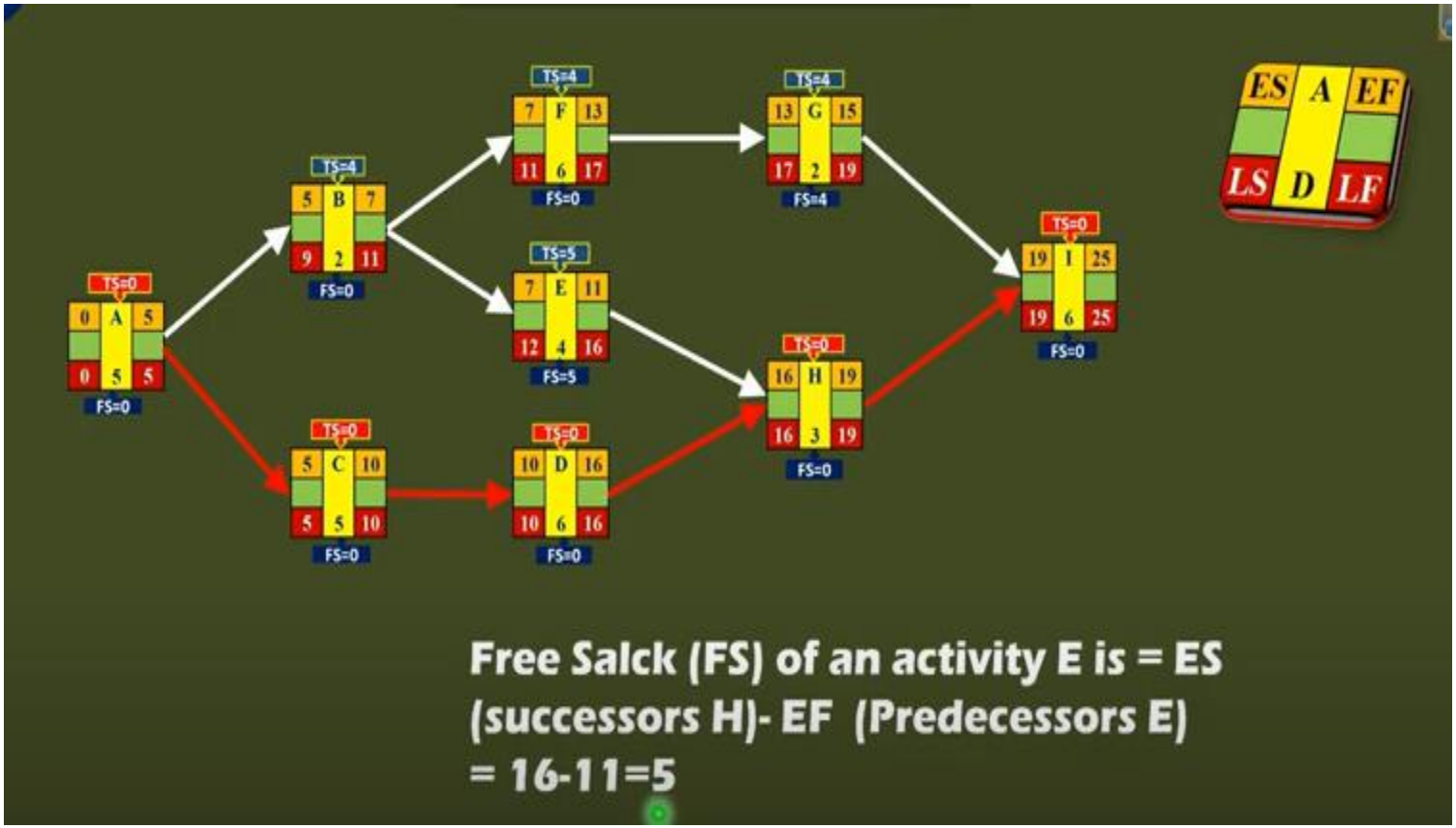
Additional example to calculate free slack and total slack



Additional example to calculate free slack and total slack



Additional example to calculate free slack and total slack



Importance of Float (Slack) and Critical Path

1. Slack or Float shows how much allowance each activity has, i.e how long it can be delayed without affecting completion date of project

2. Critical path is a sequence of activities from start to finish with zero slack. Critical activities are activities on the critical path.

3. Critical path identifies the minimum time to complete project

4. If any activity on the critical path is shortened or extended, project time will be shortened or extended accordingly

Importance of Float (Slack) and Critical Path

5. So, a lot of effort should be put in trying to control activities along this path, so that project can meet due date. If any activity is lengthened, be aware that project will not meet deadline and some action needs to be taken.

6. If can spend resources to speed up some activity, do so only for critical activities.

7. Don't waste resources on non-critical activity, it will not shorten the project time.

8. If resources can be saved by lengthening some activities, do so for non-critical activities, up to limit of float.

9. Total Float belongs to the path

Using the Critical Path to Shorten a Project Schedule

- Three main techniques for shortening schedules
  - Shortening durations of critical activities/tasks by **adding more resources** or changing their scope

1. Crashing activities by obtaining the greatest amount of schedule compression for the least incremental cost

- Results: shortens time, but increases costs

2. Fast tracking activities by doing them in parallel or overlapping them

- Disadvantage can end up lengthening the project due to the increased risks and sometimes results in rework

Cont'd

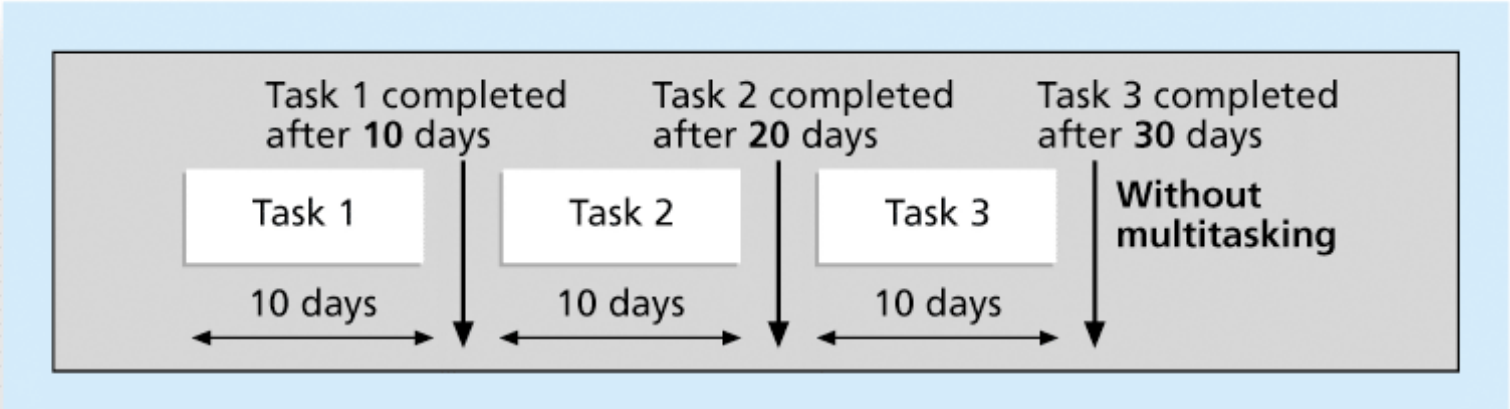
- *Importance of Updating Critical Path DataImportance of Updating Critical Path Data*

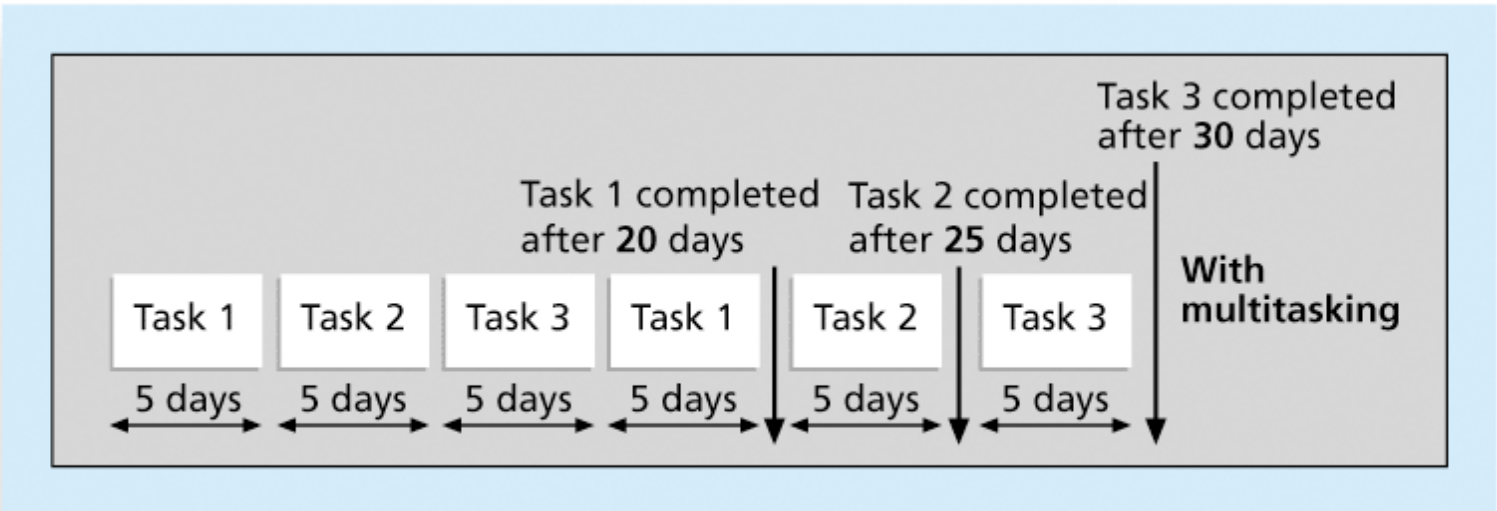
- It is important to update project schedule information to meet time goals for a project
- The critical path may change as you enter actual start and finish dates
- If you know the project completion date will slip, **negotiate** with the project sponsor
  - Ask for more time
  - Ask for more resources/money to stay on track
  - Ask to reduce scope

cont'd

- **3. Critical chain scheduling**
  - A method of scheduling that considers **limited resources** when creating a project schedule and includes buffers to protect the project completion date
- Uses the **Theory of Constraints (TOC)**
  - A management philosophy developed by Eliyahu M. Goldratt and introduced in his book *The Goal*
- Attempts to minimize **multitasking**
  - When a resource works on more than one task at a time
  - Due to the nature of starting/stopping tasks it may take even longer
  - See chart on next page
- Uses limited time buffers

Figures 6-10.a and b. Multitasking Example





Cont'd

➢ *Buffers and Critical Chain*

- A **buffer** is additional time to complete a task
- **Murphy's Law** states that if something can go wrong, it will
- **Parkinson's Law** states that work expands to fill the time allowed
- In traditional estimates, people often add a buffer to each task and use it if it's needed or not
- Critical chain scheduling removes buffers from individual tasks and instead creates
  - a **project buffer** or additional time added before the project's due date
  - **feeding buffers** or additional time added before tasks on the critical path

Program Evaluation and Review Technique (PERT) For Dealing With Uncertainty

- So far, times can be estimated with relative certainty, confidence

- For many situations this is not possible, e.g Research, development, new products and projects etc.

- Use 3 time estimates

  m= most likely time estimate, mode.

  a = optimistic time estimate,

  b = pessimistic time estimate, and

Expected Value (TE) = (a + 4m + b) /6

PERT For Dealing With Uncertainty

- **Advantage:** he main advantage of PERT is that it attempts to address the risk associated with duration estimates.
- **Disadvantage**: takes time to do the calculations

PERT Formula and Example

- PERT weighted average **=**

$$\frac{\text{optimistic time} + 4\text{X most likely time} + \text{pessimistic time}}{6}$$

- Example:

PERT weighted average =

$$\frac{8 \text{ workdays} + 4 \text{ X } 10 \text{ workdays} + 24 \text{ workdays}}{6} = \mathbf{12\ days}$$

where optimistic time = 8 days

most likely time = **10 days**, and

pessimistic time = 24 days

- Instead of using the most likely duration estimate of 10 workdays, the project team would use 12 workdays when doing critical path analysis. for the above example.

Schedule Control Suggestions

- Perform reality checks on schedules
- Allow for contingencies
- Don’t plan for everyone to work at 100% capacity all the time
  - There are things a person does in their work day:
    - Meetings
    - Email
    - Talking with the boss
    - At Toyota in our plans we used 6 hour days allowing for 2 hours of the other stuff
- Hold progress meetings with stakeholders and be clear and honest in communicating schedule issues

Controlling the Schedule

- Goals are to know the status of the schedule, influence factors that cause schedule changes, determine that the schedule has changed, and manage changes when they occur
- Tools and techniques include
  - Progress reports
  - A schedule change control system
  - Project management software, including schedule comparison charts like the tracking Gantt chart
  - Variance analysis, such as analyzing float or slack
  - Performance management, such as earned value (chapter 7)

Reality Checks on Scheduling

- First review the draft schedule or estimated completion date in the project charter
- Prepare a more detailed schedule with the project team (people who do the work)
- Get stakeholders' approval
- Make sure the schedule is realistic and followed
- Allow for contingencies throughout the life of the project
- Alert top management well in advance if there are schedule problems

Reality Checks on Scheduling

- Be proactive in managing stakeholder expectations
- Verify actual work performed, not just what people report
  - How? Ask a person who is dependent on the other person's work.
- Be honest – top management hate surprises
- Keep firm dates for key project milestones
- Avoid scope creep by managing change control

Chapter 4
Project Cost Management

Note: read PMBOK 6th edition

The Importance of Project Cost Management

- IT projects have a poor track record for meeting budget goals
- The CHAOS studies found the average cost **overrun** (the additional percentage or dollar amount by which actual costs exceed estimates) ranged from 180 percent in 1994 to 43 percent in 2010
- A 2011 Harvard Business Review study reported an average cost overrun of 27 percent. The most important finding was the discovery of a large number of gigantic overages or “black swans”

What is Cost and Project Cost Management?

- **Cost** is a resource sacrificed or foregone to achieve a specific objective or something given up in exchange
- Costs are usually measured in monetary units like dollars
- **Project cost management** includes the processes required to ensure that the project is completed within an approved budget

Project Cost Management Processes

- **Planning cost management** :determining the policies, procedures, and documentation that will be used for planning, executing, and controlling project cost.
- **Estimating costs:** developing an approximation or estimate of the costs of the resources needed to complete a project
- **Determining the budget:** allocating the overall cost estimate to individual work items to establish a baseline for measuring performance
- **Controlling costs:** controlling changes to the project budget

Figure 7-1.Project Cost Management Summary

Planning

Process: **Plan cost management**
Outputs: Cost management plan
Process: **Estimate costs**
Outputs: Activity cost estimates, basis of estimates, project documents updates
Process: **Determine budget**
Outputs: Cost baseline, project funding requirements, project documents updates

Monitoring and Controlling

Process: **Control costs**
Outputs: Work performance information, cost forecasts, change requests, project management plan updates, project documents updates, organizational process assets updates

Project Start → **Project Finish**

Basic Principles of Cost Management

- Most members of an executive board better understand and are more interested in financial terms than IT terms , so IT project managers must speak their language
  - **Profits** are revenues minus expenditures
  - **Profit margin** is the ratio of revenues to profits
  - **Life cycle costing** considers the total cost of ownership, or development plus support costs, for a project
  - **Cash flow analysis** determines the estimated annual costs and benefits for a project and the resulting annual cash flow

Types of Costs and Benefits

- **Tangible costs** or **benefits** are those costs or benefits that an organization can easily measure in dollars
- **Intangible costs** or **benefits** are costs or benefits that are difficult to measure in monetary terms
- **Direct costs** are costs that can be directly related to producing the products and services of the project
- **Indirect costs** are costs that are not directly related to the products or services of the project, but are indirectly related to performing the project
- **Sunk cost** is money that has been spent in the past; when deciding what projects to invest in or continue, you should *not* include sunk costs

More Basic Principles of Cost Management

- **Learning curve theory** states that when many items are produced repetitively, the unit cost of those items decreases in a regular pattern as more units are produced
- It is used for predicting cost reductions, estimating future performance, and improving processes.
- **Reserves** are dollars included in a cost estimate to mitigate cost risk by allowing for future situations that are difficult to predict
  - **Contingency reserves** allow for future situations that may be partially planned for (sometimes called **known unknowns**) and are included in the project cost baseline
  - **Management reserves** allow for future situations that are unpredictable (sometimes called **unknown unknowns**

Planning Cost Management

- The project team uses expert judgment, analytical techniques, and meetings to develop the cost management plan
- A cost management plan includes:
  - Level of accuracy and units of measure
  - Organizational procedure links
  - Control thresholds
  - Rules of performance measurement
  - Reporting formats
  - Process descriptions

Estimating Costs

- Project managers must take cost estimates seriously if they want to complete projects within budget constraints
- It's important to know the types of cost estimates, how to prepare cost estimates, and typical problems associated with IT cost estimates

Table 7-2. Types of Cost Estimates

Type of Estimate	When Done	Why Done	How Accurate
Rough Order of Magnitude (ROM)	Very early in the project life cycle, often 3–5 years before project completion	Provides estimate of cost for selection decisions	–50% to +100%
Budgetary	Early, 1–2 years out	Puts dollars in the budget plans	–10% to +25%
Definitive	Later in the project, less than 1 year out	Provides details for purchases, estimates actual costs	–5% to +10%

Example Table 7-2

- A ROM estimate s accuracy is typically -50 percent to +100 percent, meaning the project s actual costs could be 50 percent below the ROM estimate or 100 percent above. For example, the actual cost for a project with a ROM estimate of $100,000 could range between $50,000 to $200,000.

Example Table 7-2

- The accuracy of budgetary estimates is typically -10 percent to +25 percent, meaning the actual costs could be 10 percent less or 25 percent more than the budgetary estimate.
- For example, the actual cost for a project with a budgetary estimate of $100,000 could range between $90,000 to $125,000.

Example Table 7-2

- The accuracy of this type of estimate is normally -5 percent to +10 percent, meaning the actual costs could be 5 percent less or 10 percent more than the definitive estimate.
- For example, the actual cost for a project with a definitive estimate of $100,000 could range between $95,000 to $110,000. Table 7-2 summarizes the three basic types of cost estimates.

More on Cost Estimates

- The number and type of cost estimates vary by application area. The Association for the Advancement of Cost Engineering International identifies five types of cost estimates for construction projects: order of magnitude, conceptual, preliminary, definitive, and control
- Estimates are usually done at various stages of a project and should become more accurate as time progresses
- A large percentage of total project costs are often labor costs

Table 7-3. Maximum FTE by Department by Year

Department	Year 1	Year 2	Year 3	Year 4	Year 5	Totals
Information systems	24	31	35	13	13	116
Marketing systems	3	3	3	3	3	15
Reservations	12	29	33	9	7	90
Contractors	2	3	1	0	0	6
Totals	41	66	72	25	23	227

Cost Estimation Tools and Techniques(1)

- Basic tools and techniques for cost estimates:
  - **Analogous** or **top-down estimates:** use the actual cost of a previous, similar project as the basis for estimating the cost of the current project
  - For example, estimators often try to find a similar project and then customize/modify it for known differences. However, if the project to be estimated involves a new programming language or working with a new type of hardware or network, the analogous estimate technique could easily result in too low an estimate.

Cost Estimation Tools and Techniques(2)

- **Bottom-up estimates:** involve estimating individual work items or activities and summing them to get a project total
- **Parametric modeling** uses project characteristics (parameters) in a mathematical model to estimate project costs

Cont'd

- A parametric model might provide an estimate of $50 per **line of code called KLCO(Kilo Lines of Code)** for a software development project based on the programming language the project is using, the level of expertise of the programmers, the size and complexity of the data involved, and so on.
- Parametric models are most **reliable** when the historical information that was used to create the model is **accurate**, the **parameters are readily quantifiable**, and the model is **flexible** in terms of the size of the project.

Cont'd

- Parametric models that are more complicated are usually computerized.
- See the Suggested Readings on the companion Web site for examples of parametric models, such as the **COCOMO (Constructive Cost Model) model.**

- The COCOMO (Constructive Cost Model) is a software cost estimation model developed by Dr. Barry Boehm. It helps predict the effort, cost, and schedule required for a software development project based on the size of the software and a set of cost drivers. The model has two main versions: COCOMO I (developed in 1981) and the more advanced COCOMO II (developed in the 1990s).

Cont'd

- **In practice, many people find that using a combination or hybrid approach involving analogous, bottom up, and/or parametric modeling provides the best cost estimates.**

Typical Problems with IT Cost Estimates

- Estimates are done too quickly
- People lack estimating experience
- Human beings are biased toward underestimation
- Management desires accuracy

Sample Cost Estimate

- See pages chapter-7 for a detailed example of creating a cost estimate for the Surveyor Pro project described in the opening case
- Before creating an estimate, know what it will be used for, gather as much information as possible, and clarify the ground rules and assumptions for the estimate
- If possible, estimate costs by major WBS categories
- Create a cost model to make it easy to make changes to and document the estimate

Figure 7-2. Surveyor Pro Project Cost Estimate

Surveyor Pro Project Cost Estimate Created October 5

	# Units/Hrs.	Cost/Unit/Hr.	Subtotals	WBS Level 2 Totals	% of Total
WBS Items					
1. Project Management				**$306,300**	**20%**
Project manager	960	$100	$96,000		
Project team members	1920	$75	$144,000		
Contractors (10% of software development and testing)			$66,300		
2. Hardware				**$76,000**	**5%**
2.1 Handheld devices	100	$600	$60,000		
2.2 Servers	4	$4,000	$16,000		
3. Software				**$614,000**	**40%**
3.1 Licensed software	100	$200	$20,000		
3.2 Software development*			$594,000		
4. Testing (10% of total hardware and software costs)			$69,000	**$69,000**	**5%**
5. Training and Support				**$202,400**	**13%**
Trainee cost	100	$500	$50,000		
Travel cost	12	$700	$8,400		
Project team members	1920	$75	$144,000		
6. Reserves (20% of total estimate)			$253,540	**$253,540**	**17%**
Total project cost estimate				**$1,521,240**	

*See software development estimate.

Figure 7-3. Surveyor Pro Software Development Estimate

Surveyor Pro Software Development Estimate Created October 5

1. Labor Estimate	# Units/Hrs.	Cost/Unit/Hr.	Subtotals	**Calculations**
Contractor labor estimate	3000	$150	$450,000	3000 * 150
Project team member estimate	1920	$75	$144,000	1920 * 75
Total labor estimate			**$594,000**	Sum above two values
2. Function point estimate**	Quantity	Conversion Factor	Function Points	**Calculations**
External inputs	10	4	40	10 * 4
External interface files	3	7	21	3 * 7
External outputs	4	5	20	4 * 5
External queries	6	4	24	6 * 4
Logical internal tables	7	10	70	7 * 10
Total function points			**175**	Sum above function point values
Java 2 languange equivalency value			46	Assumed value from reference
Source lines of code (SLOC) estimate			8,050	175 * 46
Productivity×KSLOC^Penalty (in months)			29.28	3.13 * 8.05^1.072 (see reference)
Total labor hours (160 hours/month)			4,684.65	29.28 * 160
Cost/labor hour ($120/hour)			$120	Assumed value from budget expert
Total function point estimate			**$562,158**	4684.65 * 120

**Approach based on paper by William Roetzheim, "Estimating Software Costs," Cost Xpert Group, Inc. (2003) using the COCOMO II default linear productivity factor (3.13) and penalty factor (1.072).

Determining the Budget

- Cost budgeting involves allocating the project cost estimate to individual work items over time
- The WBS is a required input to the cost budgeting process since it defines the work items
- Important goal is to produce a **cost baseline**
  - a time-phased budget that project managers use to measure and monitor cost performance

Figure 7-4. Surveyor Pro Project Cost Baseline

Surveyor Pro Project Cost Baseline Created October 10*

WBS Items	1	2	3	4	5	6	7	8	9	10	11	12	Totals
1. Project Management													
1.1 Project manager	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	96,000
1.2 Project team members	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	144,000
1.3 Contractors		6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027	66,300
2. Hardware													
2.1 Handheld devices				30,000	30,000								60,000
2.2 Servers				8,000	8,000								16,000
3. Software													
3.1 Licensed software				10,000	10,000								20,000
3.2 Software development		60,000	60,000	80,000	127,000	127,000	90,000	50,000					594,000
4. Testing			6,000	8,000	12,000	15,000	15,000	13,000					69,000
5. Training and Support													
5.1 Trainee cost									50,000				50,000
5.2 Travel cost									8,400				8,400
5.3 Project team members							24,000	24,000	24,000	24,000	24,000	24,000	144,000
6. Reserves				10,000	10,000	30,000	30,000	60,000	40,000	40,000	30,000	3,540	253,540
Totals	20,000	86,027	92,027	172,027	223,027	198,027	185,027	173,027	148,427	90,027	80,027	53,567	1,521,240

*See the lecture slides for this chapter on the companion Web site for a larger view of this and other figures in this chapter. Numbers are rounded, so some totals appear to be off.

Controlling Costs

- Project cost control includes
  - Monitoring cost performance
  - Ensuring that only appropriate project changes are included in a revised cost baseline
  - Informing project stakeholders of authorized changes to the project that will affect costs
- Many organizations around the globe have problems with cost control

Earned Value Management (EVM)

- **EVM** is a project performance measurement technique that integrates scope, time, and cost data
- Given a **baseline** (original plan plus approved changes), you can determine how well the project is meeting its goals
- You must enter actual information periodically to use EVM
- More and more organizations around the world are using EVM to help control project costs

Earned Value Management Terms

- The **planned value (PV)**, formerly called the budgeted cost of work scheduled (BCWS)/**budget**, also called the budget, is that portion of the approved total cost estimate planned to be spent on an activity during a given period

- Suppose a project included a summary activity of purchasing and installing a new Web server. Suppose further that, according to the plan, it would take one week and cost a total of $10,000 for the labor hours, hardware, and software involved. The planned value (PV) for that activity that week is, therefore, $10,000.

Cont'd

- **Actual cost (AC),** formerly called actual cost of work performed (ACWP), is the total of direct and indirect costs incurred in accomplishing work on an activity during a given period

- For example, suppose it actually took two weeks and cost $20,000 to purchase and install the new Web server. Assume that $15,000 of these actual costs were incurred during Week 1 and $5,000 was incurred during Week 2. These amounts are the actual cost (AC) for the activity each week.

Cont'd

- The **earned value (EV),** formerly called the budgeted cost of work performed (BCWP), is an estimate of the value of the physical work actually completed
- EV is based on the original planned costs for the project or activity and the rate at which the team is completing work on the project or activity to date

Rate of Performance

- **Rate of performance (RP)** is the ratio of actual work completed to the percentage of work planned to have been completed at any given time during the life of the project or activity
- Brenda Taylor, Senior Project Manager in South Africa, suggests this term and approach for estimating earned value
- For example, suppose the server installation was halfway completed by the end of week 1. The rate of performance would be 50% because by the end of week 1, the planned schedule reflects that the task should be 100 percent complete and only 50 percent of that work has been completed

Table 7-4. Earned Value Calculations for One Activity After Week One

Activity	Week 1
Earned Value (EV)	5,000
Planned Value (PV)	10,000
Actual Cost (AC)	15,000
Cost Variance (CV)	–10,000
Schedule Variance (SV)	–5,000
Cost Performance Index (CPI)	33%
Schedule Performance Index (SPI)	50%

Cont'd

$EV = 10{,}000 * 50\% = 5{,}000$

$CV = 5{,}000 - 15{,}000 = -10{,}000$

$SV = 5{,}000 - 10{,}000 = -5{,}000$

$CPI = 5{,}000/15{,}000 = 33\%$

$SPI = 5{,}000/10{,}000 = 50\%$

Formula	
	$EV = PV * SPI$
	$CV = EV - AC$
	$SV = EV - PV$
	$CPI = \frac{EV}{AC} * 100$
	$SPI = \frac{EV}{PV} * 100$
	$EAC = = \frac{BAC}{CPI}$

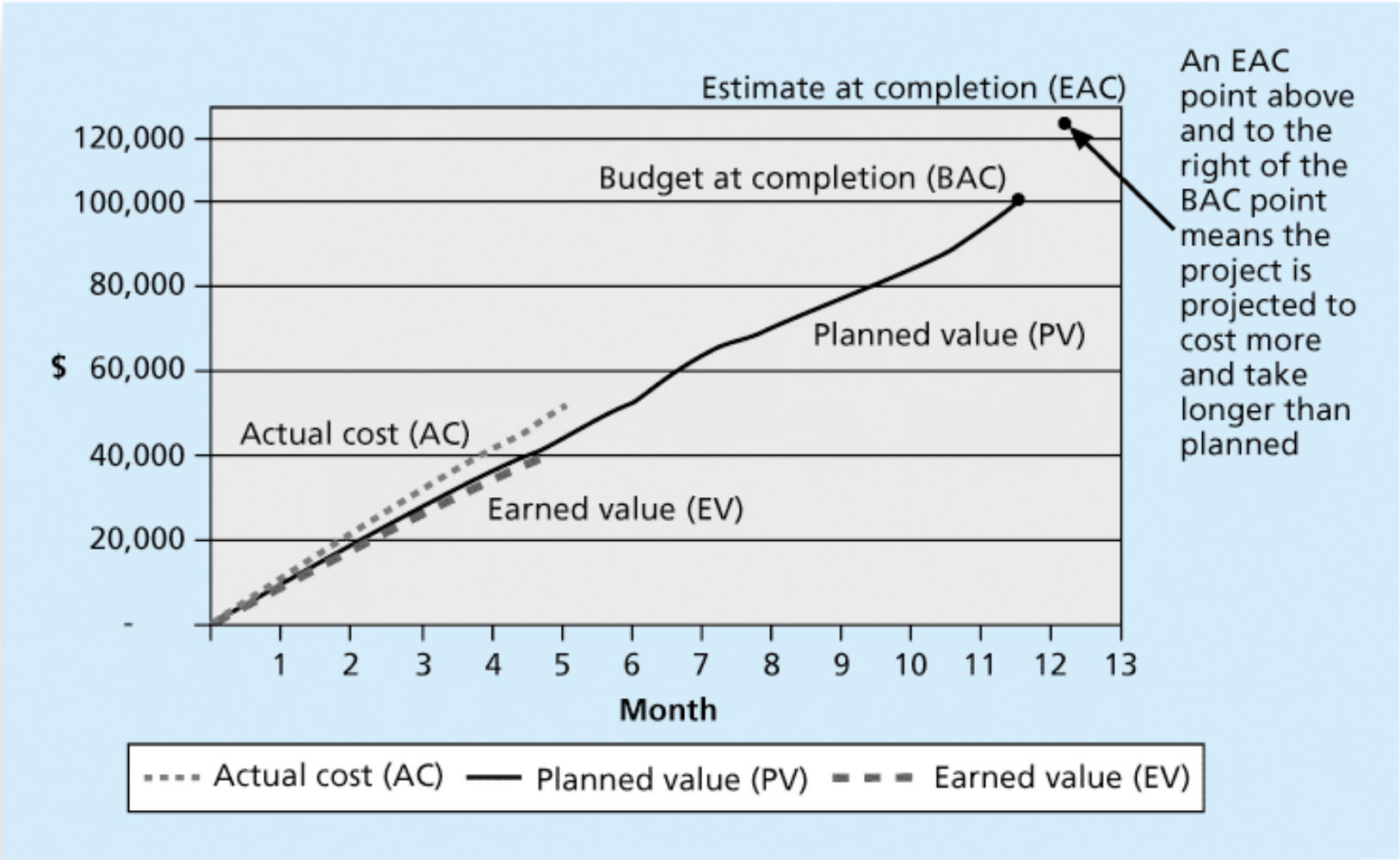
Table 7-5. Earned Value Formulas

Term	Formula
Earned value (EV)	EV = PV to date * RP
Cost variance (CV)	CV = EV − AC
Schedule variance (SV)	SV = EV − PV
Cost performance index (CPI)	CPI = EV/AC
Schedule performance index (SPI)	SPI = EV/PV
Estimate at completion (EAC)	EAC = BAC/CPI
Estimated time to complete	Original time estimate/SPI

Rules of Thumb for Earned Value Numbers

- Negative numbers for cost and schedule variance indicate problems in those areas
- CPI and SPI less than 100% indicate problems
- Problems mean the project is costing more than planned (over budget) or taking longer than planned (behind schedule)
- The CPI can be used to calculate the **estimate at completion** (EAC)—an estimate of what it will cost to complete the project based on performance to date. The **budget at completion** (BAC) is the original total budget for the project

Figure 7-5. Earned Value Chart for Project after Five Months



Using Software to Assist in Cost Management

- **Spreadsheets** are a common tool for resource planning, cost estimating, cost budgeting, and cost control
- Many companies use more sophisticated and centralized **financial applications software** for cost information
- **Project management software** has many cost-related features, especially enterprise PM software
- **Portfolio management software** can help reduce costs

Chapter Summary

- Project cost management is a traditionally weak area of IT projects, and project managers must work to improve their ability to deliver projects within approved budgets
- Main processes include
  - Plan cost management
  - Estimate costs
  - Determine the budget
  - Control costs

End of chapter 4

Chapter 5:
Project Quality Management

Information Technology Project Management, Sixth Edition

Note: See the text itself for full citations.

Learning Objectives

- Understand the importance of project quality management for information technology (IT) products and services
- Define project quality management and understand how quality relates to various aspects of IT projects
- Describe quality management planning and how quality and scope management are related
- Discuss the importance of quality assurance
- Explain the main outputs of the quality control process

Learning Objectives

- Understand the tools and techniques for quality control, such as the Seven Basic Tools of Quality, statistical sampling, Six Sigma, and testing
- Summarize the contributions of noteworthy quality experts to modern quality management
- Describe how leadership, the cost of quality, organizational influences, expectations, cultural differences, and maturity models relate to improving quality in IT projects
- Discuss how software can assist in project quality management

The Importance of Project Quality Management

- Many people joke about the **poor quality** of IT products (see cars and computers joke on pages 292-294)
- People seem to **accept systems** being down occasionally or needing to reboot their PCs
- But quality is **very important** in many IT projects

What Went Wrong?

- In 1986, two hospital patients died after receiving fatal doses of radiation from a Therac 25 machine after a software problem caused the machine to ignore calibration data
- In one of the biggest software errors in banking history, Chemical Bank mistakenly deducted about $15 million from more than 100,000 customer accounts
- In August 2008, the Privacy Rights Clearinghouse stated that more than 236 million data records of U.S. residents have been exposed due to security breaches since January 2005
- In March 2012, Consumer Reports listed several recalls on its Web site in less than 10 days, including LED lights overheating, five different models of cars having problems

What Is Project Quality?

- The International Organization for Standardization (ISO) defines **quality** as "the degree to which a set of inherent characteristics fulfils requirements" (ISO9000:2000)
- Other experts define quality based on:
  - **Conformance to requirements**: The project's processes and products meet written specifications
  - **Fitness for use**: A product can be used as it was intended

What Is Project Quality Management?

- **Project quality management** ensures that the project will satisfy the needs for which it was undertaken
- **Project quality management involves three main processes:**
  - **Plan quality management**: Identifying which quality **standards are relevant** to the project and how to satisfy them; a **metric** is a standard of measurement
  - **Perform quality assurance**: **Periodically evaluating** overall project performance to ensure the project will satisfy the relevant quality standards
  - **Control quality**: Monitoring specific project **results** to ensure that they **comply** with the relevant quality standards

Figure 8-1. Project Quality Management Summary

Planning
Process: **Plan quality management**
Outputs: Quality management plan, process improvement plan, quality metrics, quality checklists, and project documents updates

Executing
Process: **Perform quality assurance**
Outputs: Change requests, project management plan updates, project documents updates, and organizational process asset updates

Monitoring and Controlling
Process: **Perform quality control**
Outputs: Quality control measurements, validated changes, validated deliverables, work performance information, change requests, project management plan updates, project documents updates, and organizational process asset updates

Project Start → **Project Finish**

Planning Quality

- Implies the ability to **anticipate** situations and **prepare actions** to bring about the desired outcome

- Important to prevent defects by:
  - Selecting proper materials
  - Training and indoctrinating people in quality
  - Planning a process that ensures the appropriate outcome

Scope Aspects of IT Projects

- Important scope aspects of information technology projects **that affect quality** include functionality and features, system outputs, performance, and reliability and maintainability.

- **Functionality** is the degree to which a system performs its intended function
- **Features** are the system's special characteristics that appeal to users
- **System outputs** are the screens and reports the system generates
- **Performance** addresses how well a product or service performs the customer's intended use
- **Reliability** is the ability of a product or service to perform as expected under normal conditions
- **Maintainability** addresses the ease of performing maintenance on a product

Who's Responsible for the Quality of Projects?

- **Project managers** are ultimately responsible for quality management on their projects
- Several organizations and references can help project managers and their teams understand quality
  - International Organization for Standardization (www.iso.org)
  - IEEE (www.ieee.org)

Performing Quality Assurance

- **Quality assurance** includes all the **activities related to satisfying the relevant quality** standards for a project
- Another goal of quality assurance is continuous quality improvement
- **Benchmarking** generates ideas for quality improvements by comparing specific project practices or product characteristics to those of other projects or products within or outside the performing organization
- A **quality audit** is a structured review of specific quality management activities that help identify lessons learned that could improve performance on current or future projects

Controlling Quality

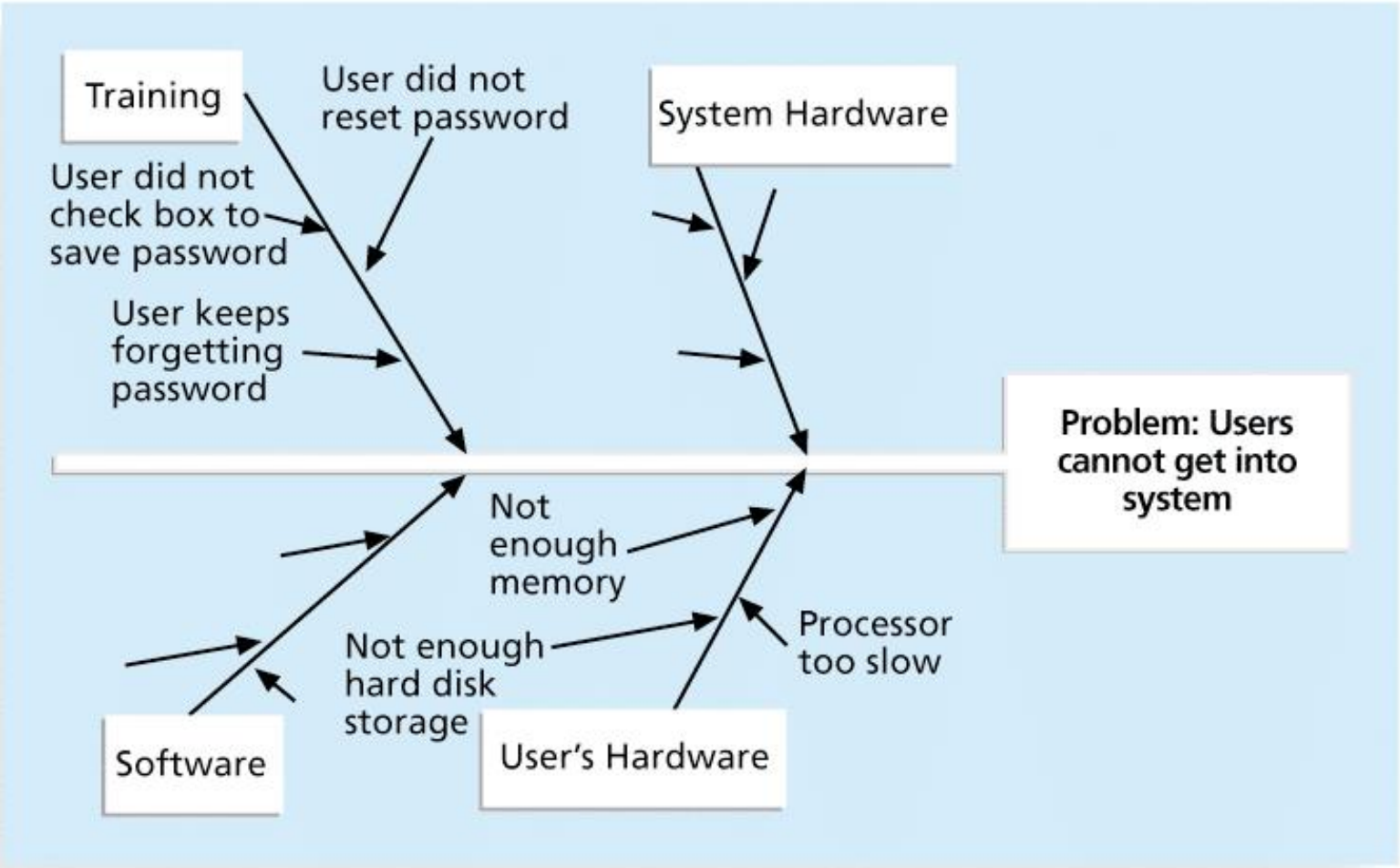
- The main outputs of quality control are:
  - Acceptance decisions
  - Rework
  - Process adjustments

➢ **There are Seven Basic Tools and Techniques that help in performing quality control**

1. Cause-and-Effect Diagrams

- **Cause-and-effect diagrams** trace complaints about quality problems back to the responsible production operations
- They help you find the root cause of a problem
- Also known as **fishbone** or **Ishikawa diagrams**
- Can also use the **5 whys** technique where you repeated ask the question “Why” (five is a good rule of thumb) to peel away the layers of symptoms that can lead to the root cause

Figure 8-2. Sample Cause-and-Effect Diagram



2. Quality Control Charts

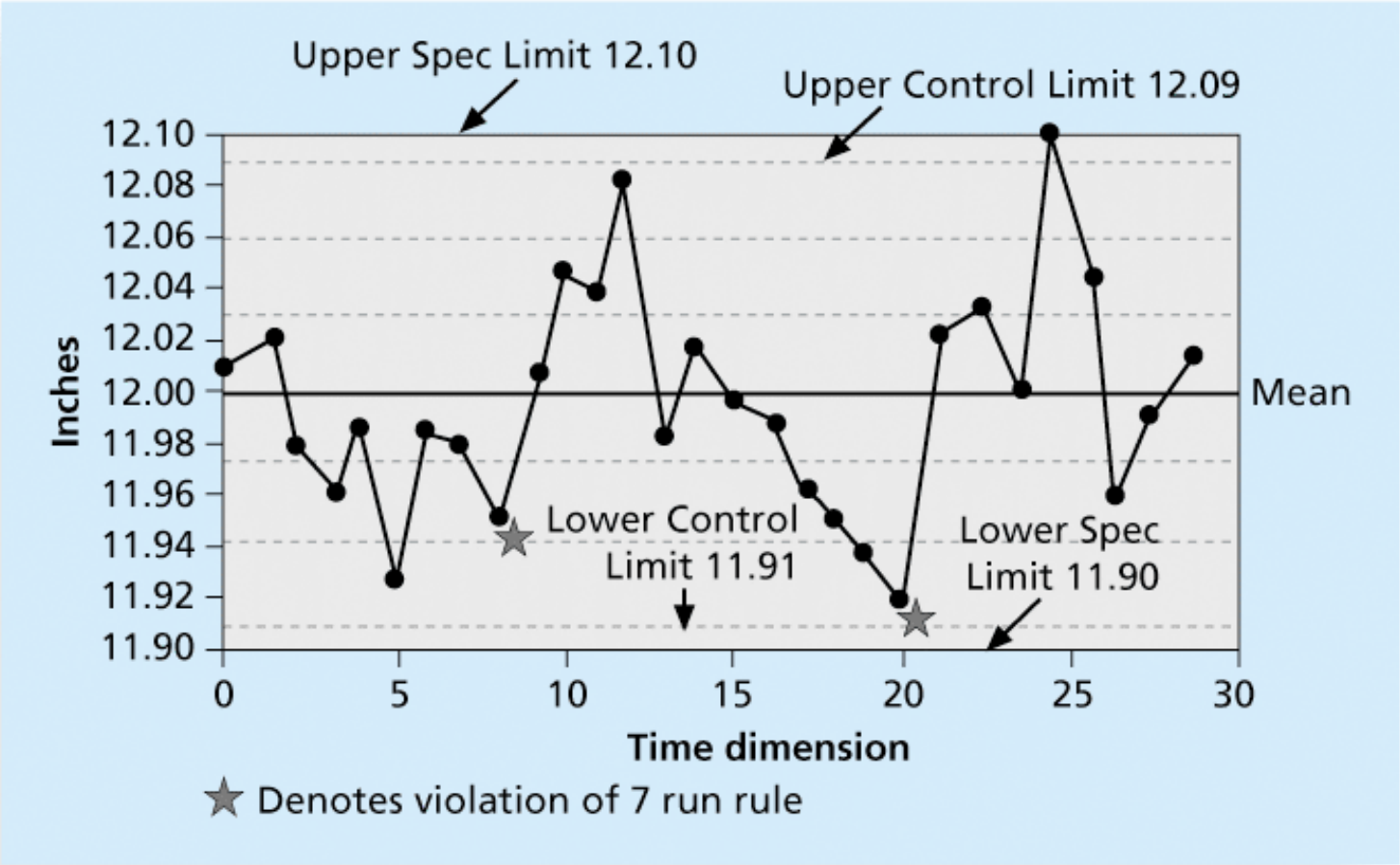
- A **control chart** is a graphic display of data that illustrates the results of a process over time
- The main use of control charts is to prevent defects, rather than to detect or reject them
- Quality control charts allow you to determine whether a process is in control or out of control
  - When a process is in control, any variations in the results of the process are created by random events; processes that are in control do not need to be adjusted
  - When a process is out of control, variations in the results of the process are caused by non-random events; you need to identify the causes of those non-random events and adjust the process to correct or eliminate them

The Seven Run Rule

- You can use quality control charts and the seven run rule to look for patterns in data

- The **seven run rule** states that if seven data points in a row are all below the mean, above the mean, or are all increasing or decreasing, then the process needs to be examined for non-random problems

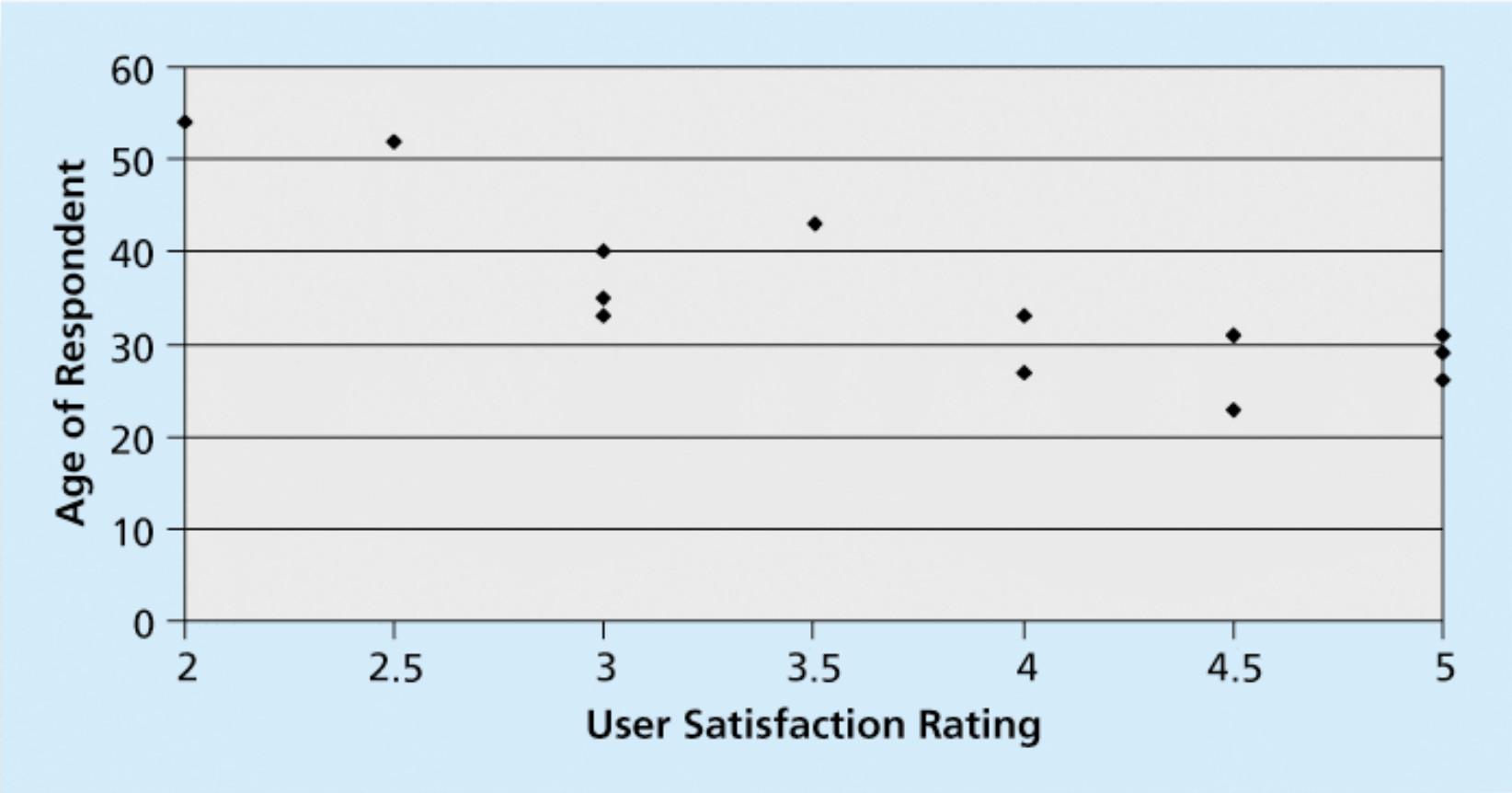
Figure 8-3. Sample Quality Control Chart



3. Scatter diagram

- A **scatter diagram** helps to show if there is a relationship between two variables
- The closer data points are to a diagonal line, the more closely the two variables are related

Figure 8-5. Sample Scatter Diagram

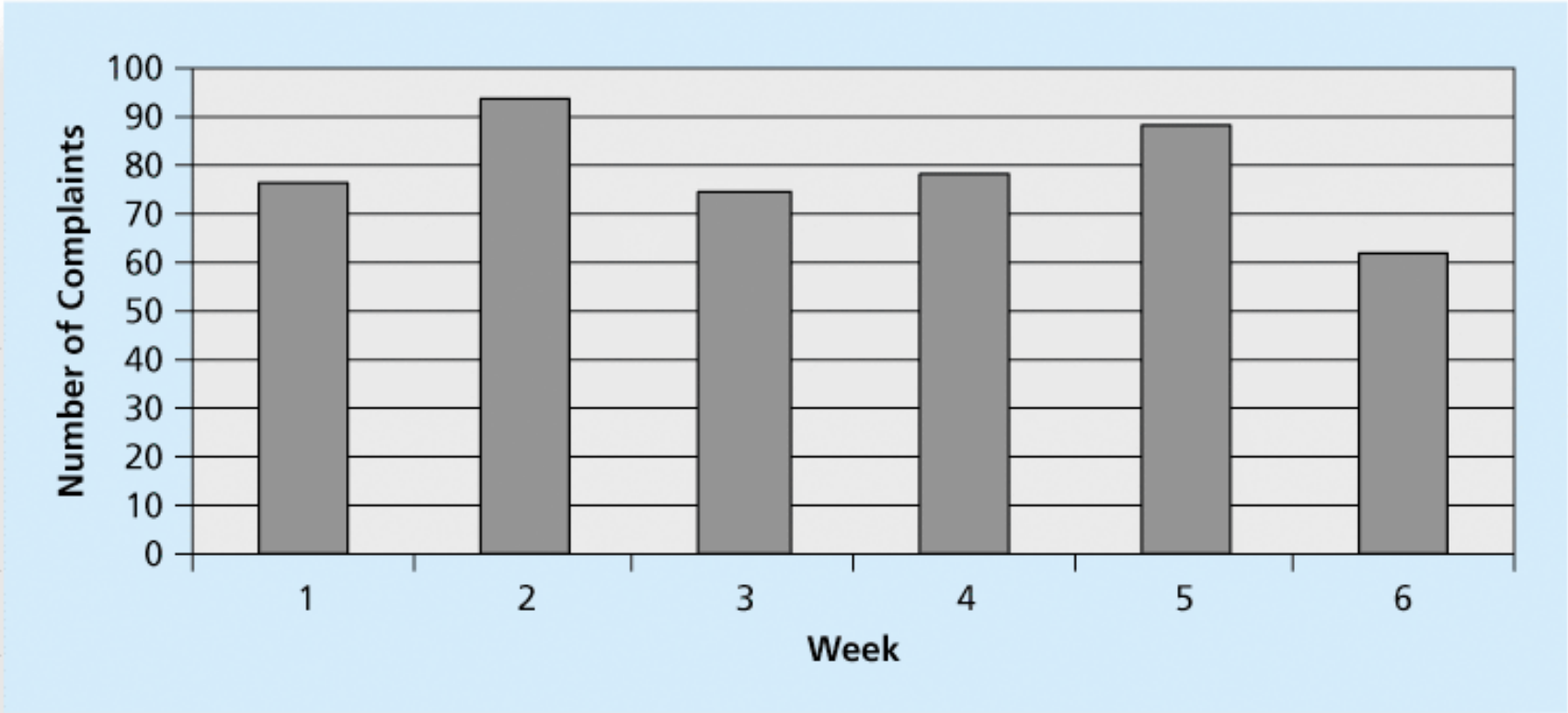


4. Histograms

- A **histogram** is a bar graph of a distribution of variables
- **Each bar** represents an attribute or characteristic of a problem or situation, and the **height** of the bar represents its frequency

For example, Scott Daniels might ask the Help Desk to create a histogram to show how many total complaints they received each week related to the EIS system. Figure 8-6 shows a sample histogram.

Figure 8-6. Sample Histogram

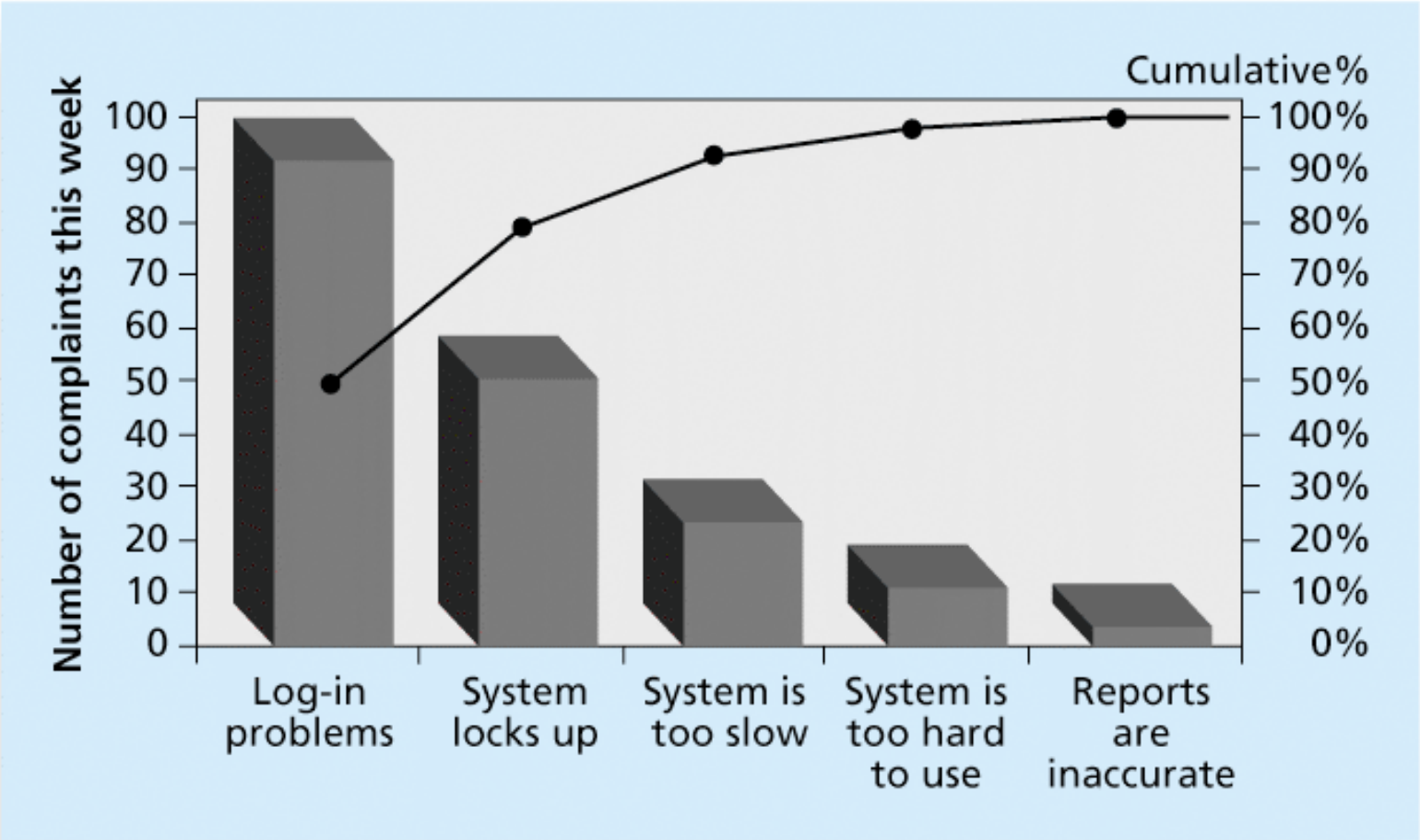


5. Pareto Charts

- A **Pareto chart** is a histogram that can help you identify and prioritize problem areas

- **Pareto analysis** is also called the 80-20 rule, meaning that 80 percent of problems are often due to 20 percent of the causes

Figure 8-7. Sample Pareto Chart

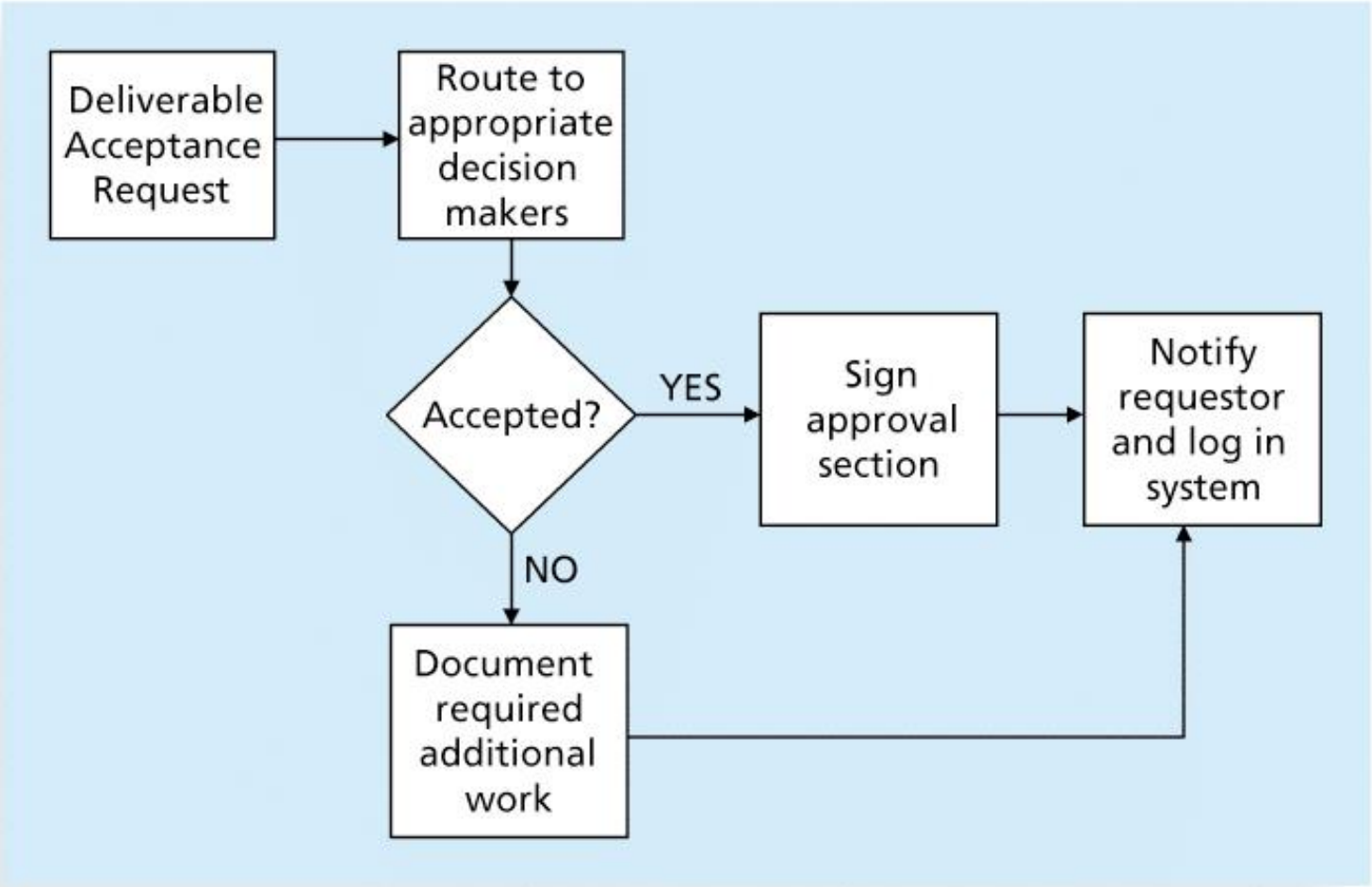


6. Flowcharts

- Flowcharts are graphic displays of the logic and flow of processes that help you analyze how problems occur and how processes can be improved
- They show activities, decision points, and the order of how information is processed

Figure 8-8 provides a simple example of a flowchart that shows the process a project team might use for **accepting or rejecting deliverables.**

Figure 8-8. Sample Flowchart



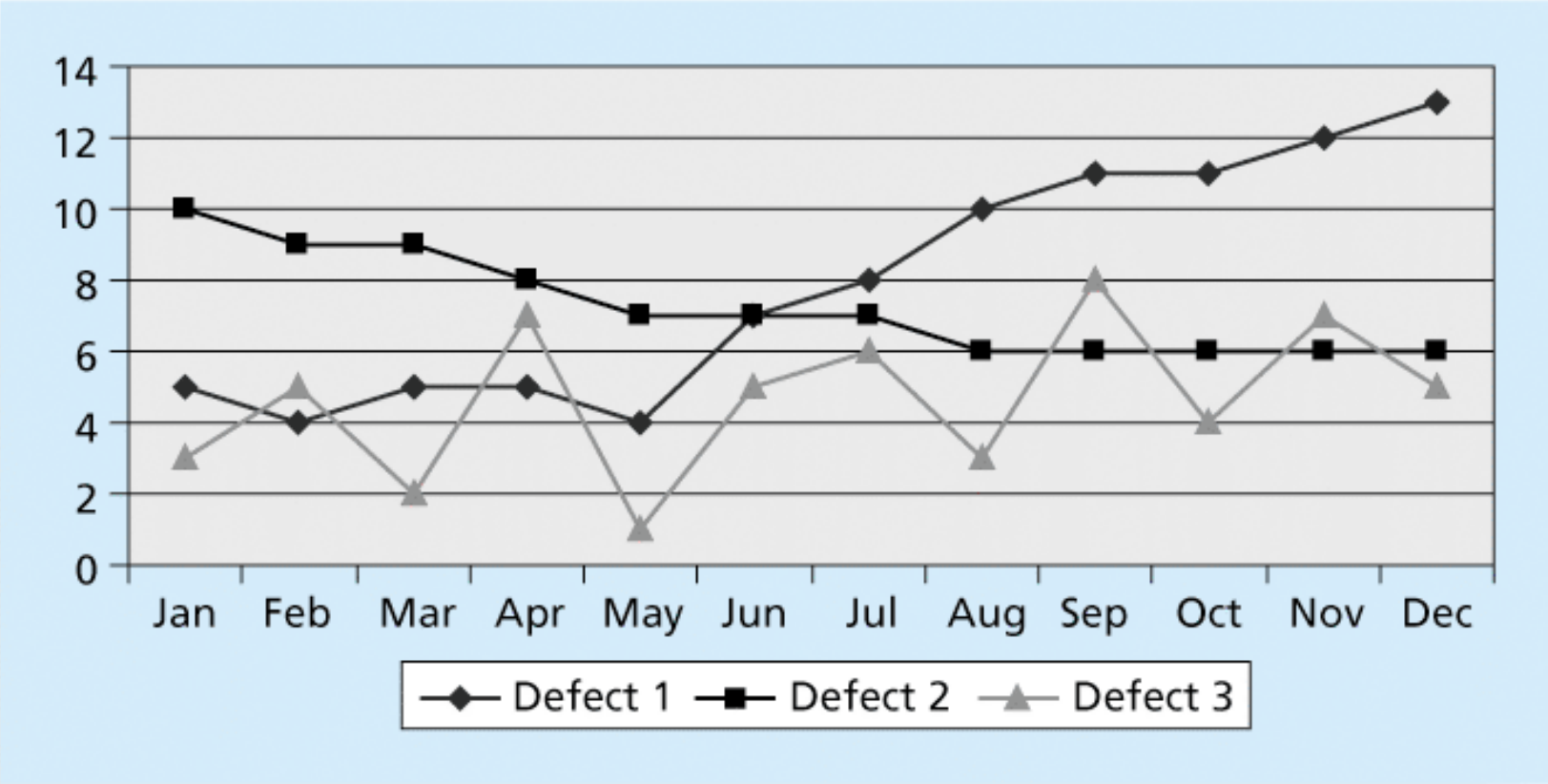
7. Run Charts

- In addition to flowcharts, run charts are also used for stratification, a technique that shows data from a variety of sources to see if a pattern emerges
- A **run chart** displays the history and pattern of variation of a process over time.
- You can use run charts to perform trend analysis and forecast future outcomes based on historical results

Cont'd

- Figure 8-4 shows a sample run chart, charting the number of defects each month for three different types of defects. Notice that you can easily see the patterns of Defect 1 continuing to increase over time, Defect 2 decreasing the first several months and then holding steady, and Defect 3 fluctuating each month.

Figure 8-9. Sample Run Chart



Statistical Sampling

- **Statistical sampling** involves choosing part of a population of interest for inspection
- The size of a sample depends on how representative you want the sample to be
- Sample size formula:

  Sample size = .25 X (certainty factor/acceptable error)^2

- Be sure to consult with an expert when using statistical analysis

Example

- Here, the certainty factor represents the desired level of confidence (usually expressed as a percentage, e.g., 95% or 99%), while the acceptable error refers to the margin of error (also expressed as a percentage).
- Please note that you should convert the percentages to decimals when using the formula. For example, if you want a 95% certainty level (0.95) with a 5% acceptable error (0.05), the formula would be:
- $n = 0.25 * (0.95 / 0.05)^2$
  $n \approx 90.25$
- In this case, you would need a sample size of approximately 91 participants to achieve a 95% certainty level with a 5% acceptable error.

Table 8-1. Commonly Used Certainty Factors

Desired Certainty	Certainty Factor
95%	1.960
90%	1.645
80%	1.281

Six Sigma

- **Six Sigma** is "a comprehensive and flexible system for achieving, sustaining, and maximizing business success. Six Sigma is uniquely driven by close understanding of customer needs, disciplined use of facts, data, and statistical analysis, and diligent attention to managing, improving, and reinventing business processes"*

*Pande, Peter S., Robert P. Neuman, and Roland R. Cavanagh, *The Six Sigma Way*, New York: McGraw-Hill, 2000, p. xi.

Basic Information on Six Sigma

- The target for perfection is the achievement of no more than **3.4 defects per million opportunities**

- The principles can apply to a wide variety of processes

- Six Sigma projects normally follow a five-phase improvement process called DMAIC

DMAIC

- **DMAIC** is a systematic, closed-loop process for continued improvement that is scientific and fact based
- DMAIC stands for:
  - **D**efine: Define the problem/opportunity, process, and customer requirements
  - **M**easure: Define measures, then collect, compile, and display data
  - **A**nalyze: Scrutinize process details to find improvement opportunities
  - **I**mprove: Generate solutions and ideas for improving the problem
  - **C**ontrol: Track and verify the stability of the improvements and the predictability of the solution

How is Six Sigma Quality Control Unique?

- It requires an organization-wide commitment.
- Training follows the “Belt” system
- Six Sigma organizations have the ability and willingness to adopt contrary objectives, such as reducing errors and getting things done faster
- It is an operating philosophy that is customer focused and strives to drive out waste, raise levels of quality, and improve financial performance at *breakthrough* levels

Testing

- Many IT professionals think of testing as a stage that comes near the end of IT product development – **Wrong!!**

- Testing should be done during almost every phase of the IT product development life cycle

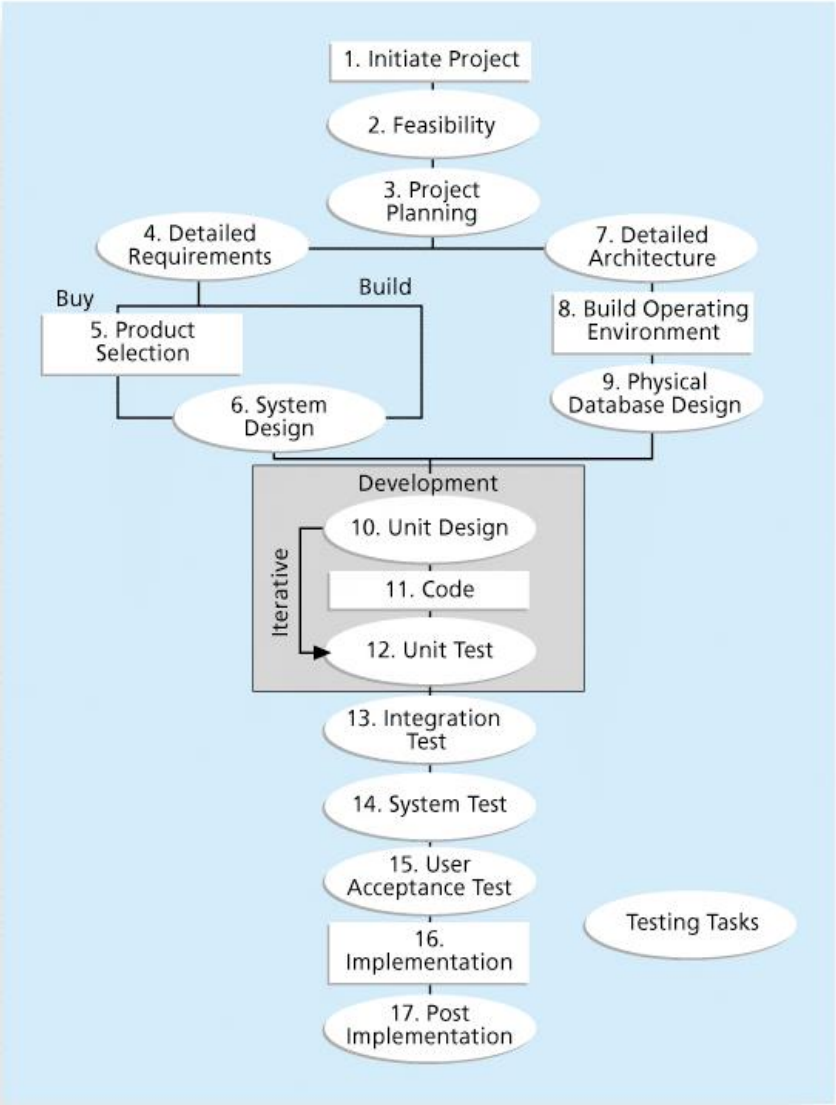
One type of Testing--Walkthroughs

- **A WALKTHROUGH after every level of design**
  - Architectural Design
    - Walkthrough
  - Database Design
    - Walkthrough
  - Medium-level Design
    - Walkthrough
  - Detailed Design
    - Walkthrough
- What is a Walkthrough???

What's new in Testing?

- TDD – Test-Driven Development
  - To clarify requirements, have users/developers write the Acceptance Test Plan immediately after defining requirements (Requirements Document)
  - Helps developers better understand what the user requires…
- DB&T –Daily Build and Test Practice
  - Promoted by Microsoft
  - The Heartbeat of the development process

Figure 8-11. Testing Tasks in the Software Development Life Cycle



Types of Tests

- **Unit testing** tests each individual component (often a program) to ensure it is as defect-free as possible
- **Integration testing** occurs between unit and system testing to test functionally grouped components
- **System testing** tests the entire system as one entity
- **User acceptance testing** is an independent test performed by end users prior to accepting the delivered system

Modern Quality Management

- Modern quality management:
  - Requires customer satisfaction
  - Prefers prevention to inspection
  - Recognizes management responsibility for quality
- Noteworthy quality experts include Deming, Juran, Crosby, Ishikawa, Taguchi, and Feigenbaum

Quality Experts

- Deming was famous for his work in rebuilding Japan and his 14 Points for Management
- Juran wrote the *Quality Control Handbook* and ten steps to quality improvement
- Crosby wrote *Quality is Free* and suggested that organizations strive for zero defects
- Ishikawa developed the concepts of quality circles and fishbone diagrams
- Taguchi developed methods for optimizing the process of engineering experimentation
- Feigenbaum developed the concept of total quality control

Malcolm Baldrige Award

- The **Malcolm Baldrige National Quality Award** originated in 1987 to recognize companies that have achieved a level of world-class competition through quality management
- Given by the President of the United States to U.S. businesses
- Three awards each year in different categories:
  - Manufacturing
  - Service
  - Small business
  - Education and health care

ISO Standards

- **ISO 9000** is a quality system standard that:
  - Is a three-part, continuous cycle of planning, controlling, and documenting quality in an organization
  - Provides minimum requirements needed for an organization to meet its quality certification standards
  - Helps organizations around the world reduce costs and improve customer satisfaction
- See www.iso.org for more information

Improving Information Technology Project Quality

- Several suggestions for improving quality for IT projects include:
  - Establish leadership that promotes quality
  - Understand the cost of quality
  - Focus on organizational influences and workplace factors that affect quality
  - Follow maturity models

Leadership

- As Joseph M. Juran said in 1945, “It is most important that top management be quality-minded. In the absence of sincere manifestation of interest at the top, little will happen below”*
- A large percentage of quality problems are associated with management, not technical issues.

*American Society for Quality (ASQ), *(www.asqc.org/about/history/juran.html*).

The Cost of Quality

- The **cost of quality** is the cost of conformance plus the cost of nonconformance
  - **Conformance** means delivering products that meet requirements and fitness for use
  - **Cost of nonconformance** means taking responsibility for failures or not meeting quality expectations
- A study reported that software bugs cost the U.S. economy $59.6 billion each year and that one third of the bugs could be eliminated by an improved testing infrastructure

Five Cost Categories Related to Quality

- **Prevention cost**: Cost of planning and executing a project so it is error-free or within an acceptable error range
- **Appraisal cost**: Cost of evaluating processes and their outputs to ensure quality
- **Internal failure cost**: Cost incurred to correct an identified defect before the customer receives the product
- **External failure cost**: Cost that relates to all errors not detected and corrected before delivery to the customer
- **Measurement and test equipment costs**: Capital cost of equipment used to perform prevention and appraisal activities

Organizational Influences, Workplace Factors, and Quality

- Study by DeMarco and Lister showed that organizational issues had a much greater influence on programmer productivity than the technical environment or programming languages
- Programmer productivity varied by a factor of one to ten across organizations, but only by 21 percent within the same organization
- Study found no correlation between productivity and programming language, years of experience, or salary.
- A dedicated workspace and a quiet work environment were key factors to improving programmer productivity

Expectations and Cultural Differences in Quality

- Project managers must understand and manage stakeholder expectations.
- Expectations also vary by:
  - Organization's culture
  - Geographic regions

Maturity Models

- **Maturity models** are frameworks for helping organizations improve their processes and systems
  - The **Software Quality Function Deployment Model** focuses on defining user requirements and planning software projects
  - The Software Engineering Institute's **Capability Maturity Model Integration** is a process improvement approach that provides organizations with the essential elements of effective processes

Capability Maturity Model Integration (CMMI)Levels

- **Capability Maturity Model Integration (CMMI)** is a process improvement approach that provides organizations with the essential elements of effective processes.
- CMMI levels, from lowest to highest, are:
  0. **Incomplete**: a process is either not performed or partially performed.
  1. **Performed**
  2. **Managed**
  3. **Defined**
  4. **Quantitatively Managed**
  5. **Optimizing**
- Companies may not get to bid on government projects unless they have a CMMI Level 3 means **Defined**.

PMI's Maturity Model

- PMI released the Organizational Project Management Maturity Model (OPM3) in December 2003

- Model is based on market research surveys sent to more than 30,000 project management professionals and incorporates 180 best practices and more than 2,400 capabilities, outcomes, and key performance indicators

- Addresses **standards** for excellence in project, program, and portfolio management best practices and explains the capabilities necessary to achieve those best practices

Using Software to Assist in Project Quality Management

- **Spreadsheet** and charting software helps create Pareto diagrams, fishbone diagrams, and so on
- **Statistical software packages** help perform statistical analysis
- **Specialized software products** help manage Six Sigma projects or create quality control charts
- **Project management software** helps create Gantt charts and other tools to help plan and track work related to quality management. Examples include Trello, Asana, Microsoft Project, and Basecamp.

End of Chapter-5

Chapter 6:
Project Human Resource Management

Information Technology Project Management, Sixth Edition

Note: See the text itself for full citations.

Learning Objectives

- Explain the importance of good human resource management on projects, including the current state of the global IT workforce and future implications for it
- Define project human resource management and understand its processes
- Summarize key concepts for managing people by understanding the theories of Abraham Maslow, Frederick Herzberg, David McClelland, and Douglas McGregor on motivation, H. J. Thamhain and D. L. Wilemon on influencing workers, and Stephen Covey on how people and teams can become more effective

Learning Objectives

- Discuss human resource management planning and be able to create a human resource plan, project organizational chart, responsibility assignment matrix, and resource histogram
- Understand important issues involved in project staff acquisition and explain the concepts of resource assignments, resource loading, and resource leveling
- Assist in team development with training, team-building activities, and reward systems
- Explain and apply several tools and techniques to help manage a project team and summarize general advice on managing teams
- Describe how project management software can assist in project human resource management

The Importance of Human Resource Management

- Many corporate executives have said, “People are our most important asset”
- People determine the success and failure of organizations and projects
- Project human resource management is a vital component of project management

The Global IT Workforce

- Although there have been ups and downs in the IT labor market, there will always be a need for good IT workers
- The Digital Planet 2010 study predicts that ICT spending will have an annual growth rate of more than 6 percent each year through 2013, when it will reach almost $5 trillion
- Thirty-three percent of the world's population is online, and 45 percent of Internet users are below the age of 25

Implications for the Future of IT Human Resource Management

- Proactive organizations are addressing workforce needs by
  - improving benefits
  - redefining work hours and incentives
  - finding future workers
  - As Ethiopia continues to develop its IT sector, it will be important for companies to prioritize human resource management.

Cont'd

- This includes recruiting and retaining top talent, providing opportunities for professional development and training, and creating a positive and supportive work environment.
- Additionally, with the increasing use of automation and artificial intelligence, companies must also consider the implications for their workforce and how to best prepare and reskill employees for the changing technological landscape.
- Overall, effective human resource management will be critical for the success of Ethiopia's IT industry in the future.

What is Project Human Resource Management?

- Making the most effective use of the people involved with a project
- **Processes include**
  - **Planning human resource management:** identifying and documenting project roles, responsibilities, and reporting relationships
  - **Acquiring the project team:** getting the needed personnel assigned to and working on the project
  - **Developing the project team:** building individual and group skills to enhance project performance
  - **Managing the project team:** tracking team member performance, motivating team members, providing timely feedback, resolving issues and conflicts, and coordinating changes to help enhance project performance

Figure 9-1. Project Human Resource Management Summary

Planning
Process: **Plan human resource management**
Output: Human resource plan

Executing
Process: **Acquire project team**
Outputs: Project staff assignments, resource calendars, project management plan updates
Process: **Develop project team**
Outputs: Team performance assessments, enterprise environmental factors updates

Monitoring and Controlling
Process: **Manage project team**
Outputs: Change requests, project management plan updates, project documents updates, enterprise environmental factors updates, and organizational process assets updates

Project Start → **Project Finish**

Keys to Managing People

- Psychologists and management theorists have devoted much research and thought to the field of managing people at work
- Important areas related to project management include
  - motivation theories
  - influence and power
  - effectiveness

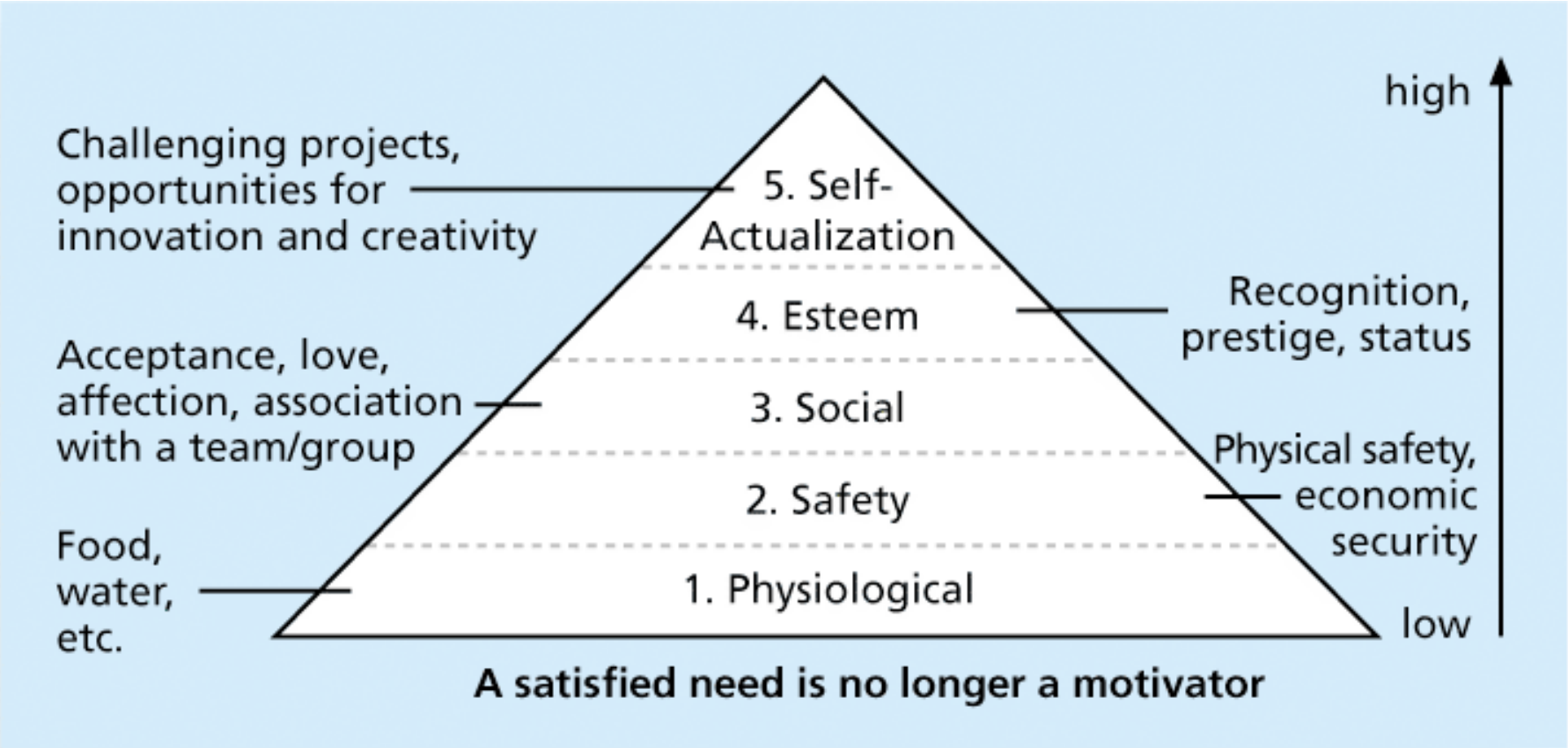
Intrinsic and Extrinsic Motivation

- **Intrinsic motivation** causes people to participate in an activity for their own enjoyment
- **Extrinsic motivation** causes people to do something for a reward or to avoid a penalty
- For example, some children take piano lessons for intrinsic motivation (they enjoy it) while others take them for extrinsic motivation (to get a reward or avoid punishment)

Maslow’s Hierarchy of Needs

- Abraham Maslow argued that humans possess unique qualities that enable them to make independent choices, thus giving them control of their destiny
- Maslow developed a **hierarchy of needs** which states that people’s behaviors are guided or motivated by a sequence of needs

Figure 9-2. Maslow's Hierarchy of Needs



Herzberg's Motivational and Hygiene Factors

- Frederick Herzberg wrote several famous books and articles about worker motivation. He distinguished between
  - **motivational factors:** achievement, recognition, the work itself, responsibility, advancement, and growth, which produce job satisfaction
  - **hygiene factors:** cause dissatisfaction if not present, but do not motivate workers to do more. Examples include larger salaries, more supervision, and a more attractive work environment

Table 9-1: Examples of Herzberg's Hygiene Factors and Motivators

Hygiene Factors	Motivators
Larger salaries	Achievement
More supervision	Recognition
More attractive work environment	Work itself
Computer or other required equipment	Responsibility
Health benefits	Advancement
Training	Growth

McClelland's Acquired-Needs Theory

- Specific needs are acquired or learned over time and shaped by life experiences, including:
  - **Achievement** (nAch): Achievers like challenging projects with achievable goals and lots of feedback
  - **Affiliation** (nAff): People with high nAff desire harmonious relationships and need to feel accepted by others, so managers should try to create a cooperative work environment for them
  - **Power**: (nPow): People with a need for power desire either personal power (not good) or institutional power (good for the organization). Provide institutional power seekers with management opportunities

McGregor's Theory X and Y

- Douglas McGregor popularized the human relations approach to management in the 1960s
- **Theory X**: assumes workers dislike and avoid work, so managers must use coercion, threats and various control schemes to get workers to meet objectives
- **Theory Y**: assumes individuals consider work as natural as play or rest and enjoy the satisfaction of esteem and self-actualization needs
- Theory Z: introduced in 1981 by William Ouchi and is based on the Japanese approach to motivating workers, emphasizing trust, quality, collective decision making, and cultural values

Thamhain and Wilemon's Ways to Have Influence on Projects

1. **Authority**: the legitimate hierarchical right to issue orders
2. **Assignment**: the project manager's perceived ability to influence a worker's later work assignments
3. **Budget**: the project manager's perceived ability to authorize others' use of discretionary funds
4. **Promotion**: the ability to improve a worker's position
5. **Money**: the ability to increase a worker's pay and benefits

Thamhain and Wilemon's Ways to Have Influence on Projects (cont'd)

6. **Penalty**: the project manager's ability to cause punishment
7. **Work challenge**: the ability to assign work that capitalizes on a worker's enjoyment of doing a particular task
8. **Expertise:** the project manager's perceived special knowledge that others deem important
9. **Friendship:** the ability to establish friendly personal relationships between the project manager and others

Ways to Influence that Help and Hurt Projects

- Projects are more likely to *succeed* when project managers influence with
  - expertise
  - work challenge
- Projects are more likely to *fail* when project managers rely too heavily on
  - authority
  - money
  - penalty

Power

- **Power** is the potential ability to influence behavior to get people to do things they would not otherwise do

- There are five main types of power, based on French and Raven s classic study, "**The Bases of Social Power**“.

Power(cont'd)

1. **Coercive power:** This type of power involves the use of threats or punishment to influence others.
2. **Reward power:** This type of power involves the ability to offer rewards or incentives to influence others.
3. **Legitimate power:** This type of power is based on an individual's formal position or authority within an organization or society.
4. **Expert power:** This type of power is based on an individual's knowledge, skills, and expertise in a particular area.
5. **Referent power:** This type of power is based on an individual's personal characteristics, such as charisma, charm, and likability, that make them attractive to others

Covey and Improving Effectiveness

- Project managers can apply Covey's 7 habits to improve effectiveness on projects
  - Be proactive
  - Begin with the end in mind
  - Put first things first
  - Think win/win
  - Seek first to understand, then to be understood
  - Synergize: is the concept that the whole is equal to more than the sum of its parts.
  - Sharpen the saw: to develop and renew their physical, spiritual, mental, and social/emotional selves.

Empathic Listening and Rapport

- Good project managers are **empathic listeners** - they listen with the intent to understand
- Before you can communicate with others, you have to have **rapport** – a relation of harmony, conformity, accord, or affinity
- **Mirroring** is the matching of certain behaviors of the other person, a technique to help establish rapport
- IT professionals need to develop empathic listening and other people skills to improve relationships with users and other stakeholders

Developing the Human Resource Plan

- Involves identifying and documenting project roles, responsibilities, skills, and reporting relationships.
- Contents include
  - project organizational charts
  - staffing management plan
  - responsibility assignment matrixes
  - resource histograms

Figure 9-3. Sample Organizational Chart for a Large IT Project

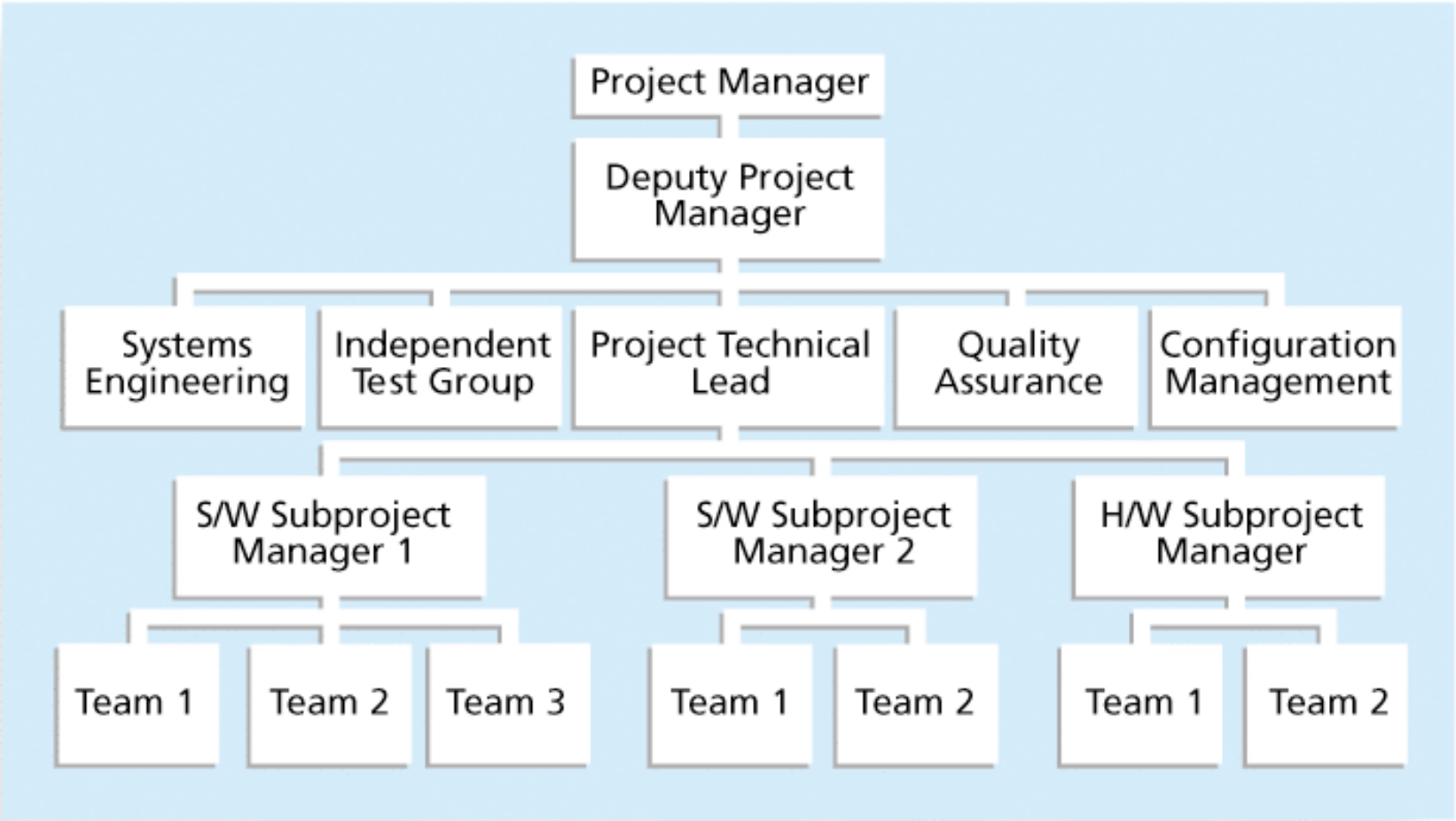
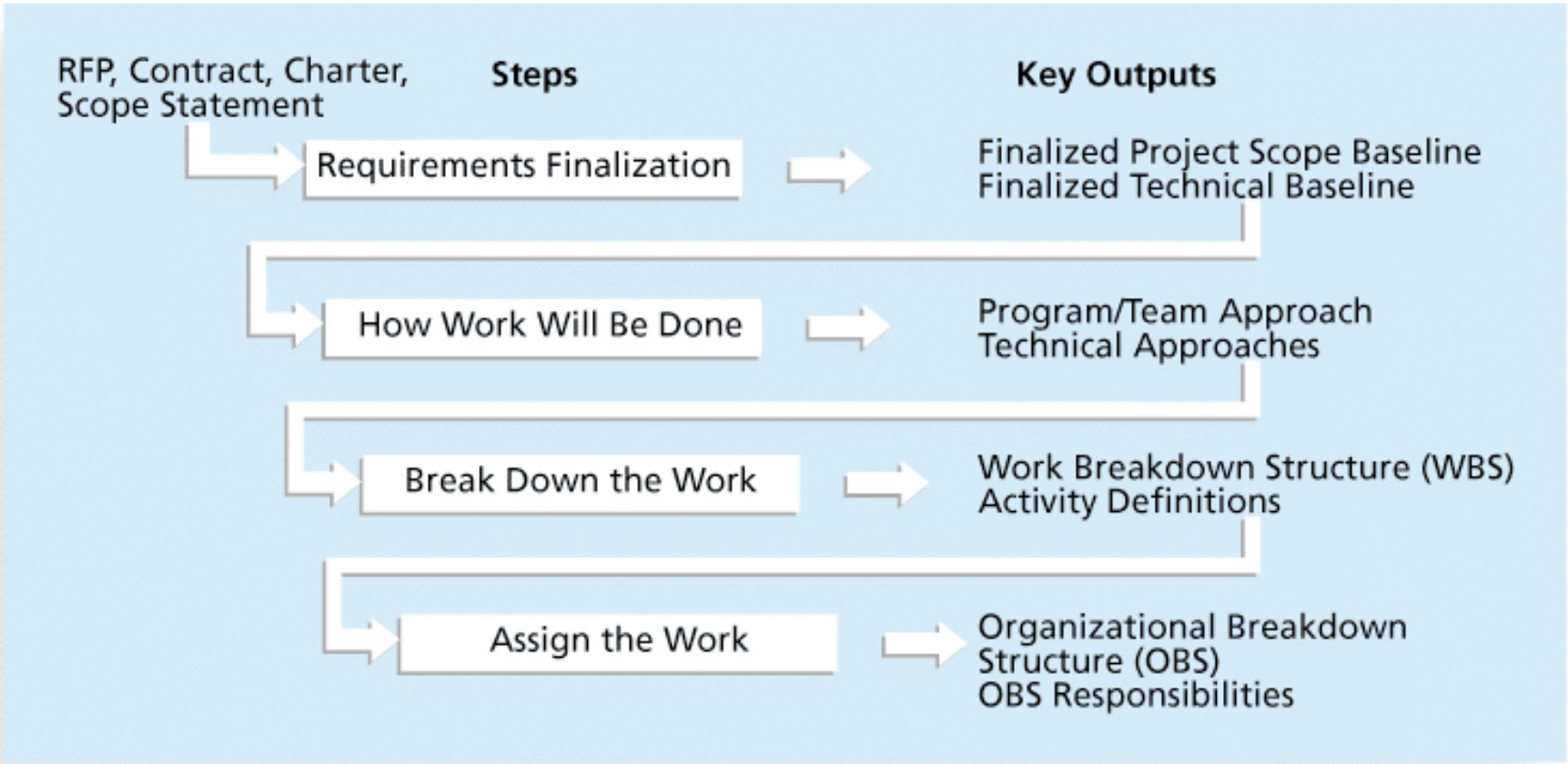


Figure 9-4. Work Definition and Assignment Process



Responsibility Assignment Matrices

- A **responsibility assignment matrix (RAM)** is a matrix that maps the work of the project as described in the WBS to the people responsible for performing the work as described in the organizational breakdown structure (OBS)
- Can be created in different ways to meet unique project needs

Figure 9-5. Sample Responsibility Assignment Matrix (RAM)

WBS activities →

OBS units ↓

	1.1.1	1.1.2	1.1.3	1.1.4	1.1.5	1.1.6	1.1.7	1.1.8
Systems Engineering	R	R P					R	
Software Development			R P					
Hardware Development				R P				
Test Engineering	P							
Quality Assurance					R P			
Configuration Management						R P		
Integrated Logistics Support							P	
Training								R P

R = Responsible organizational unit
P = Performing organizational unit

Table 9-2. Sample RACI Chart

	Group A	Group B	Group C	Group D	Group E
Test Plans	R	A	C	C	I
Unit Test	C	I	R	A	I
Integration Test	A	R	I	C	C
System Test	I	C	A	I	R
User Acceptance Test	R	I	C	R	A

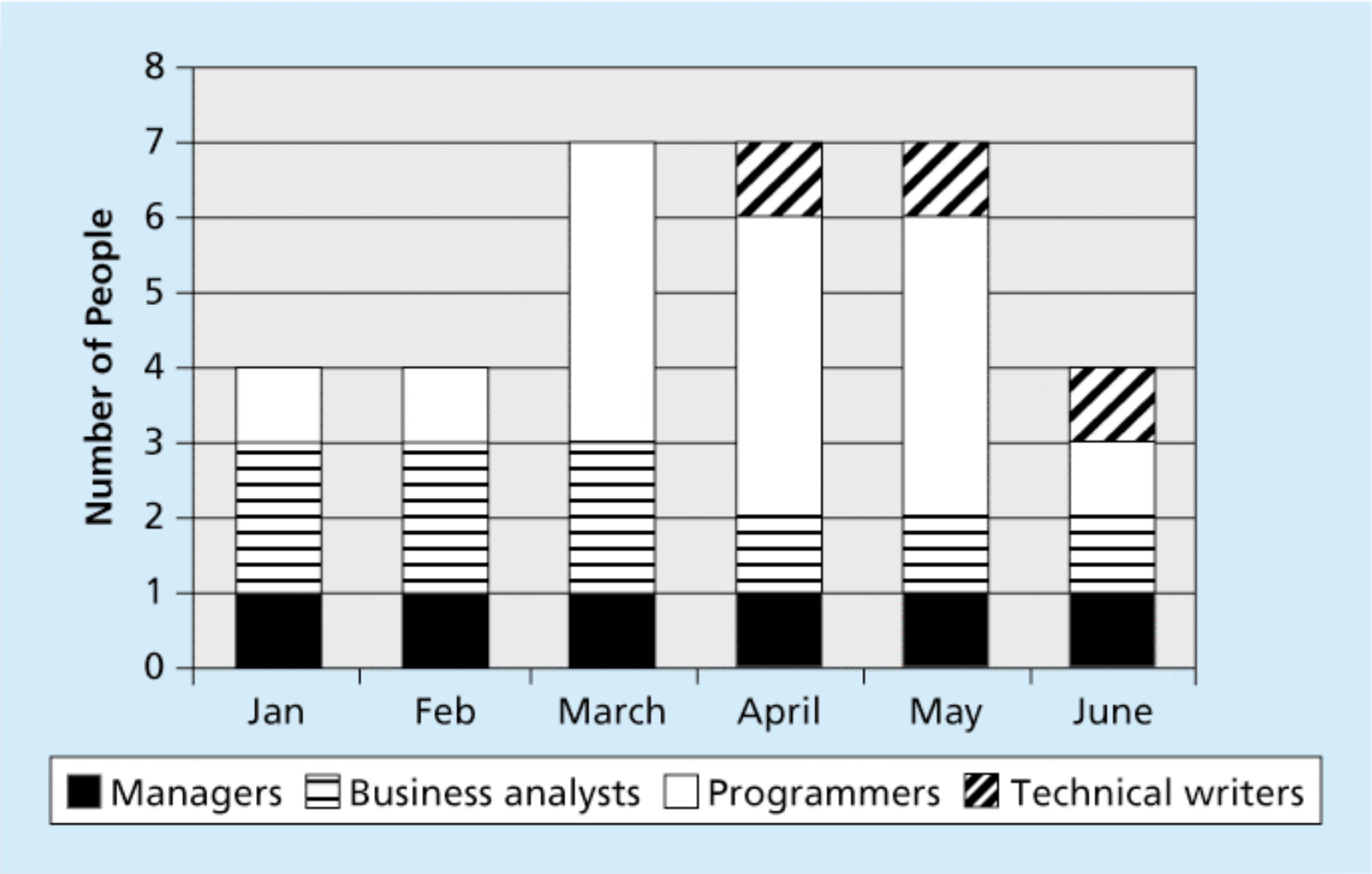
R = responsibility
A = accountability, only one A per task
C = consultation
I = informed

Note that some people reverse the definitions of responsible and accountable.

Staffing Management Plans and Resource Histograms

- A **staffing management plan** describes when and how people will be added to and taken off the project team
- A **resource histogram** is a column chart that shows the number of resources assigned to a project over time.
- Figure 9-7 provides an example of a histogram that might be used for a six-month information technology project.

Figure 9-7. Sample Resource Histogram



Acquiring the Project Team

- Acquiring qualified people for teams is crucial
- The project manager who is the smartest person on the team has done a poor job of recruiting!
- It’s important to assign the appropriate type and number of people to work on projects at the appropriate times

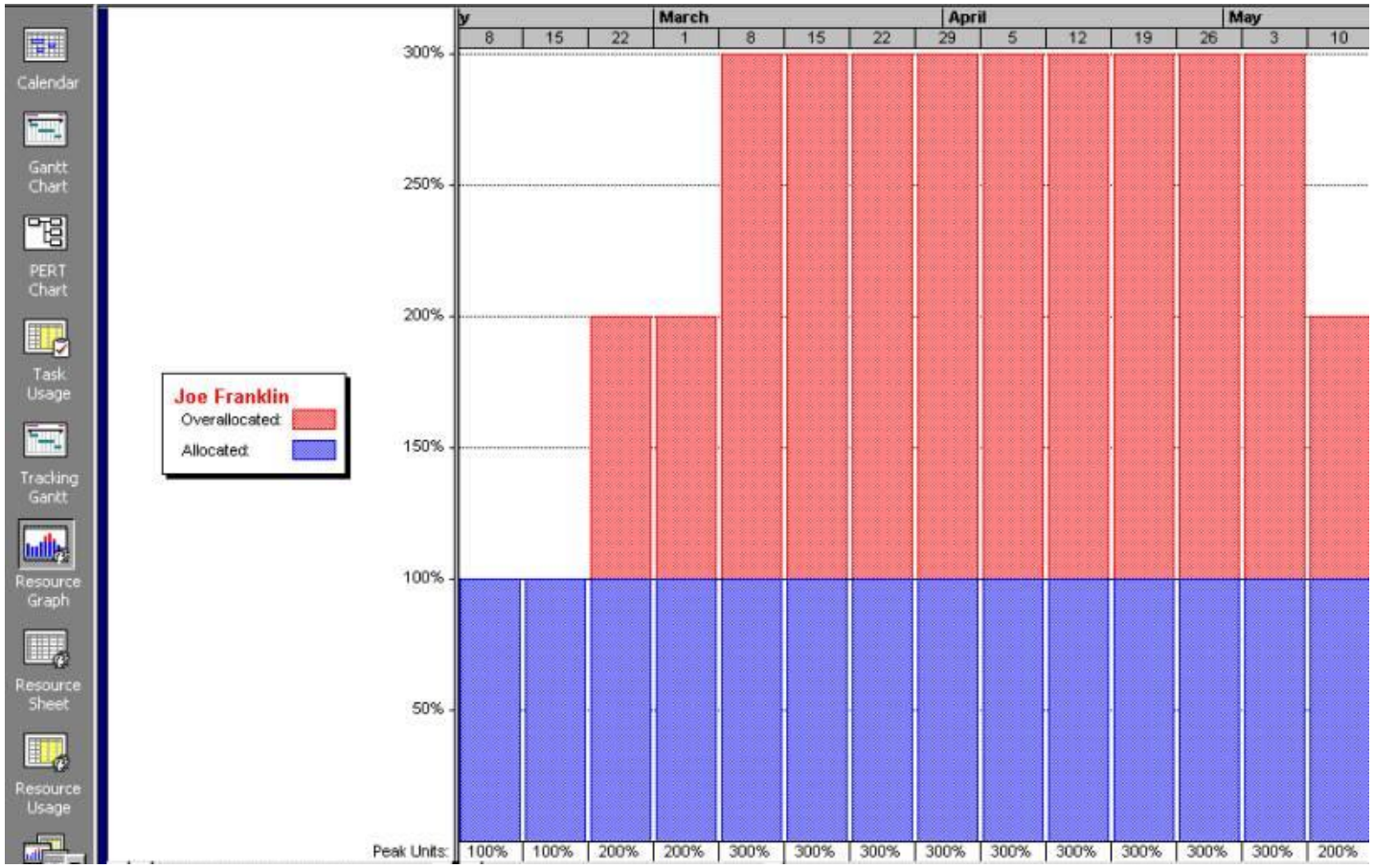
Resource Assignment

- Staffing plans and good hiring procedures are important, as are incentives for recruiting and retention
  - Some companies give their employees one dollar for every hour a new person they helped hire works
  - Some organizations allow people to work from home as an incentive
- Enrollment in U.S. computer science and engineering programs has dropped almost in half since 2000, and one-third of U.S. workers were over the age of 50 by 2010
- CIO's researchers suggest that organizations rethink hiring practices and incentives to hire and retain IT talent

Resource Loading

- **Resource loading** refers to the amount of individual resources an existing schedule requires during specific time periods
- Helps project managers develop a general understanding of the demands a project will make on the organization's resources and individual people's schedules
- **Overallocation** means more resources than are available are assigned to perform work at a given time

Figure 9-7. Sample Histogram Showing an Overallocated Individual



Resource Leveling

- **Resource leveling** is a technique for resolving resource conflicts by delaying tasks
- The main purpose of resource leveling is to create a smoother distribution of resource usage and reduce overallocation

Benefits of Resource Leveling

- Improved project schedule
- Reduced project costs
- Increased productivity
- Improved project quality: By avoiding overloading, resource leveling can help maintain the quality of project deliverables and reduce the risk of errors or rework.
- Better project control
- Overall, resource leveling is a valuable technique for ensuring the success of projects by optimizing resource utilization and balancing the workload of resources.

Developing the Project Team

- The main goal of **team development** is to help people work together more effectively to improve project performance
- It takes teamwork to successfully complete most projects

Tuckman Model of Team Development

- **Forming:** involves the introduction of team members, either at the initiation of the team, or as new members are introduced. This stage is necessary, but little work is actually achieved.
- **Storming:** occurs as team members have different opinions as to how the team should operate.
- **Norming:** is achieved when team members have developed a common working method, and cooperation and collaboration replace the conflict and mistrust of the previous phase
- **Performing:** occurs when the emphasis is on reaching the team goals, rather than working on team process.
- **Adjourning:** involves the break-up of the team after they successfully reach their goals and complete the work

Training

- Training can help people understand themselves, each other, and how to work better in teams
- Team building activities include
  - physical challenges
  - psychological preference indicator tools

Cont'd

- There is an extensive body of literature on team development.
- This section will highlight a few important tools and techniques for team development, including training, team-building activities, and reward and recognition systems

Meyers-Briggs Type Indicator (MBTI)

- MBTI is a popular tool for determining personality preferences and helping teammates understand each other
- Four dimensions include:
  - Extrovert/Introvert (E/I)
  - Sensation/Intuition (S/N)
  - Thinking/Feeling (T/F)
  - Judgment/Perception (J/P)
- NTs or rationals are attracted to technology fields
- IT people vary most from the general population in not being extroverted or sensing

Social Styles Profile

- The Social Styles Profile assesses an individual's behavior along two dimensions: assertiveness and responsiveness.
- **Assertiveness** refers to the degree to which an individual is comfortable expressing their opinions and taking charge in social situations. **Responsiveness** refers to the degree to which an individual is attuned to the needs and feelings of others, and is able to adapt their behavior accordingly.

Social Styles Profile(cont'd)

- People are perceived as behaving primarily in one of four zones, based on their assertiveness and responsiveness:
  - **Drivers** are typically assertive/proactive and task-focused, and are comfortable taking charge in social situations.

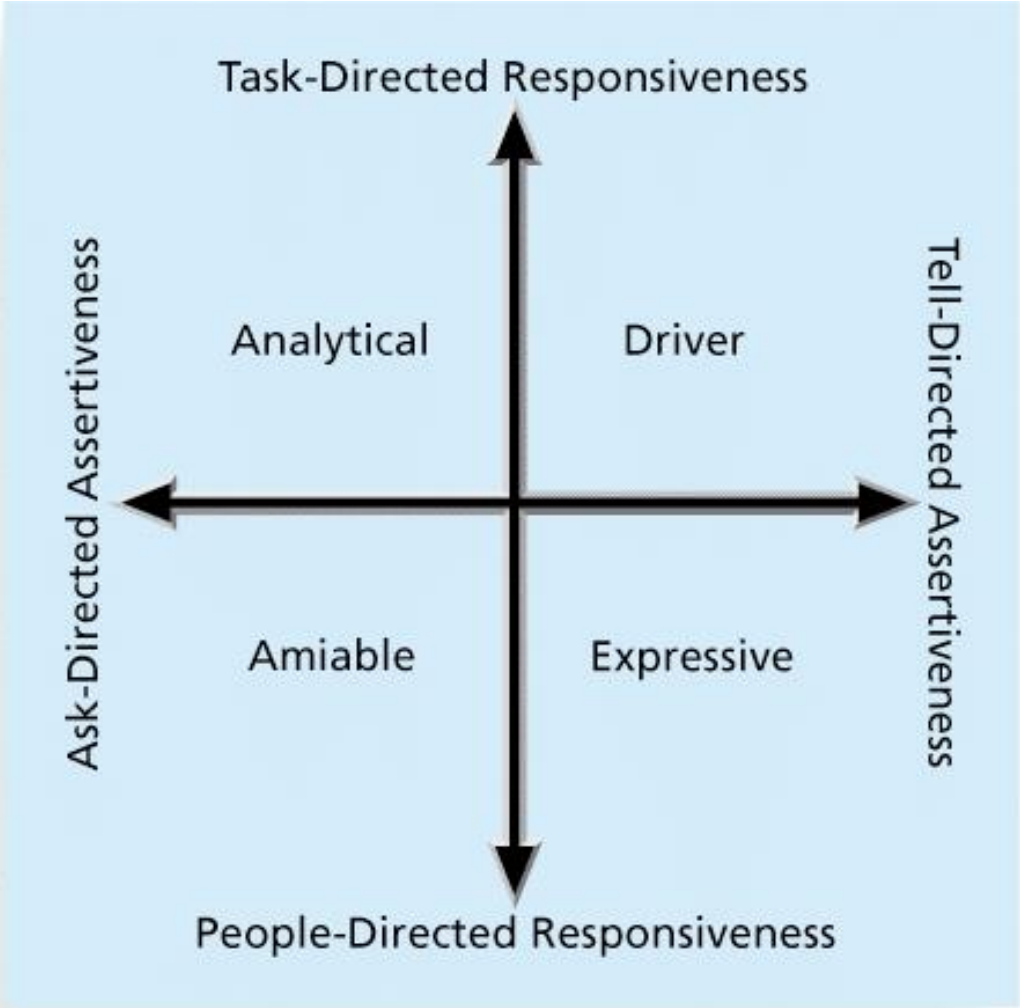
    They are firmly rooted in the present, and they strive for action
  - **Expressives** are assertive/proactive and people-focused, and are comfortable expressing their emotions and building relationships. They are future-oriented

Social Styles Profile(cont'd)

- **Amiables** are responsive/reactive and people-focused, and are skilled at building and maintaining relationships.
- Their time orientation varies depending on whom they are with at the time, and they strongly value relationships.
- **Analyticals** are responsive/reactive and task-focused, and are skilled at analyzing information and problem-solving.

  They are past-oriented and strong thinkers

Figure 9-9. Social Styles



DISC Profiles

- Similar to the Social Styles Profile, the DISC Profile uses a four-dimensional model of normal behavior.
  - Dominance
  - Influence
  - Steadiness
  - Compliance
- People in opposite quadrants can have problems understanding each other

Figure 9-10. The DISC Profile

It

Compliance (Blue)

Data driven, risk averse, concerned, works well alone, prefers processes and procedures, not very communicative or social

I

Dominance (Red)

Direct, decisive, assertive, outcome oriented, competitive, self assured, takes control, has to win

You

Steadiness (Green)

Calm, sincere, sympathetic, cooperative, cautious, conflict averse, good listener, wants to maintain stability

We

Influence (Yellow)

Persuasive, optimistic, outgoing, verbal, enthusiastic, strives to win others over, leadership through acclimation

Reward and Recognition Systems

- Another important tool for promoting team development is the use of team-based reward and recognition systems.
- Team-based reward and recognition systems can promote teamwork
- Focus on rewarding teams for achieving specific goals
- Allow time for team members to mentor and help each other to meet project goals and develop human resources

Managing the Project Team

- Project managers must lead their teams in performing various project activities
- After assessing team performance and related information, the project manager must decide
  - if changes should be requested to the project
  - if corrective or preventive actions should be recommended
  - if updates are needed to the project management plan or organizational process assets.

Tools and Techniques for Managing Project Teams

- Observation and conversation
- Project performance appraisals
- Interpersonal skills
- Conflict management

Conflict Handling Modes

1. **Confrontation**: Directly face a conflict using a problem-solving approach
2. **Compromise**: Use a give-and-take approach
3. **Smoothing**: De-emphasize areas of difference and emphasize areas of agreement
4. **Forcing**: The win-lose approach
5. **Withdrawal**: Retreat or withdraw from an actual or potential disagreement
6. **Collaborating**: Decision makers incorporate different viewpoints and insights to develop consensus and commitment

Figure 9-11. Conflict Handling Modes

Relationship Importance	Task Importance: Low	Task Importance: Medium	Task Importance: High
High	Smoothing/ Accommodating		Confrontation/ Problem-solving Collaborating
Medium		Compromise	
Low	Withdrawal/ Avoidance		Forcing

Conflict Can Be Good

- Conflict often produces important results, such as new ideas, better alternatives, and motivation to work harder and more collaboratively
- **Groupthink**: Conformance to the values or ethical standards of a group. Groupthink can develop if there are no conflicting viewpoints
- Research suggests that task-related conflict often improves team performance, but emotional conflict often depresses team performance

Five Dysfunctions of a Team

- Patrick Lencioni, author of several books on teams, says that "Teamwork remains the one sustainable competitive advantage that has been large untapped"*
- The five dysfunctions of teams are
  1. Absence of trust
  2. Fear of conflict
  3. Lack of commitment
  4. Avoidance of accountability
  5. Inattention to results

*Lencioni, Patrick, "Overcoming the Five Dysfunctions of a Team," Jossey-Bass: San Francisco, CA (2005), p. 3.

General Advice on Teams

- Be patient and kind with your team
- Fix the problem instead of blaming people
- Establish regular, effective meetings
- Allow time for teams to go through the basic team-building stages
- Limit the size of work teams to three to seven members

General Advice on Teams (cont'd)

- Plan some social activities to help project team members and other stakeholders get to know each other better
- Stress team identity
- Nurture team members and encourage them to help each other
- Take additional actions to work with virtual team members

Using Software to Assist in Human Resource Management

- Software can help in producing RAMS and resource histograms
- Project management software includes several features related to human resource management such as
  - Assigning resources
  - Identifying potential resource shortages or underutilization
  - Leveling resources

Project Resource Management Involves Much More Than Using Software

- Project managers must
  - Treat people with consideration and respect
  - Understand what motivates them
  - Communicate carefully with them
- Focus on your goal of enabling project team members to deliver their best work

Chapter Summary

- Project human resource management includes the processes required to make the most effective use of the people involved with a project
- Main processes include
  - Plan human resource management
  - Acquire project team
  - Develop project team
  - Manage project team

End of Chapter-6

Chapter 7: Project Risk Management

Note: See the text itself for full citations.

The Importance of Project Risk Management

- **Project risk management** is the **art** and **science** of identifying, analyzing, and responding to risk throughout the life of a project and in the best interests of meeting project objectives

Negative Risk

- A dictionary definition of risk is “the possibility of loss or injury”
- Negative risk involves understanding potential problems that might occur in the project and how they might impede project success
- Negative risk management is like a form of insurance; it is an investment

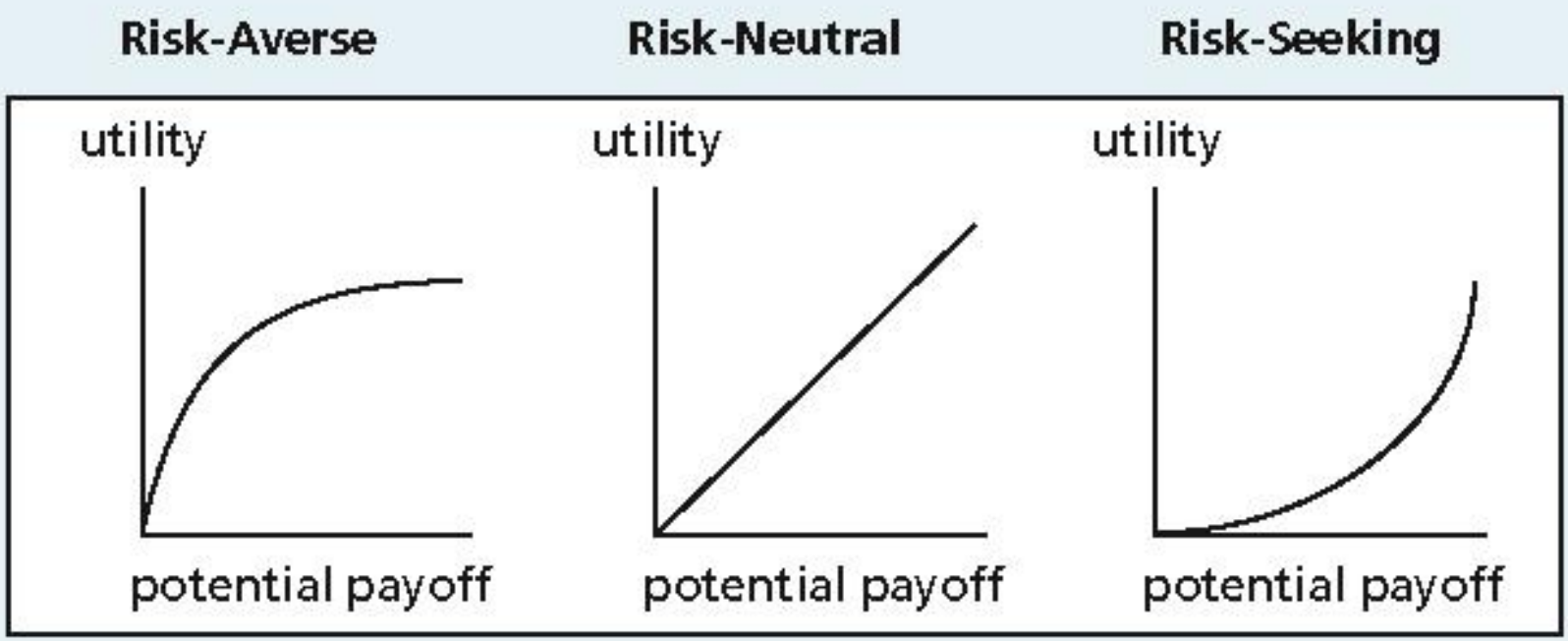
Risk Can Be Positive

- Positive risks are risks that result in good things happening; sometimes called opportunities
- A general definition of project risk is an uncertainty that can have a negative or positive effect on meeting project objectives
- The **goal of project risk management** is to **minimize** potential **negative risks** while **maximizing** potential **positive risks**

Risk Utility

- **Risk utility** or **risk tolerance** is the amount of satisfaction or pleasure received from a potential payoff
  - Utility rises at a decreasing rate for people who are risk-averse
  - Those who are risk-seeking have a higher tolerance for risk and their satisfaction increases when more payoff is at stake
  - The risk-neutral approach achieves a balance between risk and payoff

Figure 11-2. Risk Utility Function and Risk Preference



Cont'd

- Utility rises at a decreasing rate for people who are risk-averse
- Those who are risk-seeking have a higher tolerance for risk and their satisfaction increases when more payoff is at stake
- The risk-neutral approach achieves a balance between risk and payoff

Project Risk Management Processes

- **Planning risk management** : Deciding how to approach and plan the risk management activities for the project
- **Identifying risks**: Determining which risks are likely to affect a project and documenting the characteristics of each
- **Performing qualitative risk analysis**: Prioritizing risks based on their probability and impact of occurrence

Project Risk Management Processes (cont'd)

- **Performing quantitative risk analysis**: Numerically estimating the effects of risks on project objectives
- **Planning risk responses**: Taking steps to enhance opportunities and reduce threats to meeting project objectives
- **Controlling risk**: Monitoring identified and residual risks, identifying new risks, carrying out risk response plans, and evaluating the effectiveness of risk strategies throughout the life of the project

Contingency and Fallback Plans, Contingency Reserves

- **Contingency plans** are predefined actions that the project team will take if an identified risk event occurs
- **Fallback plans** are developed for risks that have a high impact on meeting project objectives, and are put into effect if attempts to reduce the risk are not effective
- **Contingency reserves** or **allowances** are provisions held by the project sponsor or organization to reduce the risk of cost or schedule overruns to an acceptable level; **management reserves** are funds held for unknown risks

Common Sources of Risk in Information Technology Projects

- Several studies show that IT projects share some common sources of risk
- The Standish Group developed an IT success potential scoring sheet based on potential risks
- Other broad categories of risk help identify potential risks

Cont'd

- Identifying risks is the process of understanding what potential events might hurt or enhance a particular project
- Another consideration is the likelihood of advanced discovery
- Risk identification tools and techniques include:
  - **Brainstorming**
  - **The Delphi Technique**
  - **Interview**
  - **SWOT analysis**

Cont'd

- **Brainstorming** is a technique by which a group attempts to generate ideas or find a solution for a specific problem by amassing ideas spontaneously and without judgment
- An experienced facilitator should run the brainstorming session
- Be careful not to overuse or misuse brainstorming.
  - Psychology literature shows that individuals produce a greater number of ideas working alone than they do through brainstorming in small, face-to-face groups
  - Group effects often inhibit idea generation

Cont'd

- **Delphi Technique**

- The **Delphi Technique** is used to derive a consensus among a panel of experts who make predictions about future developments

- Provides independent and anonymous input regarding future events

- Uses repeated rounds of questioning and written responses and avoids the biasing effects possible in oral methods, such as brainstorming

Cont'd

- **Interviewing** is a fact-finding technique for collecting information in face-to-face, phone, e-mail, or instant-messaging discussions

- Interviewing people with similar project experience is an important tool for identifying potential risks

Cont'd

- **SWOT analysis** (strengths, weaknesses, opportunities, and threats) can also be used during risk identification

- Helps identify the broad negative and positive risks that apply to a project

Risk Register

- The main output of the risk identification process is a list of identified risks and other information needed to begin creating a risk register
- A **risk register** is:
  - A document that contains the results of various risk management processes and that is often displayed in a table or spreadsheet format
  - A tool for documenting potential risk events and related information
- **Risk events** refer to specific, uncertain events that may occur to the detriment or enhancement of the project

Risk Register Contents (cont'd)

- Triggers for each risk; **triggers** are indicators or symptoms of actual risk events
- Potential responses to each risk
- The **risk owner** or person who will own or take responsibility for each risk
- The probability and impact of each risk occurring.
- The status of each risk

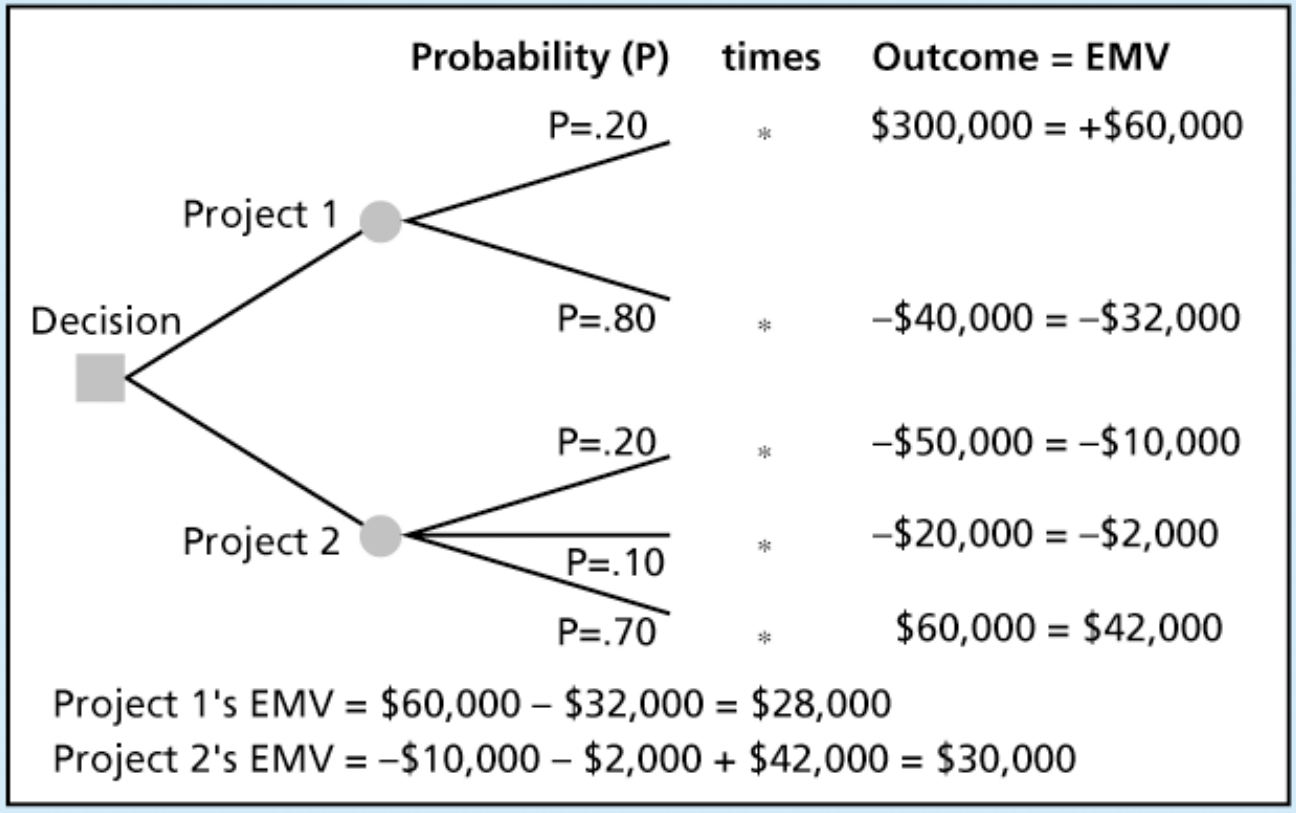
Performing Quantitative Risk Analysis

- Often follows qualitative risk analysis, but both can be done together
- Large, complex projects involving leading edge technologies often require extensive quantitative risk analysis
- Main techniques include:
  - Decision tree analysis
  - Simulation
  - Sensitivity analysis

Decision Trees and Expected Monetary Value (EMV)

- A **decision tree** is a diagramming analysis technique used to help select the best course of action in situations in which future outcomes are uncertain
- **Expected monetary value (EMV)** is the product of a risk event probability and the risk event's monetary value
- You can draw a decision tree to help find the EMV

Figure 11-7. Expected Monetary Value (EMV) Example



Project 1's EMV = $60,000 – $32,000 = $28,000

Project 2's EMV = –$10,000 – $2,000 + $42,000 = $30,000

Simulation

- Simulation uses a representation or model of a system to analyze the expected behavior or performance of the system
- **Monte Carlo analysis** simulates a model's outcome many times to provide a statistical distribution of the calculated results
- To use a Monte Carlo simulation, you must have three estimates (most likely, pessimistic, and optimistic) plus an estimate of the likelihood of the estimate being between the most likely and optimistic values

Planning Risk Responses

- After identifying and quantifying risks, you must decide how to respond to them
- **Four main response strategies for negative risks:**
  - Risk avoidance
  - Risk acceptance
  - Risk transference
  - Risk mitigation

Response Strategies for Positive Risks

- Risk exploitation— Doing whatever you can to make sure a positive risk happens

- Risk sharing— Allocating ownership of a risk to another party
- Risk enhancement— Changing the size of an opportunity by identifying and maximizing key drivers of the positive risk
- Risk acceptance— Accepting the consequences if a risk occurs

End of Software Project Management