MIS360

Foundations for Systems Development

Chapter 1: The Systems Development Environment

Learning Objectives

- Define information systems analysis and design.

- Describe the role of the systems analyst in information systems development.

- Describe the information systems development life cycle (SDLC).

- List alternatives to the systems development life cycle.
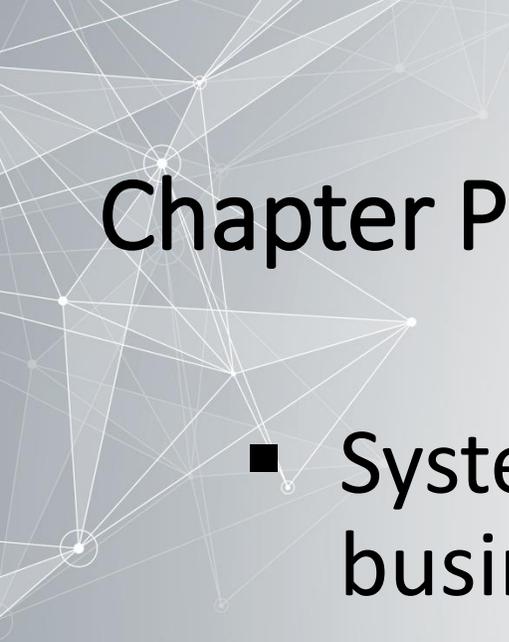
Chapter Preview

- Systems Analysis is a proven method to help a business utilize information to its fullest capacity

- Systems Development Life Cycle (SDLC)
  - Central to Information Systems Development

Chapter Preview

- Information technology (IT) can mean the difference between success and failure for any organization.

- IT is a Combination of hardware and software products and services that companies use to manage, access, communicate, and share information
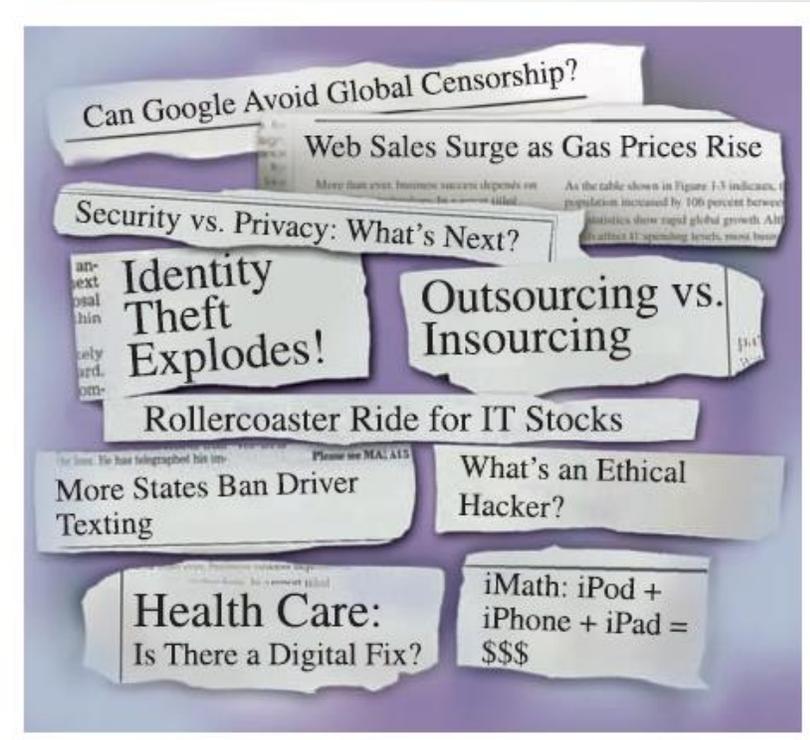
Refresh our memory from MIS300:

- What is a **System**?
  - <u>Means:</u> process of taking an input and producing an output.
  - System is anything that takes an input and generates an output. It is not exclusive to computers.

Refresh our memory from MIS300:

- Examples: Air conditioning System – Respiratory System – Printing System – Computer System.

Refresh our memory from MIS300:

- **Information System:**
  - Information systems have five key elements: ***hardware, software, data, processes, and people (stakeholder)***

- **Hardware** - the physical layer of the information system.

- **Software** – can be *System software* or *Application software*
  - ✓System Software manage the hardware components.
  - ✓Application software consists of programs that support data-to-day business functions and provides users with the information they require.

People

Hardware

Processes

Software
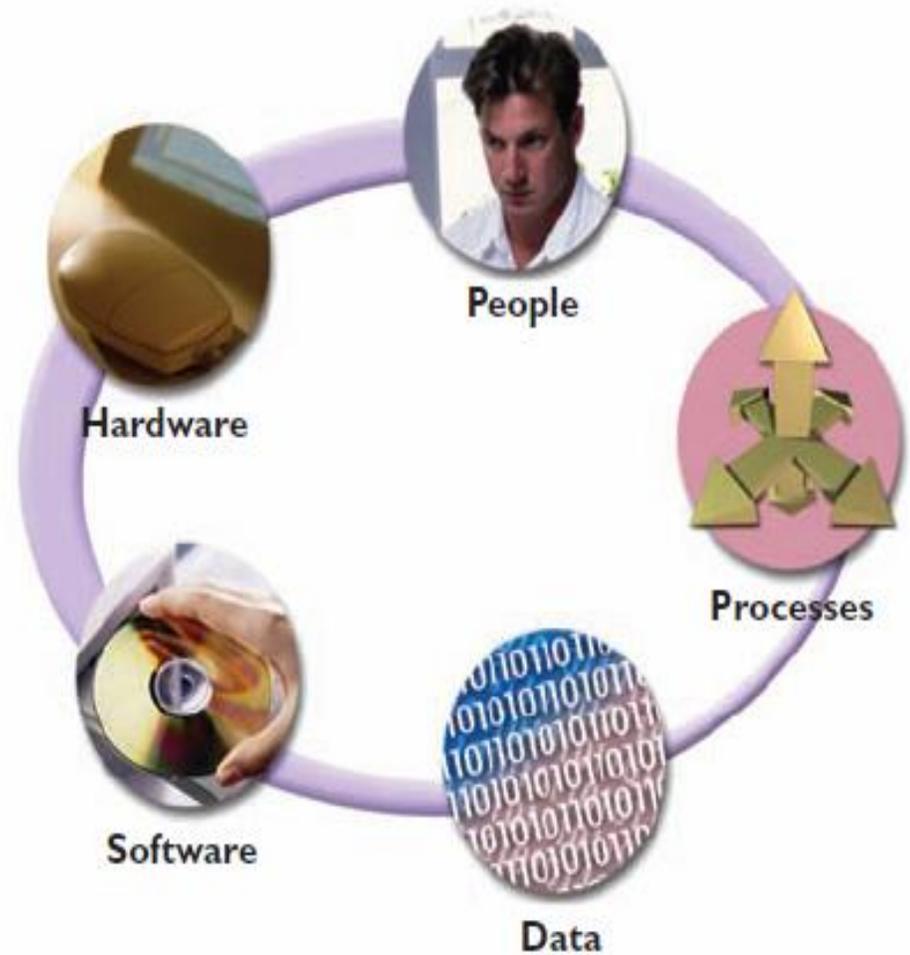
Data

Refresh our memory from MIS300:

- **Information System:**

  - *Data* – raw facts that describe a particular phenomenon such as the current temperature, the price of movie rental, or your age.
    - ✓ **Data** consists of basic facts that are the system's raw material

  - *Information* – data that have a particular meaning within a specific context.
    - ✓ **Information** is data that has been transformed into output that is valuable to *users*

  - *Processes* - Describe the tasks and business functions that users, managers, and IT staff members perform to achieve specific results

People/ Stakeholders:

- Who is a **stakeholder**?
  - A **stakeholder** is any person who has an interest in (is affected by) an existing or proposed information system.
  - Stakeholders can be technical or nontechnical workers.
  - They may also include both internal and external workers.
- **Stakeholders** could be:
  1. System Owners: also called clients & investors.
  2. System Users-(Internal or External): Customers /employees
  3. System Designers: People who know what is needed. Produce the blue prints for the builders.
  4. System Builders: People who will create, deploy, and maintain the system.
  5. System Analysts: specialists who study the problems and needs of an organization. They determine how to improve processes
  6. Project Manager

Understanding The Business

❑ Companies use information technology as a weapon in the battle to increase productivity, deliver quality products and services, maintain customer loyalty, and *make sound decisions*.

❑ IT Professional must understand a company's operations to design successful system.
   Example: retail store, medical practices and hotel chain all have unique information systems requirements.

❑ Systems analysts use a process called **business process modeling** to represent company operations and information needs.

❑ Business process modeling requires a **business profile** and a *series of models* that document business processes

Understanding The Business Concepts

- **Business Profile**: is an overview of a company's mission, functions, organization, products, services, customers, suppliers, competitors, and future direction.

- **Business Process**: is a specific set of transactions, events, and results that can be described and documented.

- **Business Process Model** (BPM): graphically displays one or more business processes, such as handling an airline reservation, filling a product order, or updating a customer account.

BUSINESS MODEL: HANDLE SALES ORDER

Event: Receive Sales Order

Process: Check Customer Status

Process: Verify Customer Credit

Process: Enter Customer Order Data

Result: Completed Sales Order

FIGURE 1-11 A simple business model might consist of an event, three processes, and a result.

What is Information Systems Analysis and Design?

- A method used by companies to create and maintain systems that perform basic business functions.
  - such as keep track of customer names and addresses, processing orders, and paying employees.

- **Main goal:** is to improve employee efficiency by applying software solutions to key business tasks.
 - A system analyst will be at the central of developing this software.

What is Information Systems Analysis and Design? (Continued)

- Systems Analysts perform analysis and design based upon:
  - Understanding of organization's objectives, structure and processes.
  - Knowledge of how to exploit information technology for advantage

  ❖ A structured approach must be used in order to ensure success, such as SDLC

What is Information Systems Analysis and Design? (Continued)

- Fig 1-1 illustrates the Systems Development Life Cycle, a four-phased approach used throughout this text
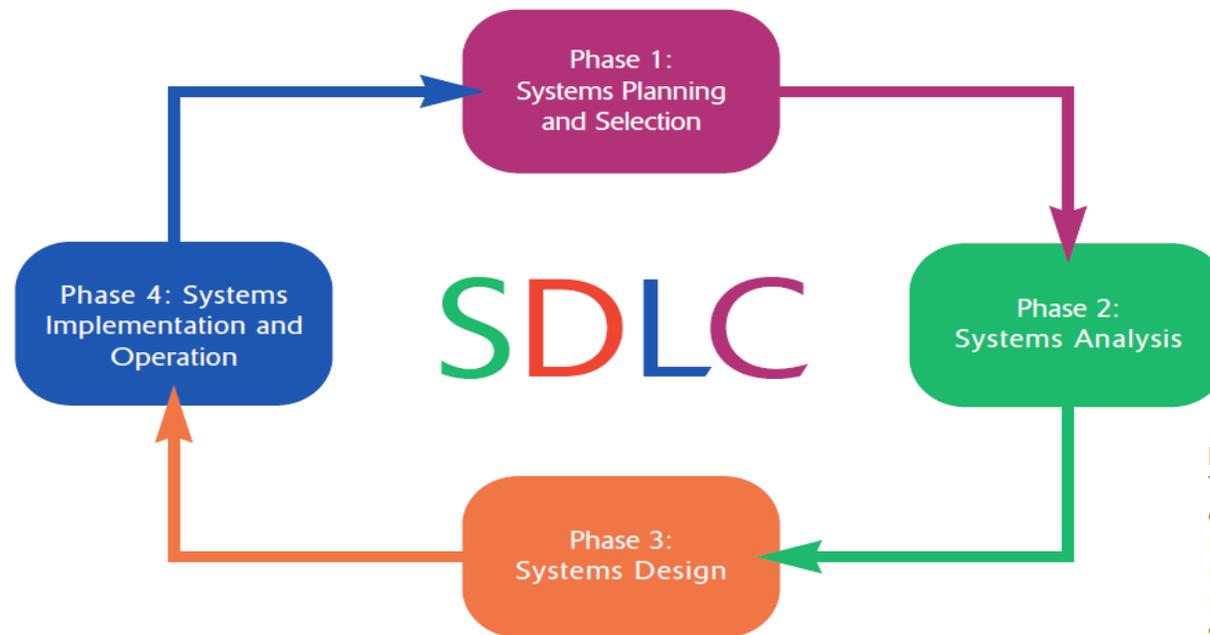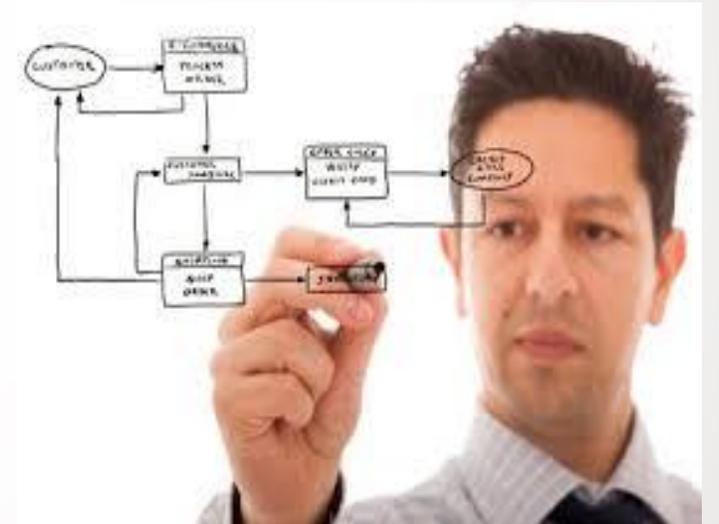

FIGURE 1-1
The four steps of the systems development life cycle (SDLC): (1) planning and selection, (2) analysis, (3) design, and (4) implementation and operation.

System Analyst:

- **System Analyst**:
  - Are specialists who study the problems and needs of an organization.
  - They determine how to improve processes.

System Analyst:

- A system analyst needs:
    - **Knowledge:** Understand both business and computing.
    - **Problem Solver:** They identify problems and opportunities.
    - **Opportunities:** to improve a situation despite the absence of complaints

System Analyst Skills set:

o A systems analyst's Skills set should include:
   1. Analytical thinking skills.
   2. Technical skills.
   3. Managerial Skills
   4. Interpersonal Skills.
   5. Flexibility and adaptability

System Analyst Role in Systems Development

- Study problems and needs of an organization
- Determine best approach to improve organization through use of:
  - People
  - Methods
  - Information technology
- Help system users and managers define their requirements for new or enhanced information systems

Systems Analysis and Design: Core Concepts

- Major goal: to improve organizational systems by developing or acquiring **_application software_**, and training employees in its use

- Application software, or a system: Designed to supports organizational functions or processes, such as inventory management, payroll, or market analysis …

- In addition, System: Turns data into information and includes:
  - Hardware and *system software*
  - Documentation and training materials
  - Job roles associated with the system
  - Controls to prevent theft or fraud
 - The people who use the software to perform their jobs

Systems Analysis and Design: Core Concepts (Continued)

Figure 1.2 illustrates all the components of a computer-based information system application.

Figure 1-2 addresses all the dimensions of the overall system.

Emphasis on application software development, which is the primary responsibility as a systems analyst.

Figure 1.2 Components of a Computer-Based Information System Application

Hardware

Computer-Based Information System Application

System Software

Specific Job Roles

Controls

Users of the System

Documentation and Training Manuals
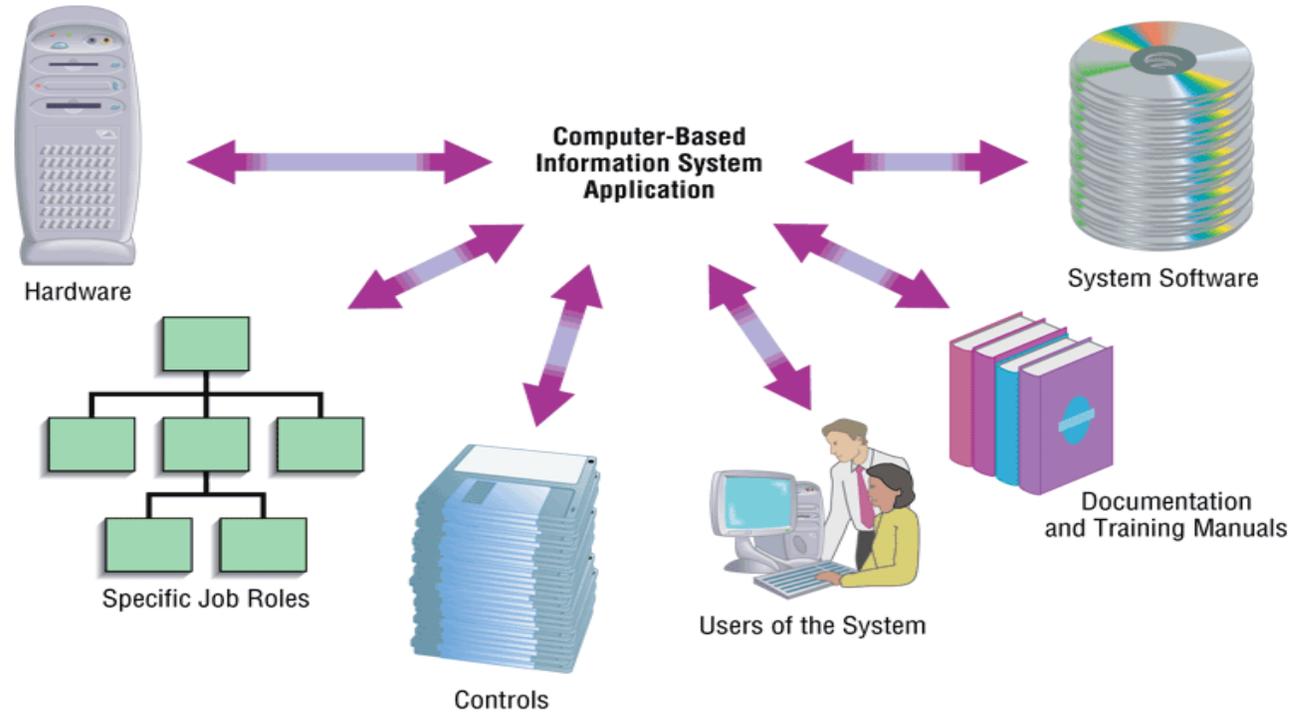
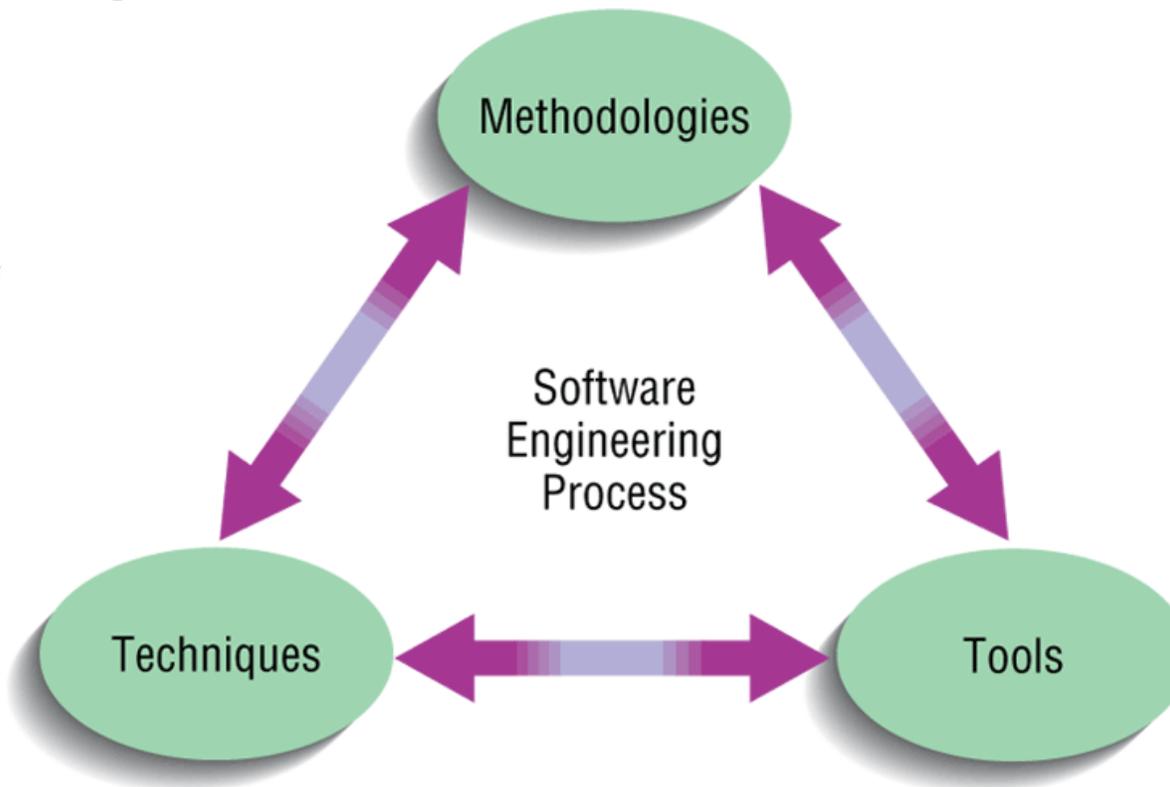# Systems Analysis and Design: Core Concepts (Continued)

❑ *Software Engineering Process*

- A process used to create an information system

- Consists of:

  - **Methodologies**
    - A sequence of step-by-step approaches that help develop the information system

  - **Techniques**
    - Processes that the analyst follows to ensure, complete and comprehensive analysis and design

  - **Tools**
    - Computer programs that aid in applying techniques

Systems Analysis and Design: Core Concepts (Continued)

The three elements work together to form an organizational approach to systems analysis and design

Figure 1.3 The software engineering process uses methodologies, techniques, and tools.

Methodologies

Software Engineering Process

Techniques

Tools

Systems Analysis and Design: Core Concepts (Continued)

❑ *System*

*A system is an interrelated set of business procedures used within one business unit, working together for a purpose*

— A system has nine characteristics

— A system exists within an environment

— A boundary separates a system from its environment

— A system takes input from outside, processes it, and sends the resulting output back to its environment.

➢ Characteristics of a System

1. Components
2. Interrelated Components
3. Boundary
4. Purpose
5. Environment
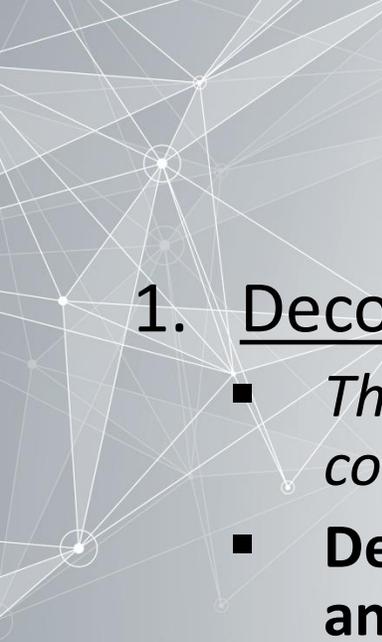6. Interfaces
7. Constraints
8. Input
9. Output

Figure 1.4 Seven Characteristics of a System
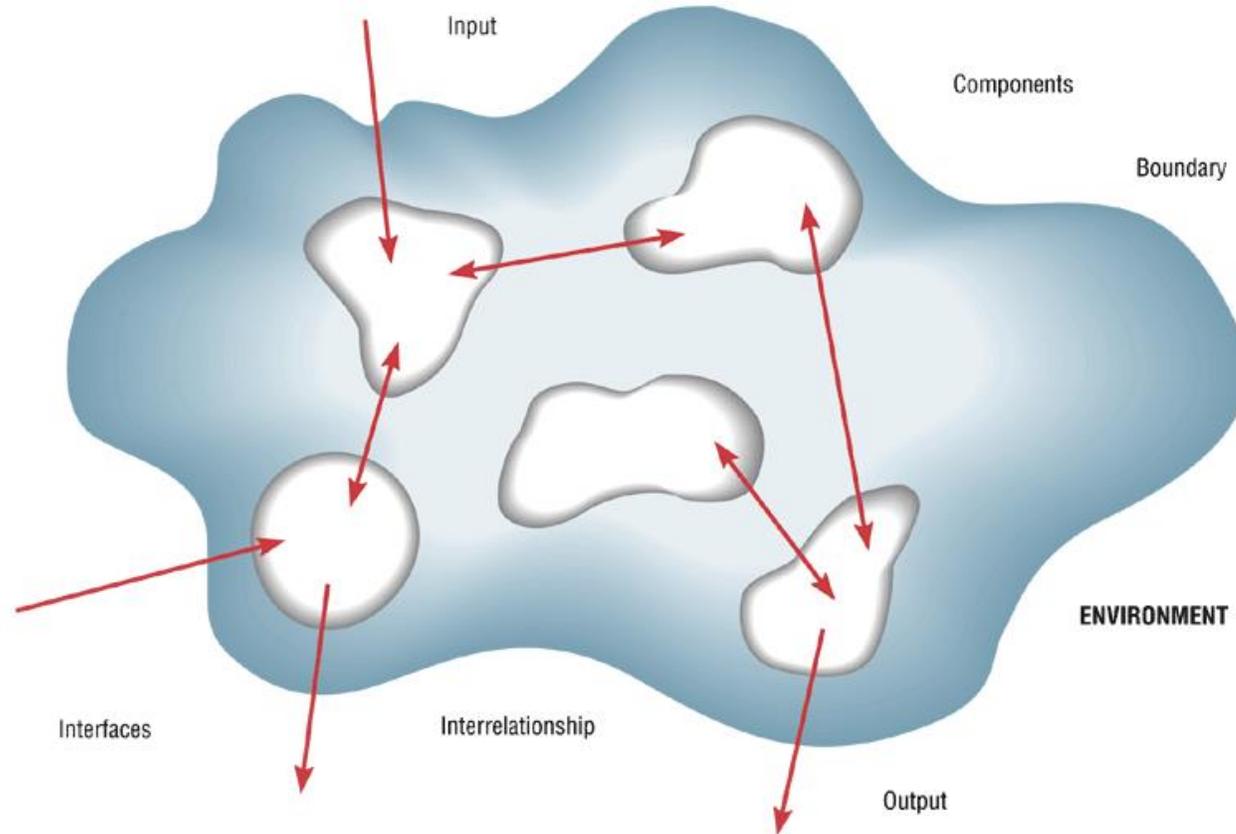
➢ Important System Concepts:

1. *Decomposition (Functional Decomposition)*
2. *Modularity*
3. *Coupling*
4. *Cohesion*

➢ Important System Concepts:

1. Decomposition (Functional Decomposition)
   - *The process of breaking down a system into smaller components, also called subsystems*
   - **Decomposition is a technique that allows the systems analyst to:**
     - Break a system into small, manageable and understandable subsystems
     - Focus on one area at a time, without interference from other areas.
     - Concentrate on component related to one group of users without confusing users with unnecessary details.
     - Build different components at independent times and have the help of different analysts.

➢ **Important System Concepts:** continued

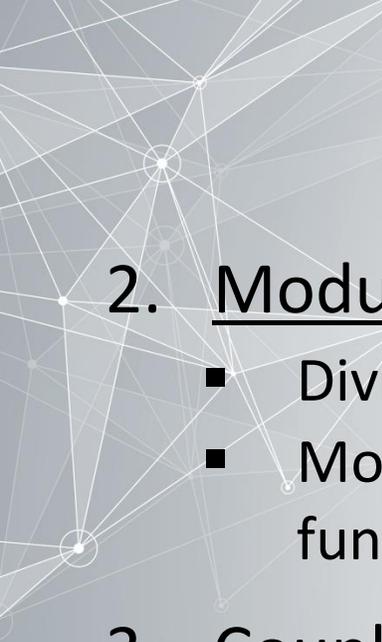Decomposing an MP3 player into three separated physical subsystems.
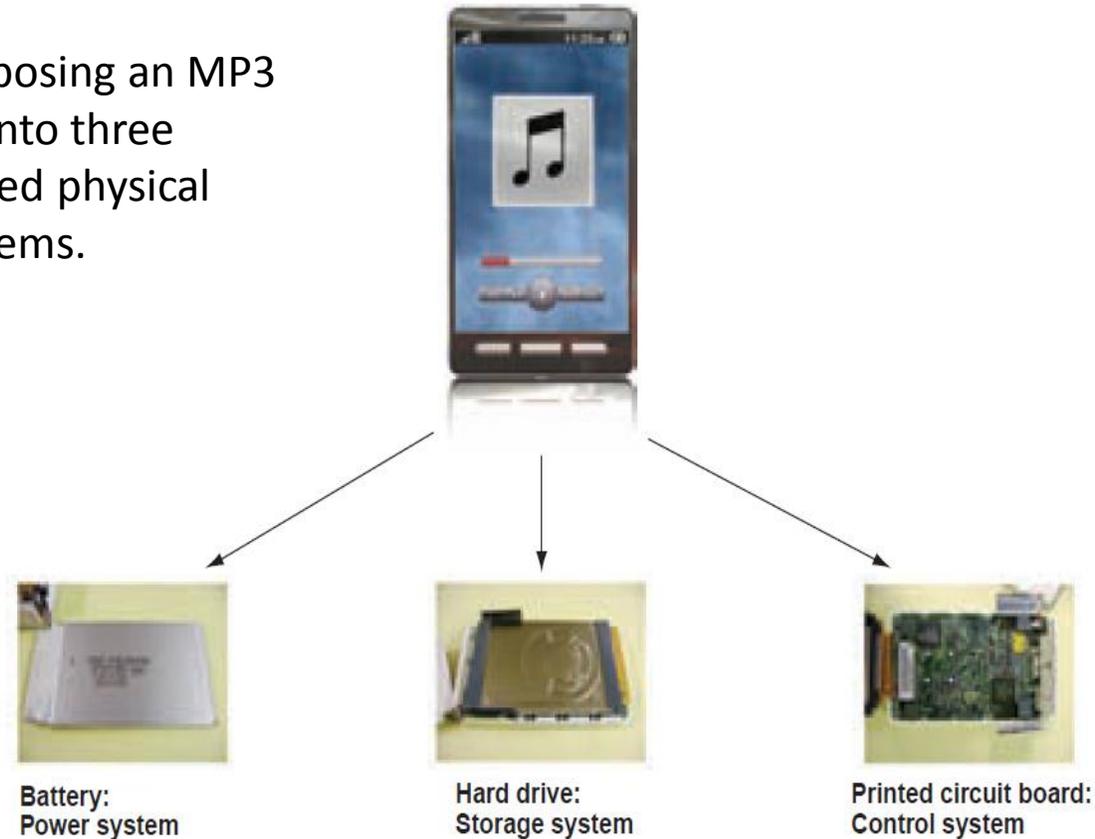
FIGURE 1-6
An MP3 player is a system with power supply, storage and control subsystems.

Sources: Shutterstock; ©Harald van Arkel/Chipmunk International;

Battery:
Power system

Hard drive:
Storage system

Printed circuit board:
Control system

➢ **Important System Concepts**: continued

2. <u>Modularity</u>: It is a direct result of decomposition
   ▪ Dividing a system into chunks/modules of a relatively uniform size.
   ▪ Modules simplify system design; each module comes with it is own functionality and design specifications.

3. <u>Coupling:</u> It is the extent to which subsystems depend on each other.
   ▪ Subsystems that are dependent upon each other are ***coupled.***

4. <u>Cohesion</u>: It is the extent to which a subsystem performs a single function

A Modern Approach to Systems Analysis and Design

— 1950s: focus on efficient automation of existing processes

— 1960s: advent of procedural third generation languages (3GL) faster and more reliable computers

— 1970s: system development becomes more like an *engineering discipline*

— 1980s: major breakthrough with 4GL, CASE tools, object-oriented methods

— 1990s: focus on **system integration**, GUI applications, client/server platforms, Internet

— The new century: Web application development, wireless PDAs and smart phones, component-based applications, per-use cloud-based application services.

A Modern Approach to Systems Analysis and Design
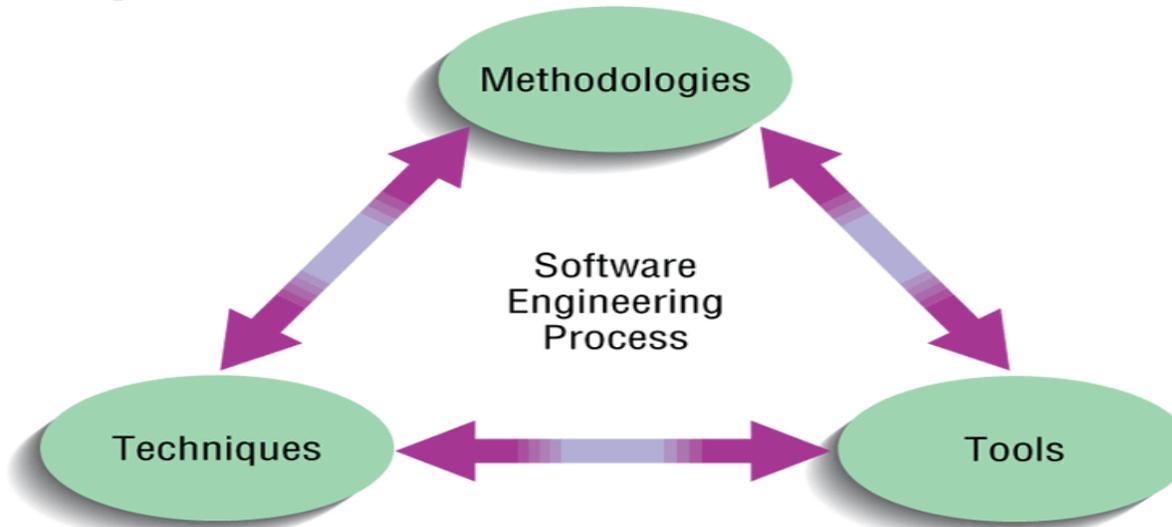
❑ **Systems Integration**

- The process of building a unified information system out of diverse components of purchased software, custom-built software, hardware, and networking.

- Allows hardware and software from different vendors to work together.

- Enables procedural language systems to work with visual programming systems.

- Visual programming environment uses client/server model.

Developing Information Systems and the Systems Development Life Cycle

- ### *Systems Development:*

  Business information systems are developed by people who are technically qualified, business-oriented, and highly motivated.

The three elements work together to form an organizational approach to systems analysis and design

Figure 1.3 The software engineering process uses methodologies, techniques, and tools.

Methodologies

Software Engineering Process

Techniques

Tools

System Development Techniques and tools

- In addition to *understanding business operations*,
- systems analysts must know how to use a variety of techniques

such as

modeling, prototyping, and computer-aided systems engineering (Case) tools

to plan, analyze, design, and implement information systems

System Development Techniques and tools

❑ ***Modeling:*** produces a graphical representation of a concept or process that systems developers can analyze, test, and modify.

— A systems analyst can describe and simplify an information system by using a set of *business*, *data*, *object*, *network*, and *process* models.

o **Business Model (Requirement Model):** describes the information/ functions that a system must provide.

Requirement Modeling:
✓ involves fact-finding to describe the current system.
✓ Identification and structuring of the requirements for the new system, such as **outputs**, **inputs**, **processes**, **performance**, and **security**.

System Development Techniques and tools

❑ ***Modeling:*** produces a graphical representation of a concept or process that systems developers can analyze, test, and modify.

o **Process Model:** describes the logic that programmers use to write code modules.

o **Data model** describes data structures and design.

We will use the process modeling and data modeling to continue the modeling process by learning how to represent graphically system data and processes using traditional ***structured analysis techniques*** that treats processes and data as separated components

o **Object model** describes objects, which combine data and processes.
It use **object-oriented analysis (O-O) technique** .

System Development Methods

- **<u>Structured Analysis</u>**
  - Systems development life cycle (SDLC)
  - Predictive approach
  - Uses a set of process models to describe a system graphically
  - Process-centered technique
  - Waterfall model
  - The SDLC model usually includes steps as:
    - Systems planning
    - Systems analysis
    - Systems design
    - Systems implementation
    - Systems support and security
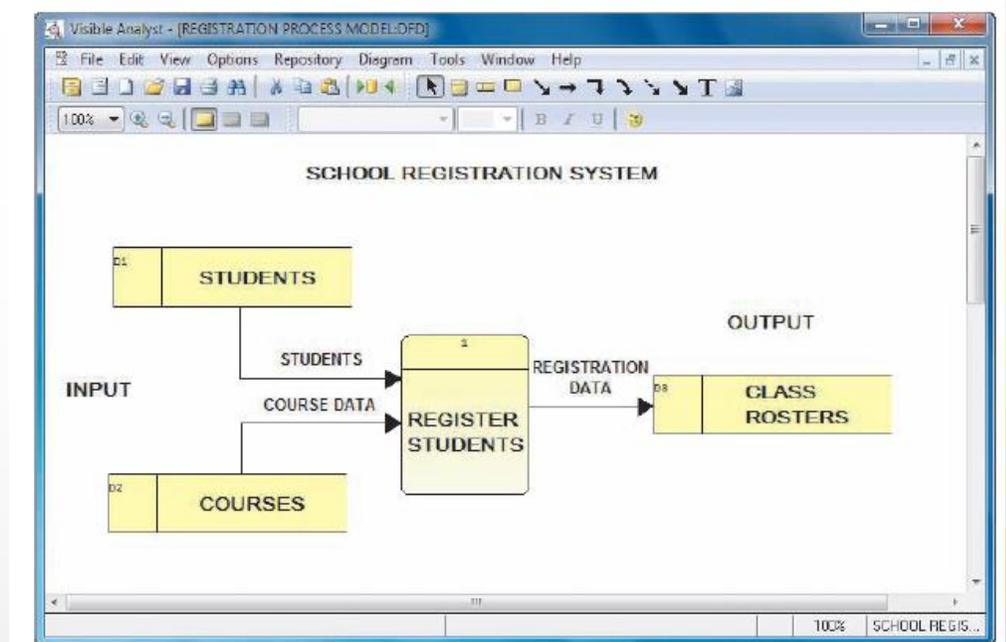
System Development Methods

- **Object-oriented Analysis**
  - Combines data & processes that act on the data into things called objects
  - Object is a member of a class
  - Objects possess properties
  - Methods change an object's properties
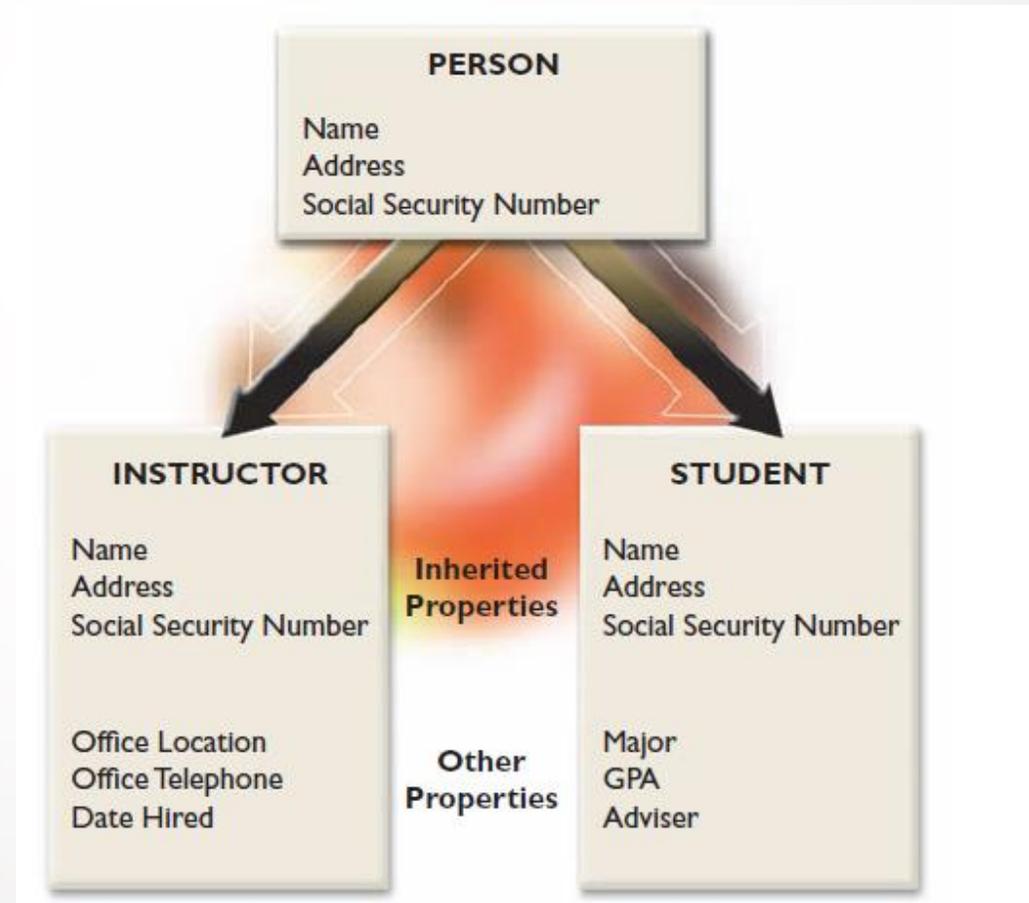
System Development Methods

- **<u>Other Development Methods</u>**
  - Agile Methods
  - Joint application development (JAD)
  - Rapid application development (RAD)

Developing Information Systems and the Systems Development Life Cycle
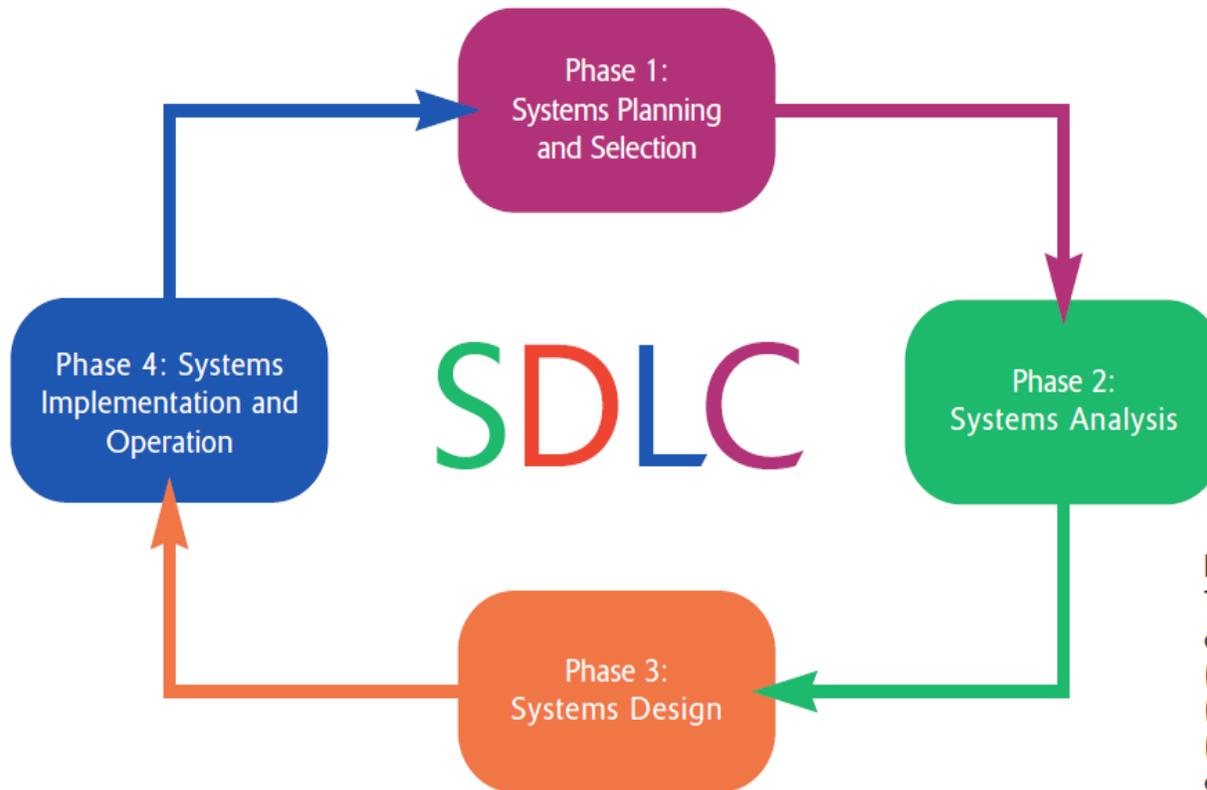
- ***Systems Development:***

Business information systems are developed by people who are technically qualified, business-oriented, and highly motivated

- ***Systems Development Methodology***
  - A standard process followed in an organization to conduct all the steps necessary to
    - analyze
    - design
    - implement
    - and maintain information systems.

Developing Information Systems and the Systems Development Life Cycle (Continued)

❑ <u>Systems Development Life Cycle (SDLC)</u> (Structured Analysis)

- Series of steps used to manage the phases of development for an information system
- Consists of four phases:
  - Planning and Selection
  - Analysis
  - Design
  - Implementation and Operation.
- Phases are not necessarily sequential
- Each phase has a specific outcome and deliverable
- Every company customizes the life-cycle model to its individual needs

FIGURE 1-1
The four steps of the systems development life cycle (SDLC): (1) planning and selection, (2) analysis, (3) design, and (4) implementation and operation.

Developing Information Systems and the Systems Development Life Cycle (Continued)

❑ <u>Phases of the Systems Development Life Cycle:</u>

1. **Systems Planning and Selection**

   - Two Main Activities
     - Identification of needs
     - Investigation and determination of scope

2. **Systems Analysis**

   - Study of current procedures and information systems.
   - Analysis has several sub-phases:
     1. Determine requirements
     2. Study and Structure requirements according to their interrelationships
        - Generate alternative designs
        - Compare alternatives
     3. Recommend best alternative.
   - The output: a description of the alternative solution recommended by the analysis team.

❑ <u>Phases of the Systems Development Life Cycle:</u> (continued)

3. **System Design**
   - Logical Design
     - Concentrates on business aspects of the system
   - Physical Design
     - Technical specifications

4. **System Implementation and Operation**
   - Implementation
     - Hardware and software installation
     - Programming
     - User Training
     - Documentation
   - Operation
     - System changed to reflect changing conditions
     - System obsolescence

Alternative (Specialized) Approaches to System Development:

❑ In this chapter we will discuss Seven approaches (techniques, tools and methods) to system development:

1. Prototyping.
2. Computer-Assisted Software Engineering (CASE) Tools.
3. Joint Application Design (JAD)
4. Rapid Application Development (RAD)
5. Agile Methodologies

Alternative (Specialized) Approaches to System Development:

❑ **<u>Prototyping</u>**

- ▪ Building a scaled-down working version of the system.

- ▪ Advantages:

    - ▪ Users are involved in design

    - ▪ Captures requirements in concrete form.

Alternative (Specialized) Approaches to System Development: (Continued)

❑ **Computer-Assisted Software Engineering (CASE) Tools**

- Automated software tools used by systems analysts to develop information systems.

- Can be used throughout SDLC

- Product and tool integration is provided through a repository: A central repository provides integrated storage of diagrams, reports, and project management specifications.

Alternative (Specialized) Approaches to System Development: (CASE) Tools (Continued)

❖ <u>General types of CASE tools</u>

1. Diagramming tools enable graphical representation.

2. Computer display and report generators help prototype how systems "look and feel".

3. Analysis tools automatically check for consistency in diagrams, forms, and reports.

Alternative (Specialized) Approaches to System Development: (CASE) Tools (Continued)

❖ <u>General types of CASE tools</u>

4. A central repository provides integrated storage of diagrams, reports, and project management specifications.

5. Documentation generators standardize technical and user documentation.

6. Code generators enable automatic generation of programs and database code directly from design documents, diagrams, forms, and reports.

CASE Tools (Cont.)

TABLE 1-2 Examples of CASE Usage within the SDLC

SDLC Phase	Key Activities	CASE Tool Usage
Project identification and selection	Display and structure high-level organizational information	Diagramming and matrix tools to create and structure information
Project initiation and planning	Develop project scope and feasibility	Repository and documentation generators to develop project plans
Analysis	Determine and structure system requirements	Diagramming to create process, logic, and data models
Logical and physical design	Create new system designs	Form and report generators to prototype designs; analysis and documentation generators to define specifications
Implementation	Translate designs into an information system	Code generators and analysis, form and report generators to develop system; documentation generators to develop system and user documentation
Maintenance	Evolve information system	All tools are used (repeat life cycle)

Alternative (Specialized) Approaches to System Development : (Continued)

- **Joint Application Design (JAD)**

  - Users, Managers and Analysts work together for several days

  - System requirements are reviewed

  - Structured meetings

- **Rapid Application Development (RAD)**

  - Utilizes prototyping to delay producing system design until after user requirements are clear

Alternative (Specialized) Approaches to System Development: (Continued)

❑ **Agile Methodologies**

- Motivated by recognition of software development as fluid, unpredictable, and dynamic.

- Three key principles

    - Adaptive rather than predictive

    - Emphasize people rather than roles

    - Self-adaptive processes
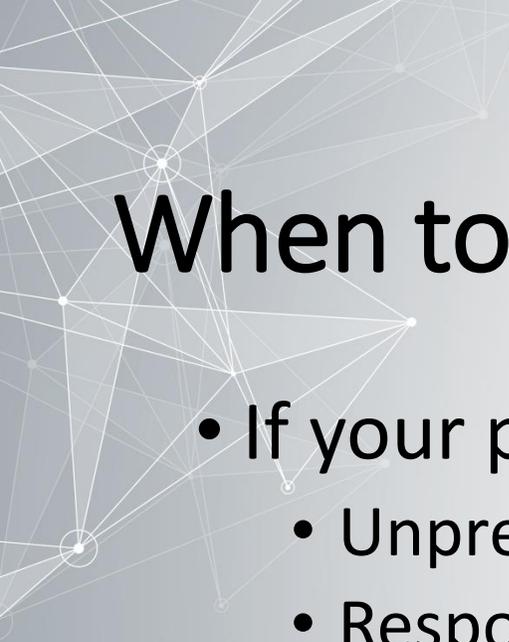
When to use Agile Methodologies

- If your project involves:
  - Unpredictable or dynamic requirements
  - Responsible and motivated developers
  - Customers who understand the process and will get involved

TABLE 1-4   Five Critical Factors That Distinguish Agile and Traditional Approaches to Systems Development

Factor	Agile Methods	Traditional Methods
Size	Well matched to small products and teams. Reliance on tacit knowledge limits scalability.	Methods evolved to handle large products and teams. Hard to tailor down to small projects.
Criticality	Untested on safety-critical products. Potential difficulties with simple design and lack of documentation.	Methods evolved to handle highly critical products. Hard to tailor down to products that are not critical.
Dynamism	Simple design and continuous refactoring are excellent for highly dynamic environments but a source of potentially expensive rework for highly stable environments.	Detailed plans and Big Design Up Front, excellent for highly stable environment but a source of expensive rework for highly dynamic environments.
Personnel	Requires continuous presence of a critical mass of scarce experts. Risky to use non-agile people.	Needs a critical mass of scarce experts during project definition but can work with fewer later in the project, unless the environment is highly dynamic.
Culture	Thrives in a culture where people feel comfortable and empowered by having many degrees of freedom (thriving on chaos).	Thrives in a culture where people feel comfortable and empowered by having their roles defined by clear practices and procedures (thriving on order).

# Alternative (Specialized) Approaches to System Development: (Continued)

❑ Object-Oriented Analysis and Design (OOAD)

- Based on objects rather than data or processes
- **Object**: a structure encapsulating attributes and behaviors of a real-world entity
- **Object class**: a logical grouping of objects sharing the same attributes and behaviors
- **Inheritance**: hierarchical arrangement of classes enable subclasses to inherit properties of superclasses.

Summary

- Information systems analysis and design
  - Process of developing and maintaining an information system
- Modern approach to systems analysis
  - Process-oriented
  - Data-oriented
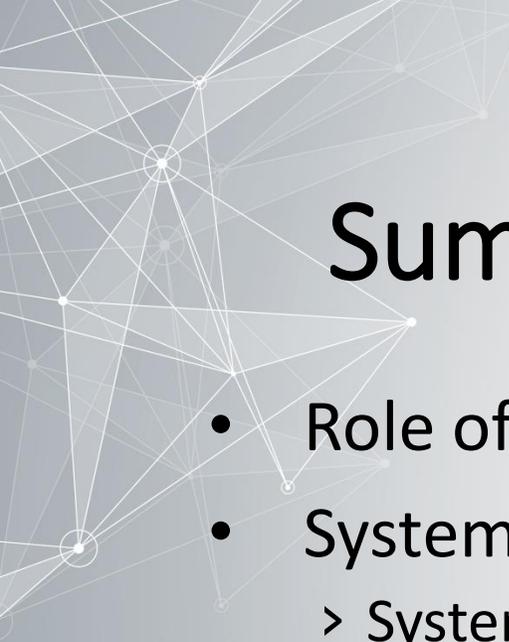
Summary: (continued)

- Role of Systems Analyst

- Systems Development Life Cycle (SDLC)
  - › Systems Planning and Selection
  - › Systems Analysis
  - › Systems Design
  - › Systems Implementation

Summary: (continued)

- Alternatives to Systems Development Life Cycle
    - Prototyping
    - Rapid Application Development (RAD)
    - CASE
    - Joint Application Design (JAD)
    - Participatory Design (PD)
    - Agile Methodologies