Chapter 1

Systems Development in an Organization Context

Learning Objectives

- ✓ Define information systems analysis and design.
- ✓ Describe the information Systems Development Life Cycle (SDLC).
- ✓ Explain Rapid Application Development (RAD), prototyping, Computer Aided Software Engineering (CASE), and Service-Oriented Architecture (SOA).
- ✓ Describe agile methodologies and eXtreme programming.
- ✓ Explain Object Oriented Analysis and Design and the Rational Unified Process (RUP).

Introduction

- Information Systems Analysis and Design
  - Complex organizational process
  - Used to develop and maintain computer-based information systems
  - Used by a team of business and systems professionals

Introduction (Cont.)

- Information Systems Analysis and Design (cont.)
  - based on
    1. The understanding of the organization's objectives, structure, and processes.
    2. Knowledge of how to exploit IT for advantages.
  - One of the important results is

    Application Software
  - Our goal in this course is to emphasize application software development , the primary responsibility of a **system analyst**.

Introduction (Cont.)

- Application Software
  - Computer software designed to support organizational functions or processes
- Systems Analyst
  - Organizational role most responsible for analysis and design of information systems
    - Study the problems and needs of organization.
    - Determine how people, methods and IT combined to improve the organization.

Introduction (Cont.)

FIGURE 1-1 An organizational approach to systems analysis and design is driven by methodologies, techniques, and tools

A Modern Approach to Systems Analysis and Design

- 1950s: focus on efficient automation of existing processes
- 1960s: advent of 3GL, faster and more reliable computers
- 1970s: system development becomes more like an engineering discipline

A Modern Approach to Systems Analysis and Design (Cont.)

- 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, component-based applications

Developing Information Systems

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

Systems Development Life Cycle (SDLC)

- Traditional methodology used to develop, maintain, and replace information systems.
- Phases in SDLC:
  - Planning
  - Analysis
  - Design
  - Implementation
  - Maintenance

SDLC Characteristics

- Circular Processes
- In any phase, the project can return to an earlier phase if necessary
- It can complete some activities in one phase in parallel with some activities of another phase
- Sometimes it is iterative; phases are repeated as required until an acceptable system is found
- Sometimes it considered to be a spiral, cycle through the phase at different levels of detail
- Software is the most end product; other outputs include documentation and training.

Standard and Evolutionary Views of SDLC

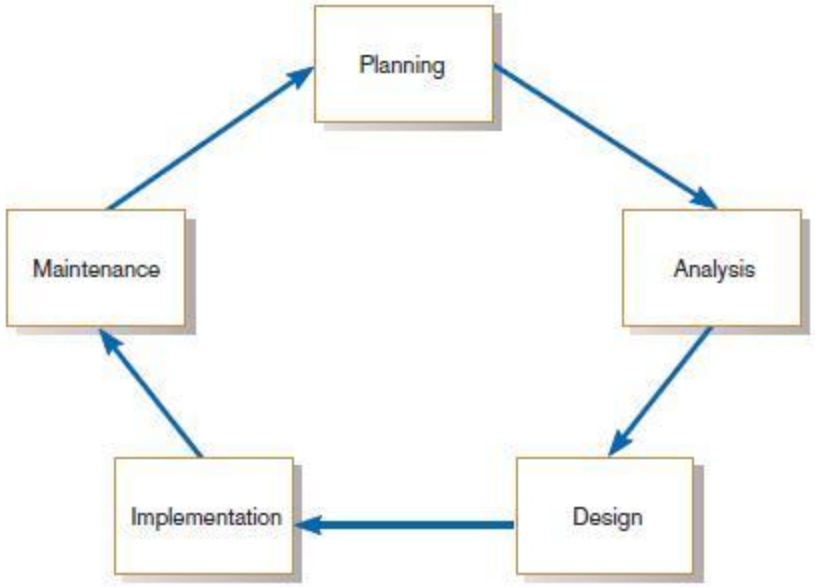


FIGURE 1-2
The systems development life cycle

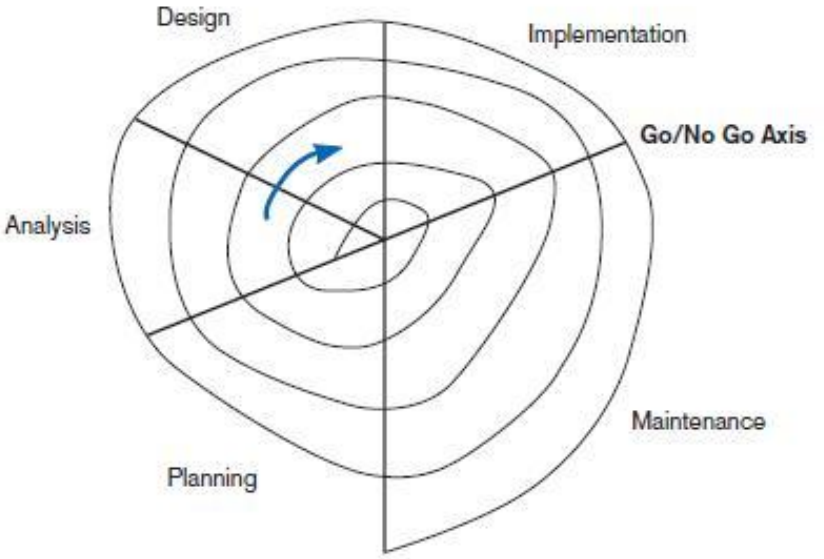


FIGURE 1-3 Evolutionary model

Systems Development Life Cycle (SDLC) (Cont.)

- **Planning** – an organization's total information system needs are identified, analyzed, prioritized, and arranged
- **Analysis** – system requirements are studied and structured
- **Design** – a description of the recommended solution is converted into logical and then physical system specifications

Systems Development Life Cycle (SDLC) (Cont.)

- **Logical design** – all functional features of the system chosen for development in analysis are described independently of any computer platform

- **Physical design** – the logical specifications of the system from logical design are transformed into the technology-specific details from which all programming and system construction can be accomplished

Systems Development Life Cycle (SDLC) (Cont.)

- **Implementation** – the information system is coded, tested, installed and supported in the organization
- **Maintenance** – an information system is systematically repaired and improved

TABLE 1-1 Products of SDLC Phases

Phase	Products, Outputs, or Deliverables
Planning	Priorities for systems and projects; an architecture for data, networks, and selection hardware, and IS management are the result of associated systems
	Detailed steps, or work plan, for project
	Specification of system scope and planning and high-level system requirements or features
	Assignment of team members and other resources
	System justification or business case
Analysis	Description of current system and where problems or opportunities are with a general recommendation on how to fix, enhance, or replace current system
	Explanation of alternative systems and justification for chosen alternative
Design	Functional, detailed specifications of all system elements (data, processes, inputs, and outputs)
	Technical, detailed specifications of all system elements (programs, files, network, system software, etc.)
	Acquisition plan for new technology
Implementation	Code, documentation, training procedures, and support capabilities
Maintenance	New versions or releases of software with associated updates to documentation, training, and support

The Heart of the Systems Development Process

FIGURE 1-7
The analysis–design–code–test loop

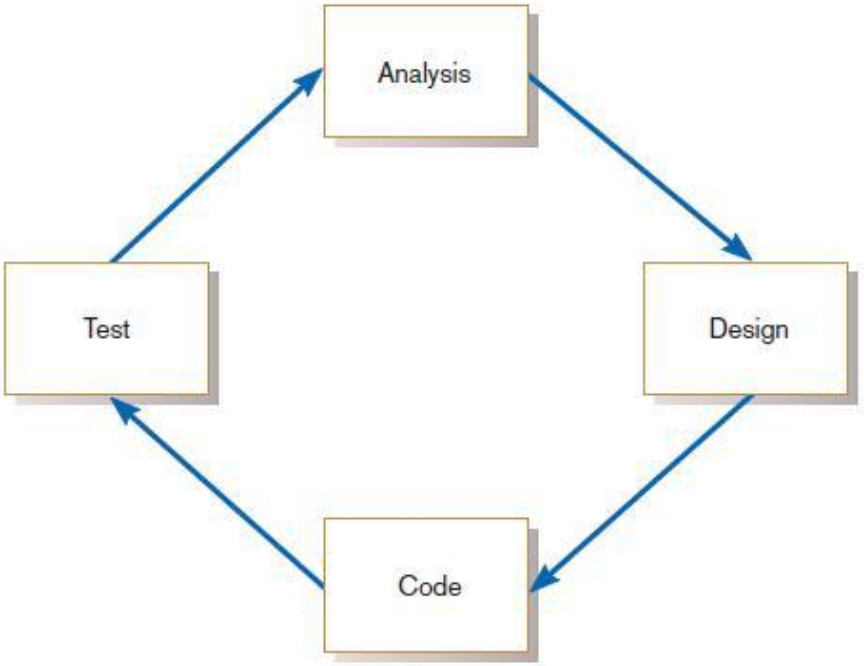
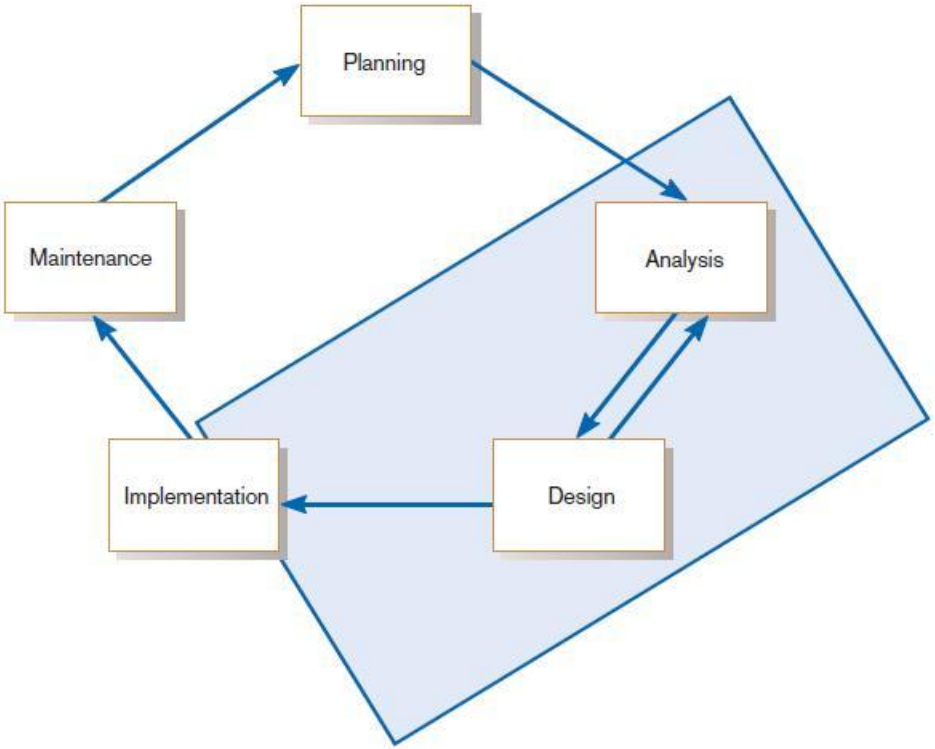


FIGURE 1-8
The heart of systems development



Current practice combines analysis, design, and implementation into a single iterative and parallel process of activities.

Traditional Waterfall SDLC

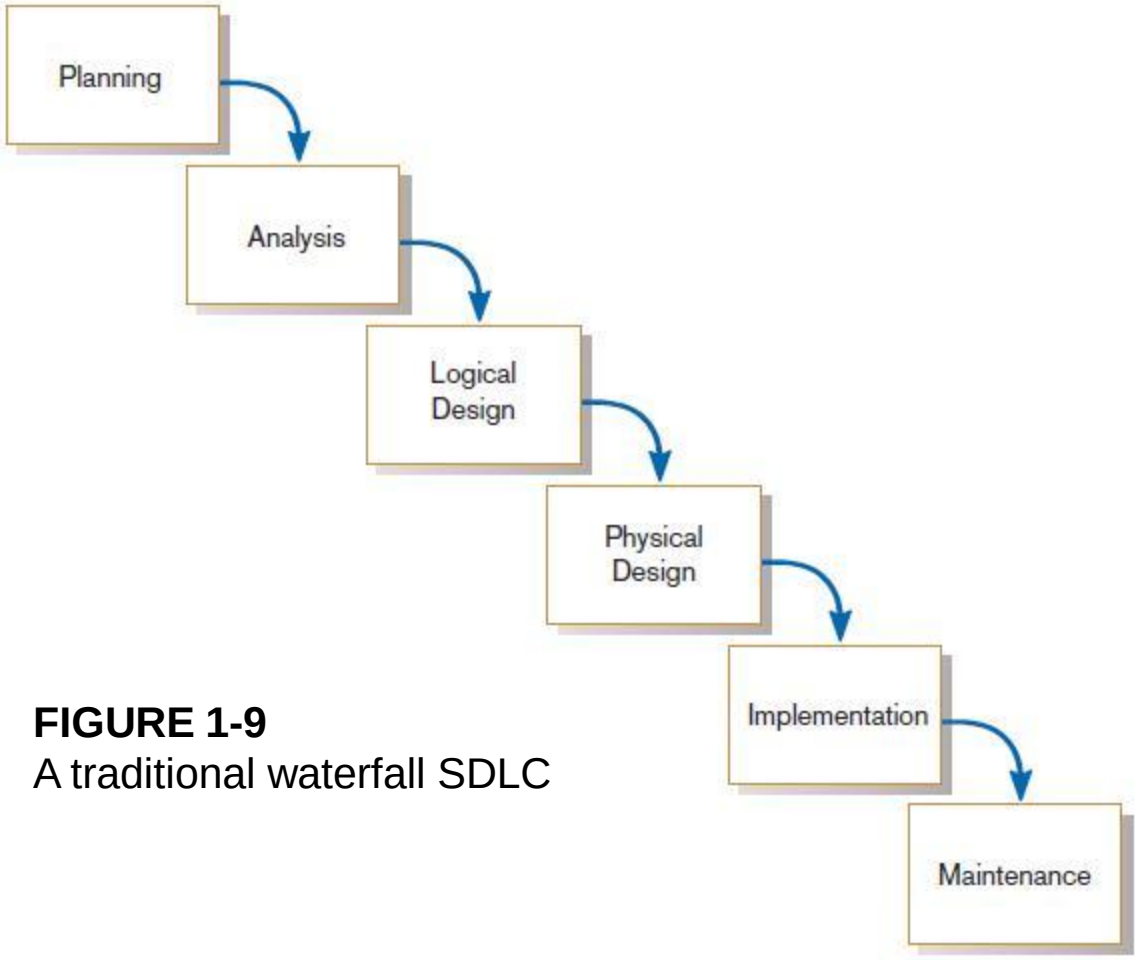


FIGURE 1-9
A traditional waterfall SDLC

One phase begins when another completes, with little backtracking and looping.

Problems with Waterfall Approach

- System requirements “locked in” after being determined (can't change)
- Limited user involvement (only in requirements phase)
- Too much focus on milestone deadlines of SDLC phases to the detriment of sound development practices

Different Approaches to Improving Development

- Computer-aided software engineering (CASE) Tools
- Rapid Application Development (RAD)
- Service-Oriented Architecture (SOA)
- Agile Methodologies
- eXtreme Programming

Computer-Aided Software Engineering (CASE) Tools

- Diagramming tools enable graphical representation.
- Computer displays and report generators help prototype how systems “look and feel”.
- Analysis tools automatically check for consistency in diagrams, forms, and reports.

Computer-Aided Software Engineering (CASE) Tools (Cont.)

- A central repository provides integrated storage of diagrams, reports, and project management specifications.
- Documentation generators standardize technical and user documentation.
- Code generators enable automatic generation of programs and database code directly from design documents, diagrams, forms, and reports.

CASE Tools (Cont.)

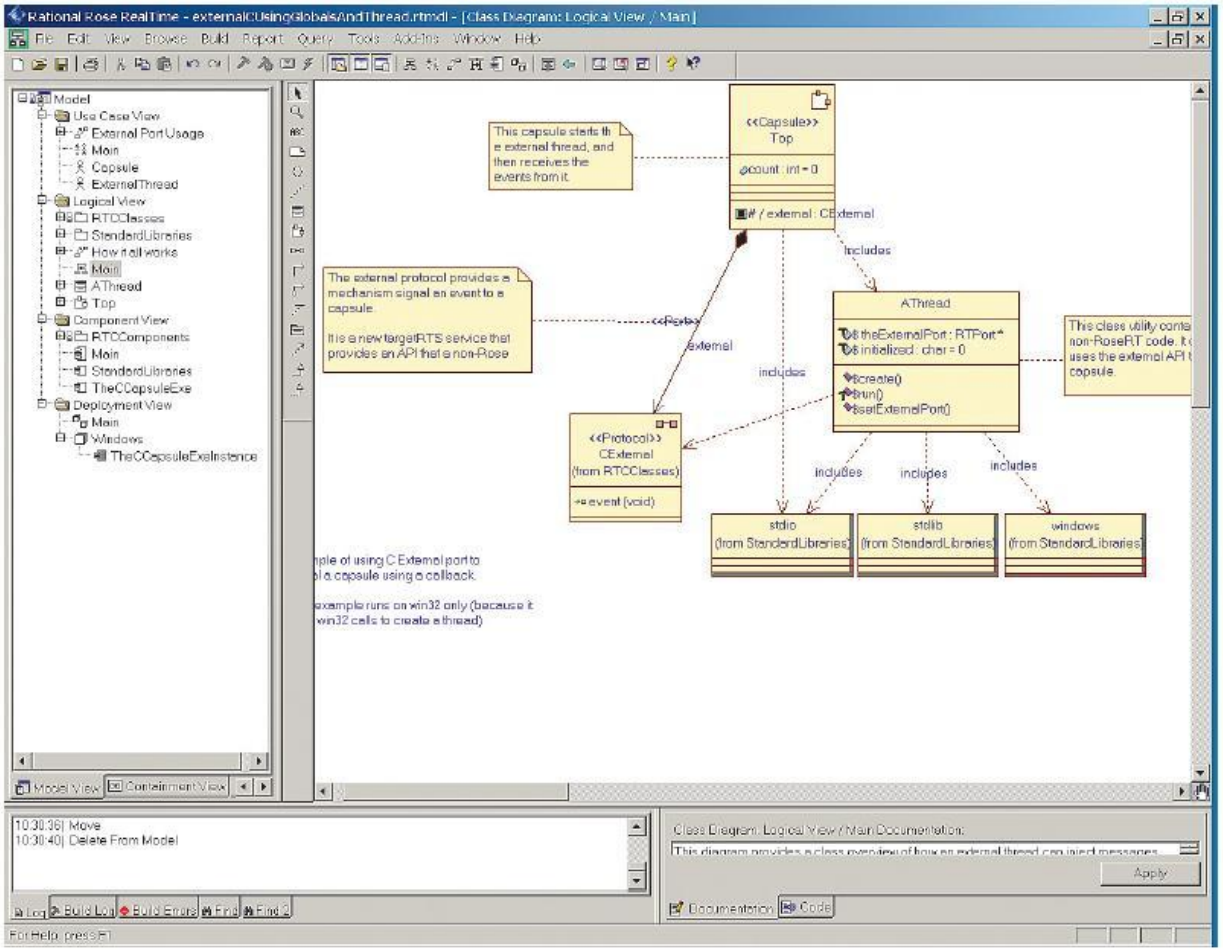


FIGURE 1-10
A class diagram from IBM's Rational Rose

(*Source: IBM)*

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)

Rapid Application Development (RAD)

- Methodology to radically decrease design and implementation time
- Involves: extensive user involvement, prototyping, integrated CASE tools, and code generators

Rapid Application Development (RAD) (Cont.)

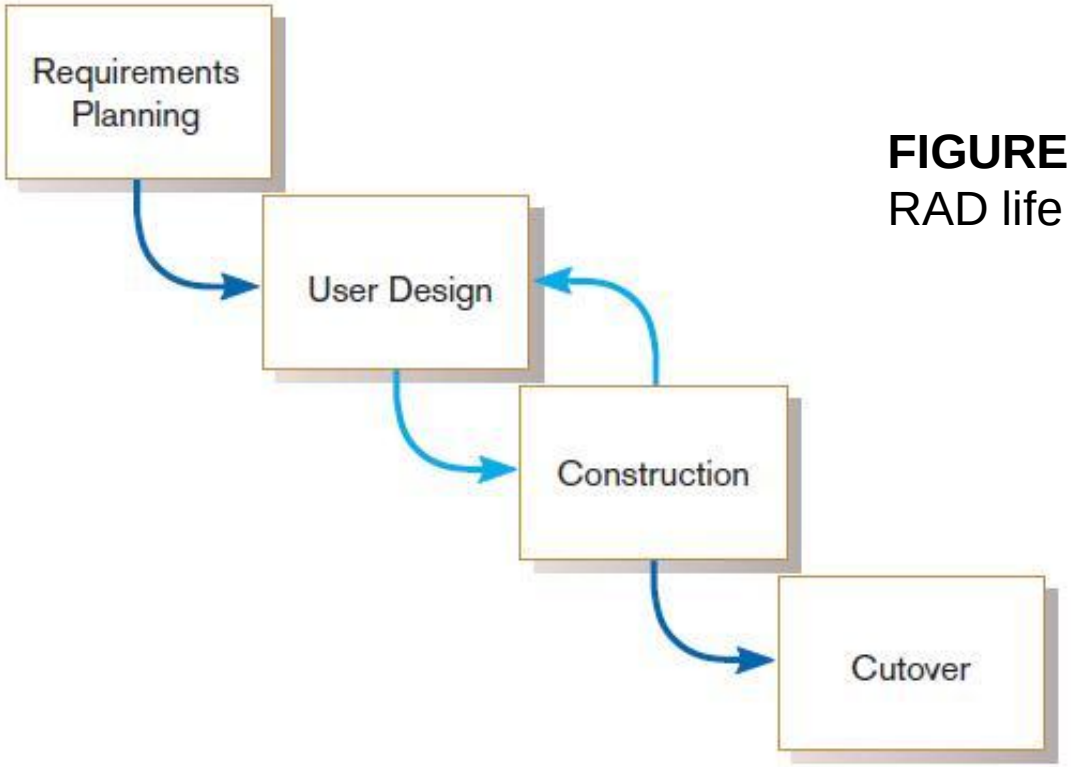


FIGURE 1-11
RAD life cycle

Service-Oriented Architecture (SOA)

- An approach to systems development based on building complete systems through assembling software components, each of which model generic business functions

Service-Oriented Architecture (SOA) (Cont.)

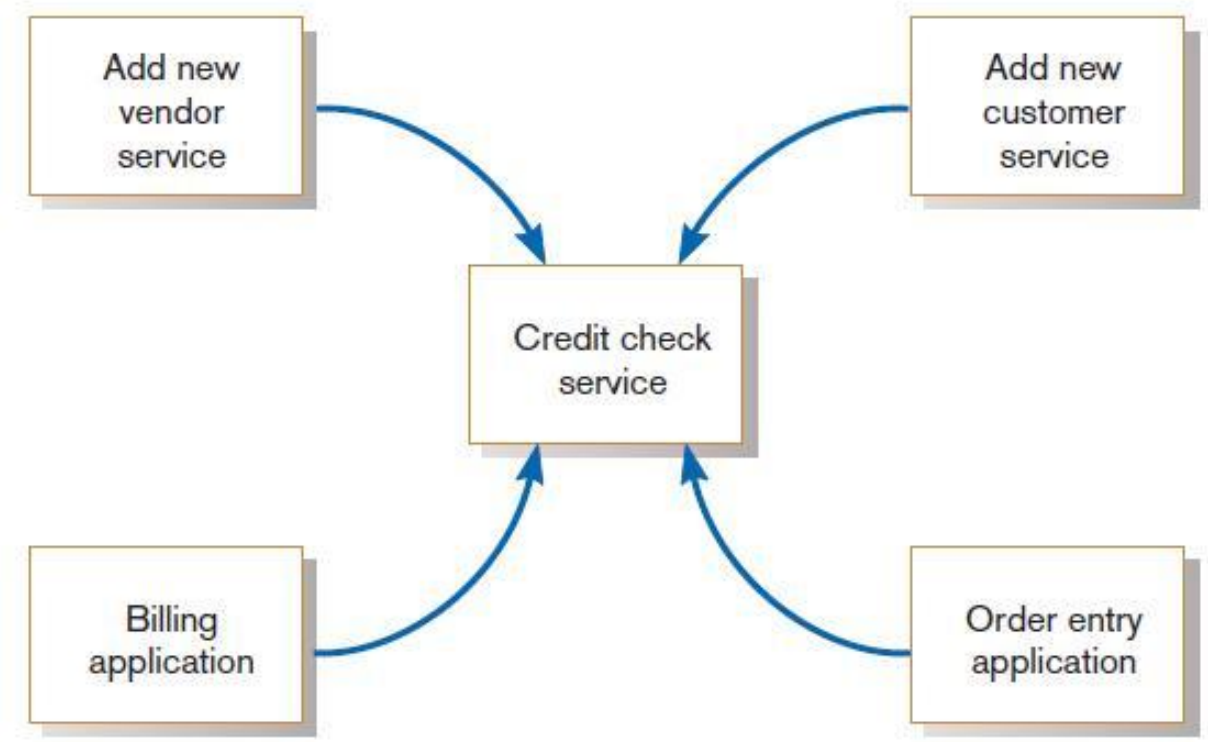


FIGURE 1-12
Illustration of a service, a credit check, used by applications and other services

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

TABLE 1-3 The Agile Manifesto

The Manifesto for Agile Software Development

Seventeen anarchists agree:

We are uncovering better ways of developing software by doing it and helping others do it.

Through this work we have come to value:

- *Individuals and interactions* over processes and tools.
- *Working software* over comprehensive documentation.
- *Customer collaboration* over contract negotiation.
- *Responding to change* over following a plan.

That is, while we value the items on the right, we value the items on the left more.

We follow the following principles:

- Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.
- Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.
- Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.
- Business people and developers work together daily throughout the project.
- Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.
- The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.
- Working software is the primary measure of progress.
- Continuous attention to technical excellence and good design enhances agility.
- Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.
- Simplicity—the art of maximizing the amount of work not done—is essential.
- The best architectures, requirements, and designs emerge from self-organizing teams.
- At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.

—Kent Beck, Mike Beedle, Arie van Bennekum, Alistair Cockburn, Ward Cunningham, Martin Fowler, James Grenning, Jim Highsmith, Andrew Hunt, Ron Jeffries, Jon Kern, Brian Marick, Robert C. Martin, Steve Mellor, Ken Schwaber, Jeff Sutherland, Dave Thomas (www.agileAlliance.org)

(*Source:* From Fowler and Highsmith, 2001. Used by permission.)

The Agile Methodologies group argues that software development methodologies adapted from engineering generally do not fit with real-world software development.

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 refac toring 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 environ-ment but a source of expensive rework for highly dynamic environments.
Personnel	Requires continuous presence of a critical mass of scarce experts. Risky to use no-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).

(*Source:* Boehm and Turner, 2004. Used by permission.)

eXtreme Programming

- Short, incremental development cycles
- Automated tests
- Two-person programming teams

eXtreme Programming (Cont.)

- Coding and testing operate together
- Advantages:
  - Communication between developers
  - High level of productivity
  - High-quality code

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

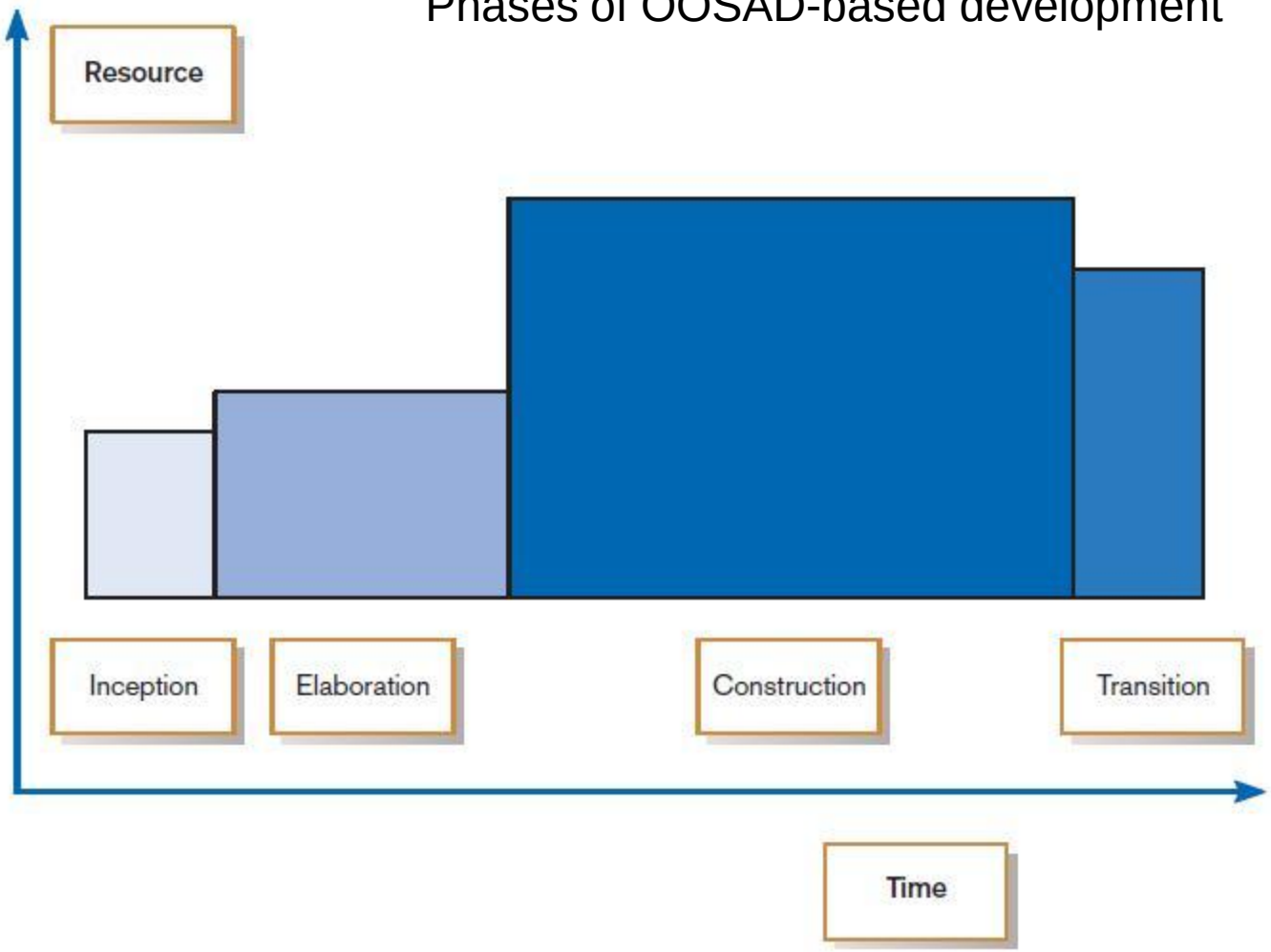
Object-Oriented Analysis and Design (OOAD) (Cont.)

- **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

Rational Unified Process (RUP)

- An object-oriented systems development methodology
- RUP establishes four phase of development: inception, elaboration, construction, and transition.
- Each phase is organized into a number of separate iterations.

FIGURE 1-13
Phases of OOSAD-based development



Our Approach to Systems Development

- The SDLC is an organizing and guiding principle in this book.
- We may construct artificial boundaries or artificially separate activities and processes for learning purposes.
- Our intent is to help you understand all the pieces and how to assemble them.

Summary

- In this chapter you learned how to:

- ✓ Define information systems analysis and design.
- ✓ Describe the information Systems Development Life Cycle (SDLC).
- ✓ Explain Rapid Application Development (RAD), prototyping, Computer Aided Software Engineering (CASE), and Service-Oriented Architecture (SOA).
- ✓ Describe agile methodologies and eXtreme programming.
- ✓ Explain Object Oriented Analysis and Design and the Rational Unified Process (RUP).