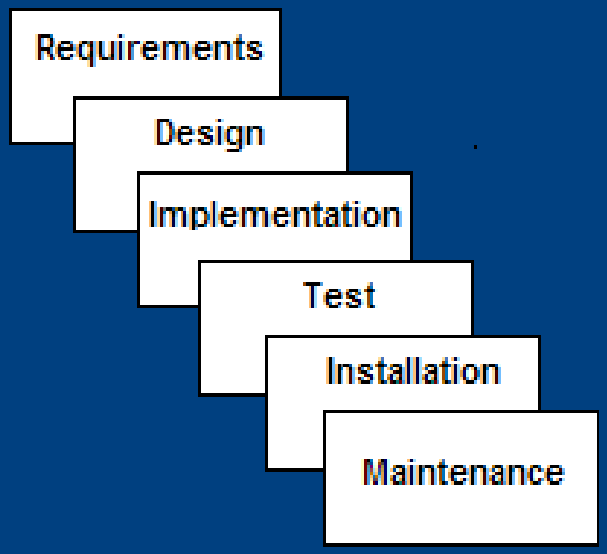
Software Development Life Cycle (SDLC)

SDLC Model

A framework that describes the activities performed at each stage of a software development project.

Waterfall Model



- **Requirements** – defines needed information, function, behavior, performance and interfaces.
- **Design** – data structures, software architecture, interface representations, algorithmic details.
- **Implementation** – source code, database, user documentation, testing.

Waterfall Strengths

- Easy to understand, easy to use
- Provides structure to inexperienced staff
- Milestones are well understood
- Sets requirements stability
- Good for management control (plan, staff, track)
- Works well when quality is more important than cost or schedule

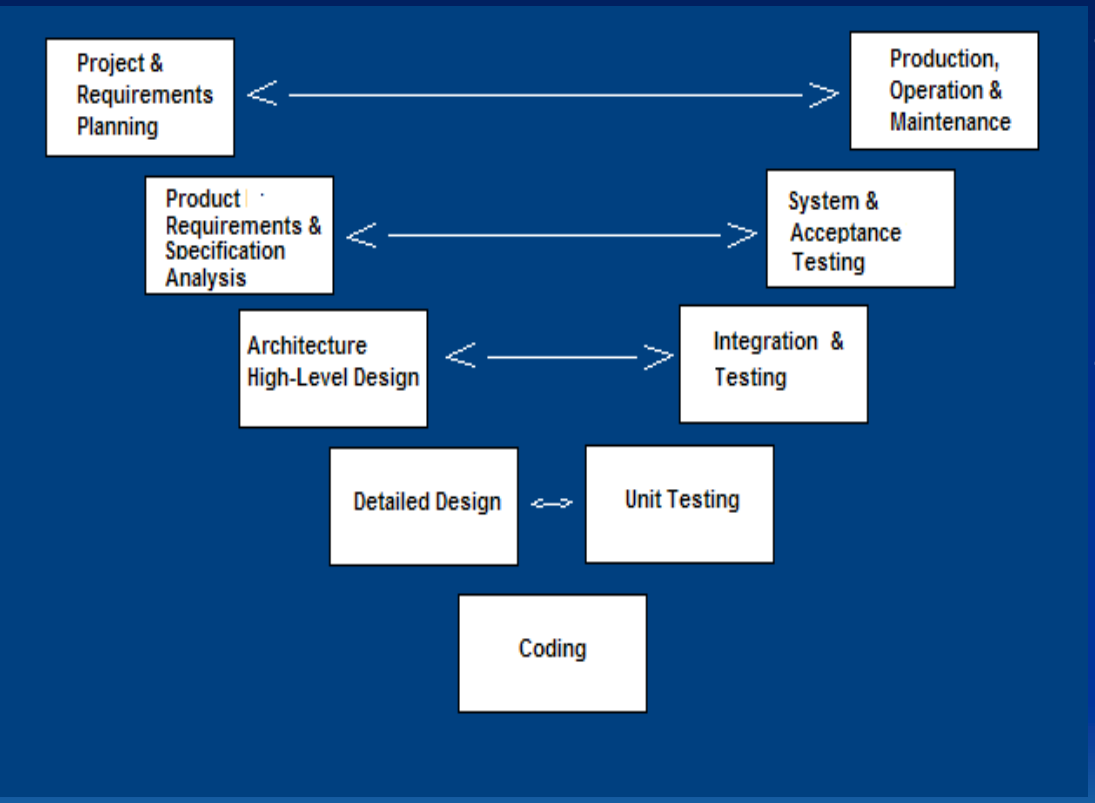
Waterfall Deficiencies

- All requirements must be known upfront
- Deliverables created for each phase are considered frozen – inhibits flexibility
- Can give a false impression of progress
- Does not reflect problem-solving nature of software development – iterations of phases
- Integration is one big bang at the end
- Little opportunity for customer to preview the system (until it may be too late)

When to use the Waterfall Model

- Requirements are very well known
- Product definition is stable
- Technology is understood
- New version of an existing product
- Porting an existing product to a new platform.

V-Shaped SDLC Model



- A variant of the Waterfall that emphasizes the verification and validation of the product.
- Testing of the product is planned in parallel with a corresponding phase of development

V-Shaped Steps

- Project and Requirements Planning – allocate resources
- Product Requirements and Specification Analysis – complete specification of the software system
- Architecture or High-Level Design – defines how software functions fulfill the design
- Detailed Design – develop algorithms for each architectural component
- Production, operation and maintenance – provide for enhancement and corrections
- System and acceptance testing – check the entire software system in its environment
- Integration and Testing – check that modules interconnect correctly
- Unit testing – check that each module acts as expected
- Coding – transform algorithms into software

V-Shaped Strengths

- Emphasize planning for verification and validation of the product in early stages of product development
- Each deliverable must be testable
- Project management can track progress by milestones
- Easy to use

V-Shaped Weaknesses

- Does not easily handle concurrent events
- Does not handle iterations or phases
- Does not easily handle dynamic changes in requirements
- Does not contain risk analysis activities

When to use the V-Shaped Model

- Excellent choice for systems requiring high reliability – hospital patient control applications
- All requirements are known up-front
- When it can be modified to handle changing requirements beyond analysis phase
- Solution and technology are known

Structured Evolutionary Prototyping Model

- Developers build a prototype during the requirements phase
- Prototype is evaluated by end users
- Users give corrective feedback
- Developers further refine the prototype
- When the user is satisfied, the prototype code is brought up to the standards needed for a final product.

Structured Evolutionary Prototyping Steps

- A preliminary project plan is developed
- An partial high-level paper model is created
- The model is source for a partial requirements specification
- A prototype is built with basic and critical attributes
- The designer builds
  - the database
  - user interface
  - algorithmic functions
- The designer demonstrates the prototype, the user evaluates for problems and suggests improvements.
- This loop continues until the user is satisfied

Structured Evolutionary Prototyping Strengths

- Customers can "see" the system requirements as they are being gathered
- Developers learn from customers
- A more accurate end product
- Unexpected requirements accommodated
- Allows for flexible design and development
- Steady, visible signs of progress produced
- Interaction with the prototype stimulates awareness of additional needed functionality

Structured Evolutionary Prototyping Weaknesses

- Tendency to abandon structured program development for “code-and-fix” development
- Bad reputation for “quick-and-dirty” methods
- Overall maintainability may be overlooked
- The customer may want the prototype delivered.
- Process may continue forever (scope creep)

When to use Structured Evolutionary Prototyping

- Requirements are unstable or have to be clarified
- As the requirements clarification stage of a waterfall model
- Develop user interfaces
- Short-lived demonstrations
- New, original development

Rapid Application Model (RAD)

- Requirements planning phase (a workshop utilizing structured discussion of business problems)
- User description phase – automated tools capture information from users
- Construction phase – productivity tools, such as code generators, screen generators, etc. inside a time-box. (“Do until done”)
- Cutover phase -- installation of the system, user acceptance testing and user training

RAD Strengths

- Reduced cycle time and improved productivity with fewer people means lower costs
- Time-box approach mitigates cost and schedule risk
- Customer involved throughout the complete cycle minimizes risk of not achieving customer satisfaction and business needs
- Focus moves from documentation to code (WYSIWYG).
- Uses modeling concepts to capture information about business, data, and processes.

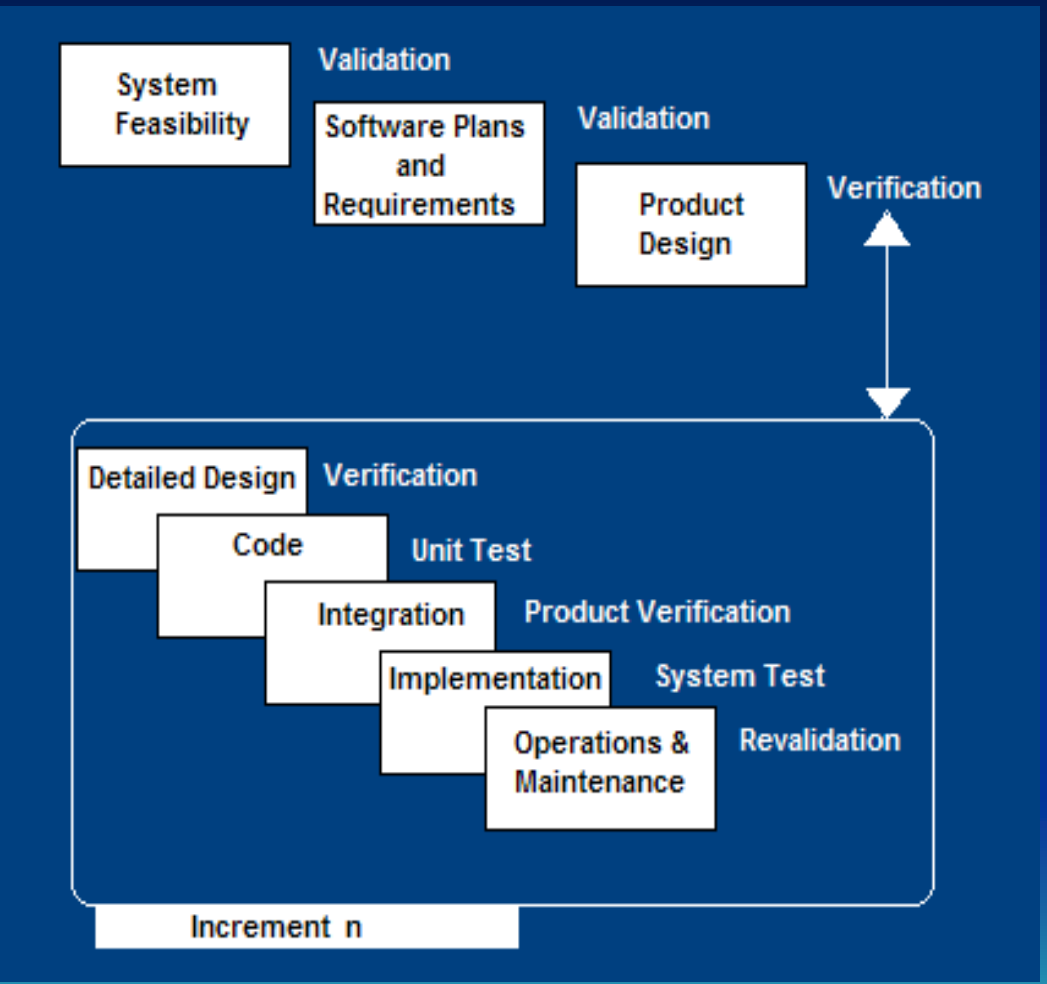
RAD Weaknesses

- Accelerated development process must give quick responses to the user
- Risk of never achieving closure
- Hard to use with legacy systems
- Requires a system that can be modularized
- Developers and customers must be committed to rapid-fire activities in an abbreviated time frame.

When to use RAD

- Reasonably well-known requirements
- User involved throughout the life cycle
- Project can be time-boxed
- Functionality delivered in increments
- High performance not required
- Low technical risks
- System can be modularized

Incremental SDLC Model



- Construct a partial implementation of a total system
- Then slowly add increased functionality
- The incremental model prioritizes requirements of the system and then implements them in groups.
- Each subsequent release of the system adds function to the previous release, until all designed functionality has been implemented.

Incremental Model Strengths

- Develop high-risk or major functions first
- Each release delivers an operational product
- Customer can respond to each build
- Uses "divide and conquer" breakdown of tasks
- Lowers initial delivery cost
- Initial product delivery is faster
- Customers get important functionality early
- Risk of changing requirements is reduced

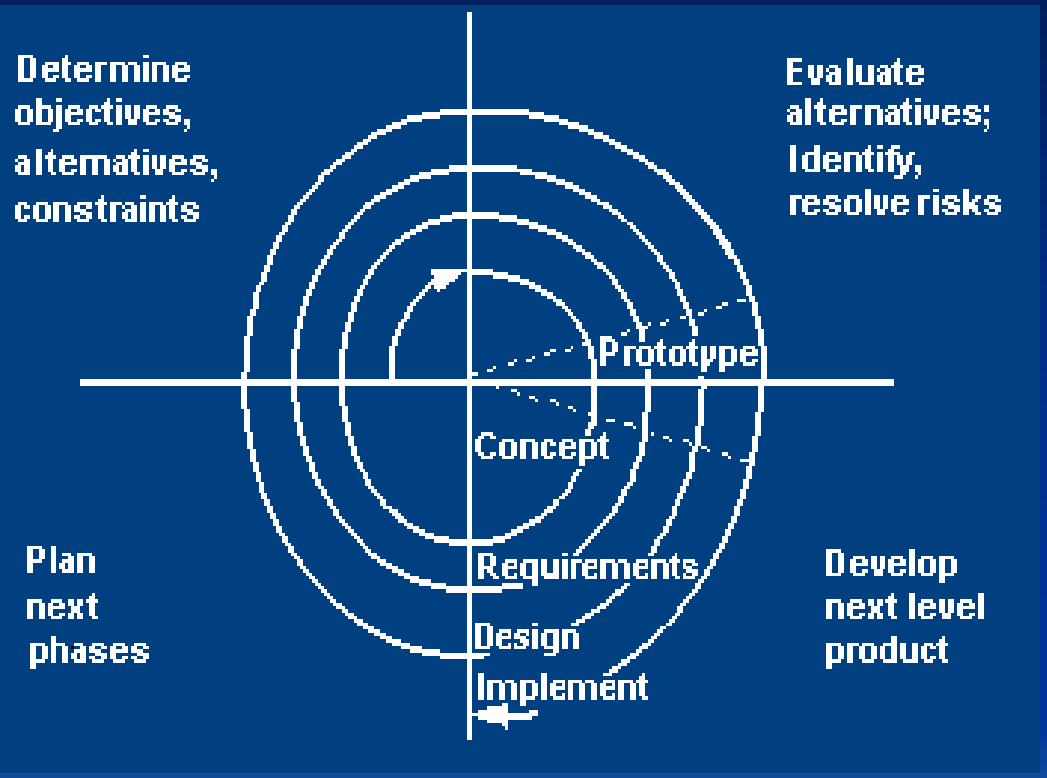
Incremental Model Weaknesses

- Requires good planning and design
- Requires early definition of a complete and fully functional system to allow for the definition of increments
- Well-defined module interfaces are required (some will be developed long before others)
- Total cost of the complete system is not lower

When to use the Incremental Model

- Risk, funding, schedule, program complexity, or need for early realization of benefits.
- Most of the requirements are known up-front but are expected to evolve over time
- A need to get basic functionality to the market early
- On projects which have lengthy development schedules
- On a project with new technology

Spiral SDLC Model



- Adds risk analysis, and 4gl RAD prototyping to the waterfall model
- Each cycle involves the same sequence of steps as the waterfall process model

Spiral Quadrant
Determine objectives, alternatives and constraints

- Objectives: functionality, performance, hardware/software interface, critical success factors, etc.
- Alternatives: build, reuse, buy, sub-contract, etc.
- Constraints: cost, schedule, interface, etc.

Spiral Quadrant
Evaluate alternatives, identify and resolve risks

- Study alternatives relative to objectives and constraints
- Identify risks (lack of experience, new technology, tight schedules, poor process, etc.
- Resolve risks (evaluate if money could be lost by continuing system development

Spiral Quadrant
Develop next-level product

- Typical activites:
  - Create a design
  - Review design
  - Develop code
  - Inspect code
  - Test product

Spiral Quadrant
Plan next phase

- Typical activities
  - Develop project plan
  - Develop configuration management plan
  - Develop a test plan
  - Develop an installation plan

Spiral Model Strengths

- Provides early indication of insurmountable risks, without much cost
- Users see the system early because of rapid prototyping tools
- Critical high-risk functions are developed first
- The design does not have to be perfect
- Users can be closely tied to all lifecycle steps
- Early and frequent feedback from users
- Cumulative costs assessed frequently

Spiral Model Weaknesses

- Time spent for evaluating risks too large for small or low-risk projects
- Time spent planning, resetting objectives, doing risk analysis and prototyping may be excessive
- The model is complex
- Risk assessment expertise is required
- Spiral may continue indefinitely
- Developers must be reassigned during non-development phase activities
- May be hard to define objective, verifiable milestones that indicate readiness to proceed through the next iteration

When to use Spiral Model

- When creation of a prototype is appropriate
- When costs and risk evaluation is important
- For medium to high-risk projects
- Long-term project commitment unwise because of potential changes to economic priorities
- Users are unsure of their needs
- Requirements are complex
- New product line
- Significant changes are expected (research and exploration)

Agile SDLC's

- Speed up or bypass one or more life cycle phases
- Usually less formal and reduced scope
- Used for time-critical applications
- Used in organizations that employ disciplined methods

Some Agile Methods

- Adaptive Software Development (ASD)
- Feature Driven Development (FDD)
- Crystal Clear
- Dynamic Software Development Method (DSDM)
- Rapid Application Development (RAD)
- Scrum
- Extreme Programming (XP)
- Rational Unify Process (RUP)

Extreme Programming - XP

For small-to-medium-sized teams developing software with vague or rapidly changing requirements

Coding is the key activity throughout a software project

- Communication among teammates is done with code
- Life cycle and behavior of complex objects defined in test cases – again in code

XP Practices

1. Planning game – determine scope of the next release by combining business priorities and technical estimates
2. Small releases – put a simple system into production, then release new versions in very short cycle
3. Metaphor – all development is guided by a simple shared story of how the whole system works
4. Simple design – system is designed as simply as possible (extra complexity removed as soon as found)
5. Testing – programmers continuously write unit tests; customers write tests for features
6. Refactoring – programmers continuously restructure the system without changing its behavior to remove duplication and simplify