Software Development Life Cycle (SDLC)

by

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SDLC Model

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

Capability Maturity Model (CMM)

- A bench-mark for measuring the maturity of an organization's software process
- CMM defines 5 levels of process maturity based on certain Key Process Areas (KPA)

CMM Levels

Level 5 – Optimizing (< 1%)

-- process change management
-- technology change management
-- defect prevention

Level 4 – Managed (< 5%)

-- software quality management
-- quantitative process management

Level 3 – Defined (< 10%)

-- peer reviews
-- intergroup coordination
-- software product engineering
-- integrated software management
-- training program
-- organization process definition
-- organization process focus

Level 2 – Repeatable (~ 15%)

-- software configuration management
-- software quality assurance
-- software project tracking and oversight
-- software project planning
-- requirements management

Level 1 – Initial (~ 70%)

Life Cycle Model

- It provides a fixed generic framework that can be tailored to a specific project.
- Project specific parameters will include:
- Size, (person-years)
- Budget,
- Duration

project plan = lifecycle model + project parameters

By changing the lifecycle model, we can **Improve**

- **Development speed (time to market)**
- **Product quality**
- **Project visibility**
- **Administrative overhead**
- **Risk exposure**
- **Customer relations, etc, etc.**

The Waterfall Model

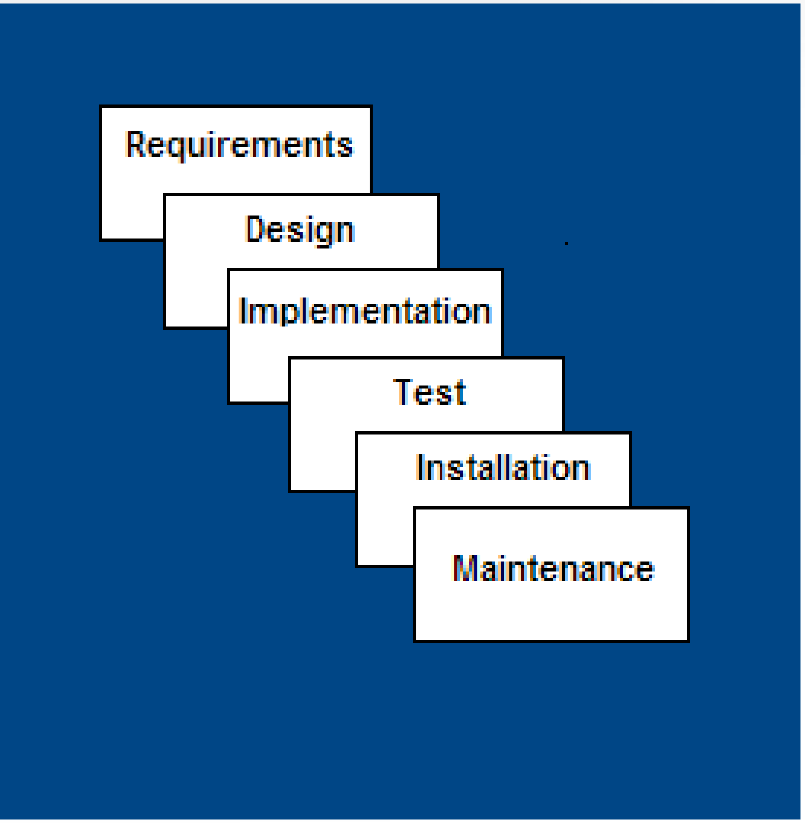
•The waterfall model is the classic lifecycle model

–it is widely known, understood and (commonly?) used.

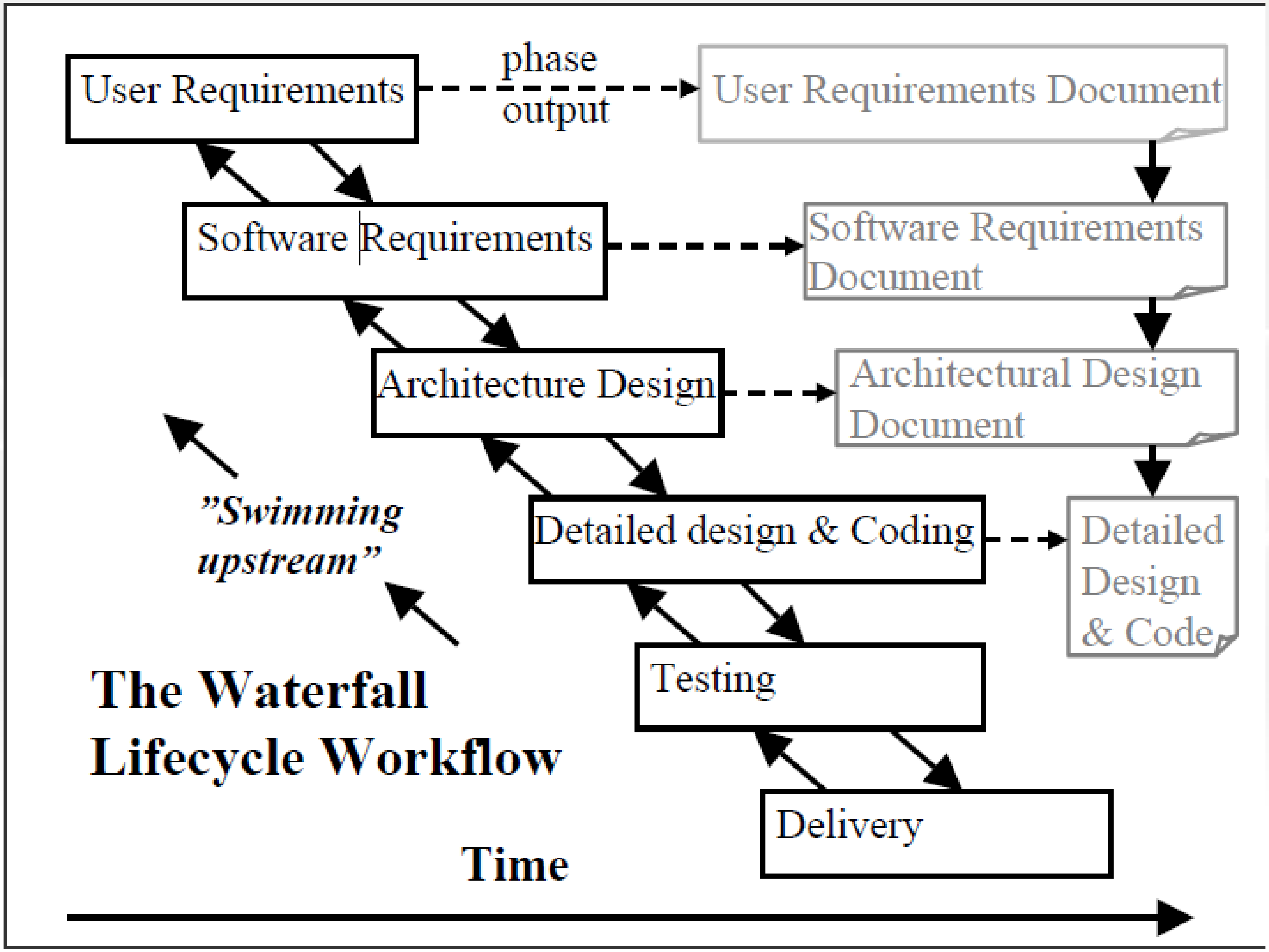
In some respect, waterfall is the ”commonsense” approach.

Introduced by ***Royce*** in 1970.

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.


User Requirements
phase
output
User Requirements Document
Software Requirements
Software Requirements Document
Architecture Design
Architectural Design Document
Detailed design & Coding
Detailed Design & Code
Testing
Delivery
"Swimming upstream"
The Waterfall Lifecycle Workflow
Time

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

1. Idealised, does not match reality well.

2. Doesn’t reflect iterative nature of exploratory development.

3. Unrealistic to expect accurate requirements so early in project

4. Software is delivered late in project, delays discovery of serious errors.
5. Difficult to integrate risk management

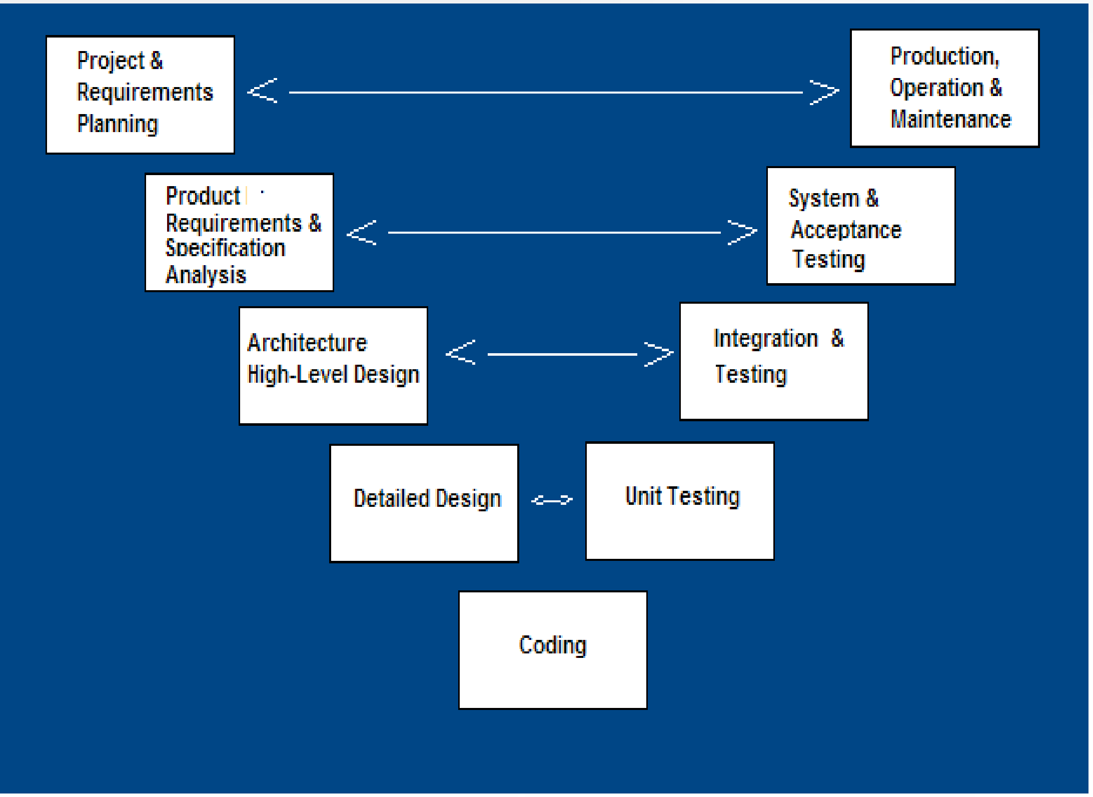
6. Difficult and expensive to make changes
to documents, ”swimming upstream”.

7. Significant administrative overhead,
costly for small teams and projects.

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



Project & Requirements Planning
Production, Operation & Maintenance
Product Requirements & Specification Analysis
System & Acceptance Testing
Architecture High-Level Design
Integration & Testing
Detailed Design
Unit Testing
Coding

- 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

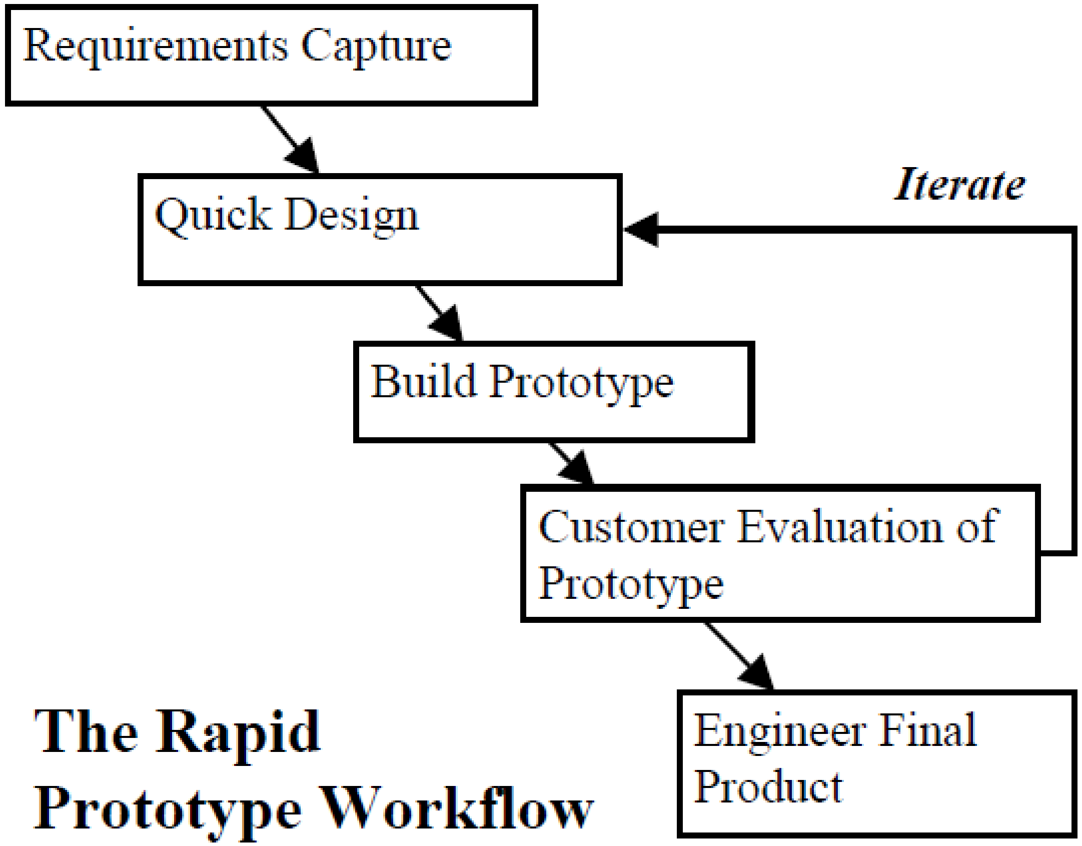
- Excellent choice for systems requiring high reliability – hospital patient control applications

- All requirements are known up-front

- 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.



The Rapid Prototype Workflow

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
- With the analysis and design portions of object-oriented 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")
- Cut over 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
- 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
- Developers and customers must be committed to rapid-fire activities in an abbreviated time frame.

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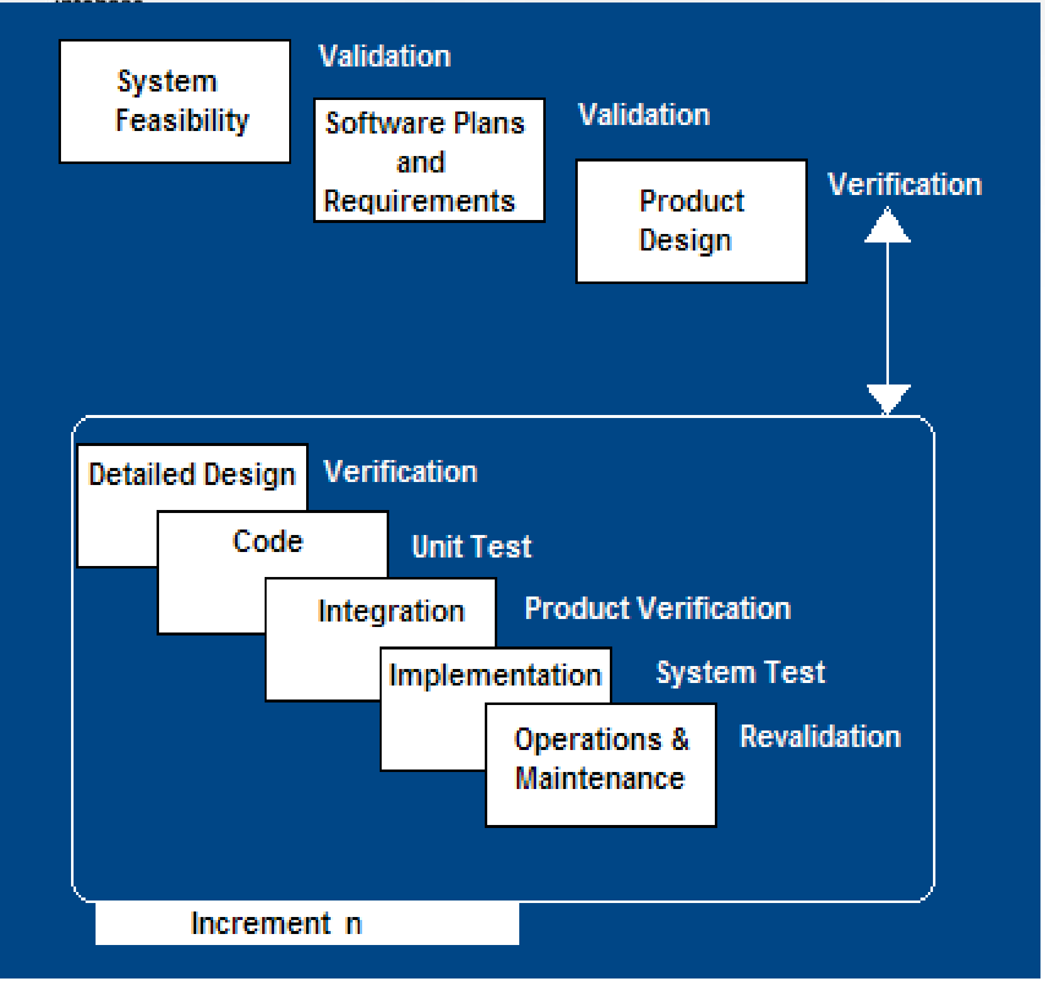
When to use RAD

- User involved throughout the life cycle
- Project can be time-boxed
- Functionality delivered in increments

Timeboxing is a Planning technique common in planning projects (typically for software development), where the schedule is divided into a number of separate time periods (timeboxes, normally two to six weeks long), with each part having its own deliverables, deadline and budget. Timeboxing is a core aspect of rapid application development (RAD) software development processes such as dynamic systems development method (DSDM) and agile software development.

Timeboxes are used as a form of risk management, especially for tasks that may easily extend past their deadlines. The end date (deadline) is one of the primary drivers in the planning and should not be changed as it is usually linked to a delivery date of the product. If the team exceeds the deadline, the team failed in proper planning and / or effective execution of the plan. This can be the result of: the wrong people on the wrong job (lack of communication between teams, lack of experience, lack of commitment / drive / motivation, lack of speed) or underestimation of the (complexity of the) requirements

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

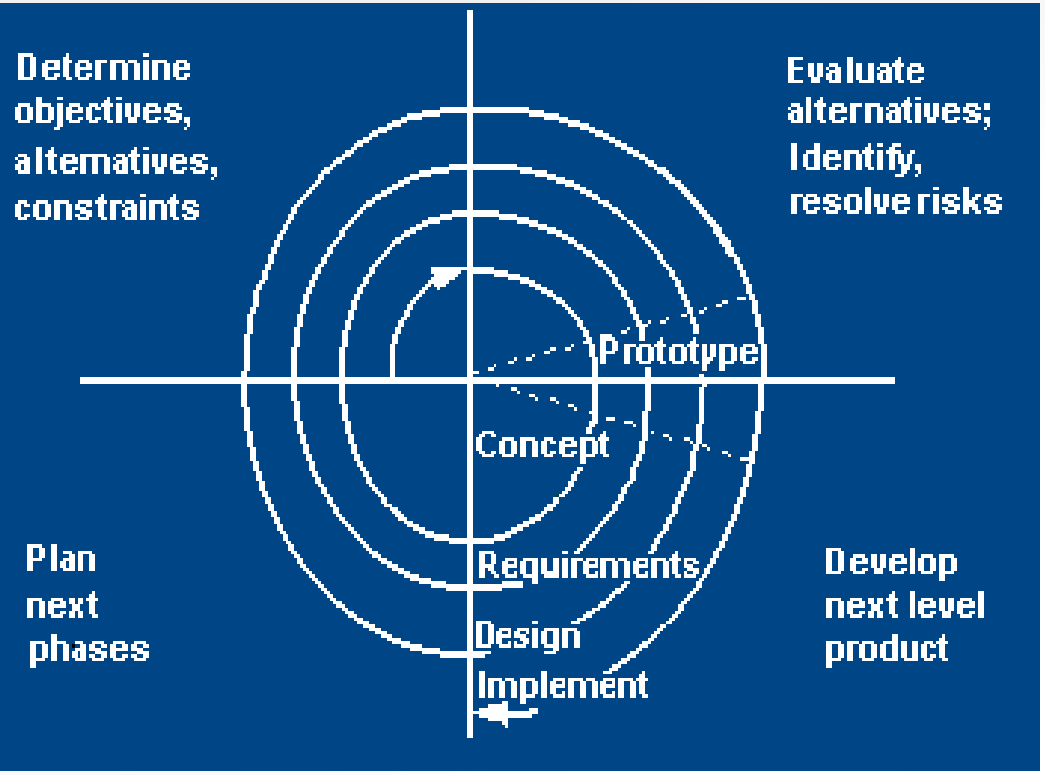
Incremental Model Weaknesses

- 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

- 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


Determine objectives, alternatives, constraints
Evaluate alternatives; Identify, resolve risks
Prototype
Concept
Requirements
Design
Implement
Plan next phases
Develop next level product

- Adds risk analysis, and 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 activities:

  - 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)

Dynamic Systems Development Method (DSDM)

Applies a framework for RAD and short time frames

Paradigm is the 80/20 rule

– majority of the requirements can be delivered in a relatively short amount of time.

DSDM Principles

1. Active user involvement imperative (Ambassador users)

3. DSDM teams empowered to make decisions

5. Focus on frequent product delivery

7. Product acceptance is fitness for business purpose

9. Iterative and incremental development - to converge on a solution

11. Requirements initially agreed at a high level

13. All changes made during development are reversible

15. Testing is integrated throughout the life cycle

17. Collaborative and co-operative approach among all stakeholders essential

DSDM Lifecycle

- Feasibility study
- Business study – prioritized requirements
- Functional model iteration
  - risk analysis
  - Time-box plan
- Design and build iteration
- Implementation

Adaptive Steps

1. Project initialization – determine intent of project

3. Determine the project time-box (estimation duration of the project)

5. Determine the optimal number of cycles and the time-box for each

7. Write an objective statement for each cycle

9. Assign primary components to each cycle

11. Develop a project task list

13. Review the success of a cycle

15. Plan the next cycle

Tailored SDLC Models

- Any one model does not fit all projects
- If there is nothing that fits a particular project, pick a model that comes close and modify it for your needs.
- Project should consider risk but complete spiral too much – start with spiral & pare it done
- Project delivered in increments but there are serious reliability issues – combine incremental model with the V-shaped model
- Each team must pick or customize a SDLC model to fit its project

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Thank you