THE SOFTWARE PROCESS

Chapter 2

Software Engineering

Computer Science Engineering School

DSIC – UPV

Goals

- Define term "Software Process"
- Present main development process models that have been proposed
- Introduce the notion of methodology, presenting RUP and the main features of agile methodologies.

Contents

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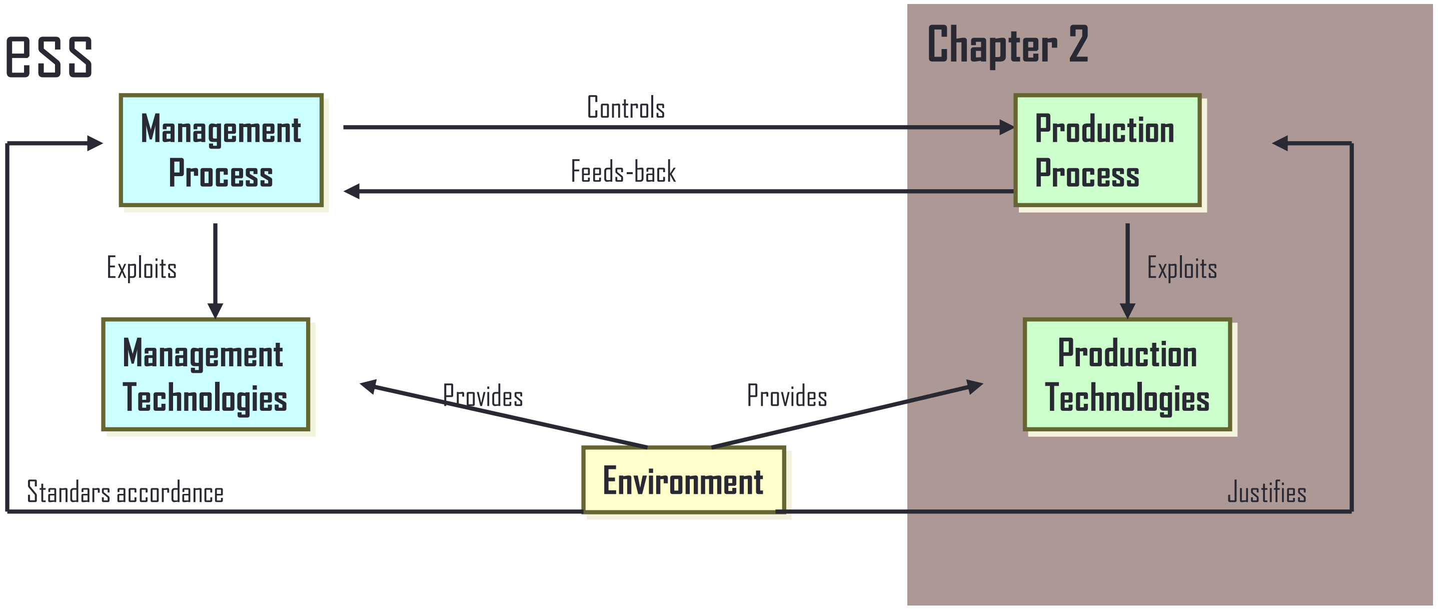
The Software process

- It is a framework for the development of software
- In general the term "Software Process" is associated to the production process... but it includes the management process



The Development Process

- Collection of activities towards the development or evolution of software
- Also known as **Lifecycle**

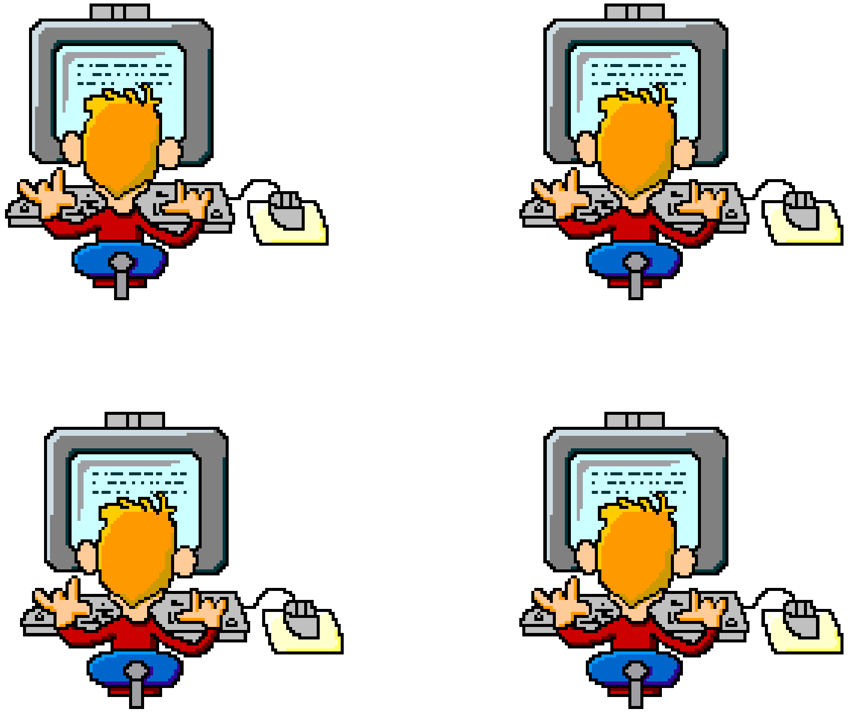
- **Generic Activities** that are always carried out:
  - Specification
  - Development
  - Validation
  - Evolution

- Analysis
- Design
- Implementation
- Testing
- Maintenance

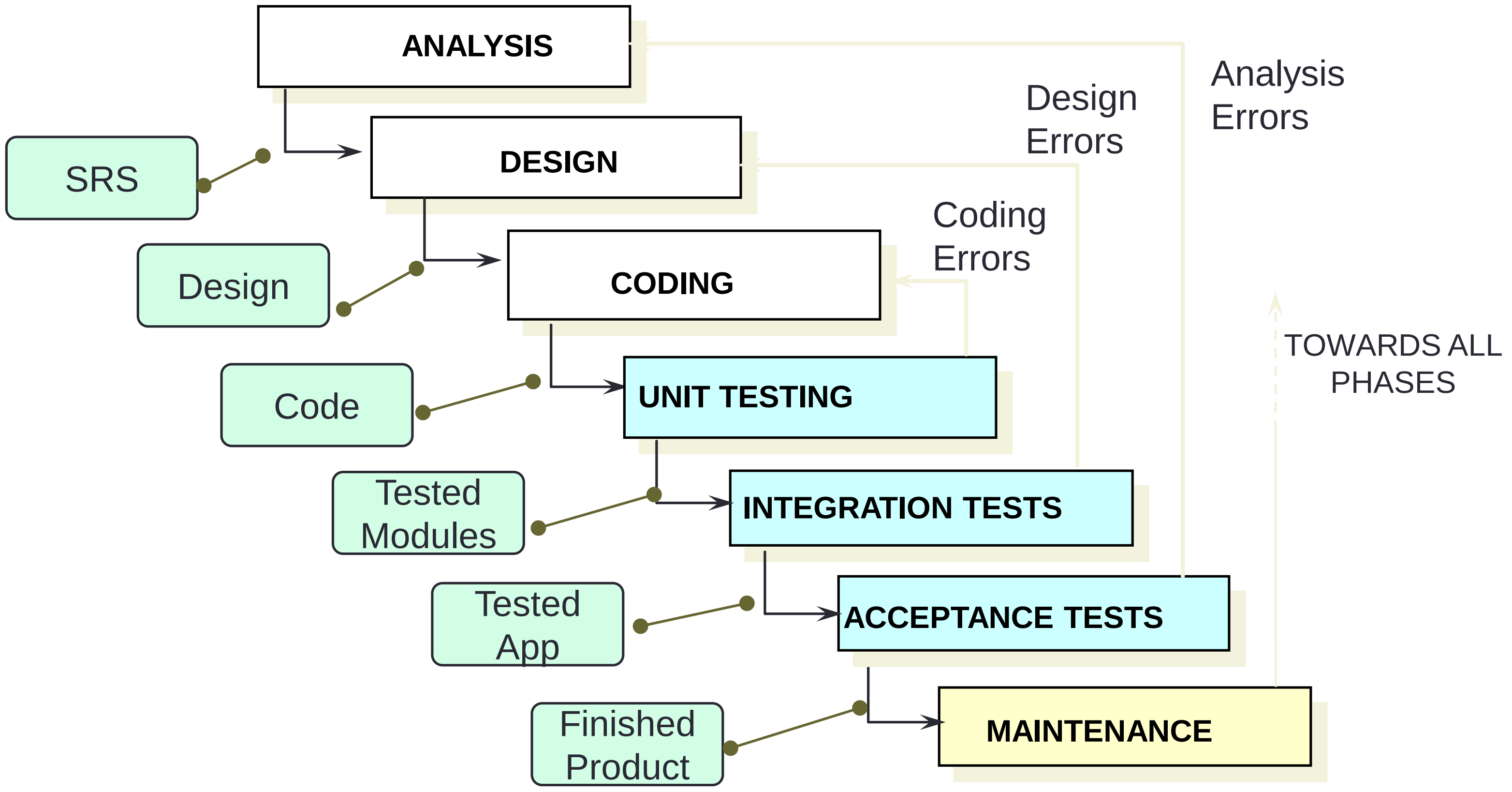
Lifecycle Models

- *Code-and-fix*
- Classic or Waterfall
- Classic with prototyping
- Automatic Code Generation
- Evolutionary Models:
  - Incremental
  - Spiral

Code and Fix

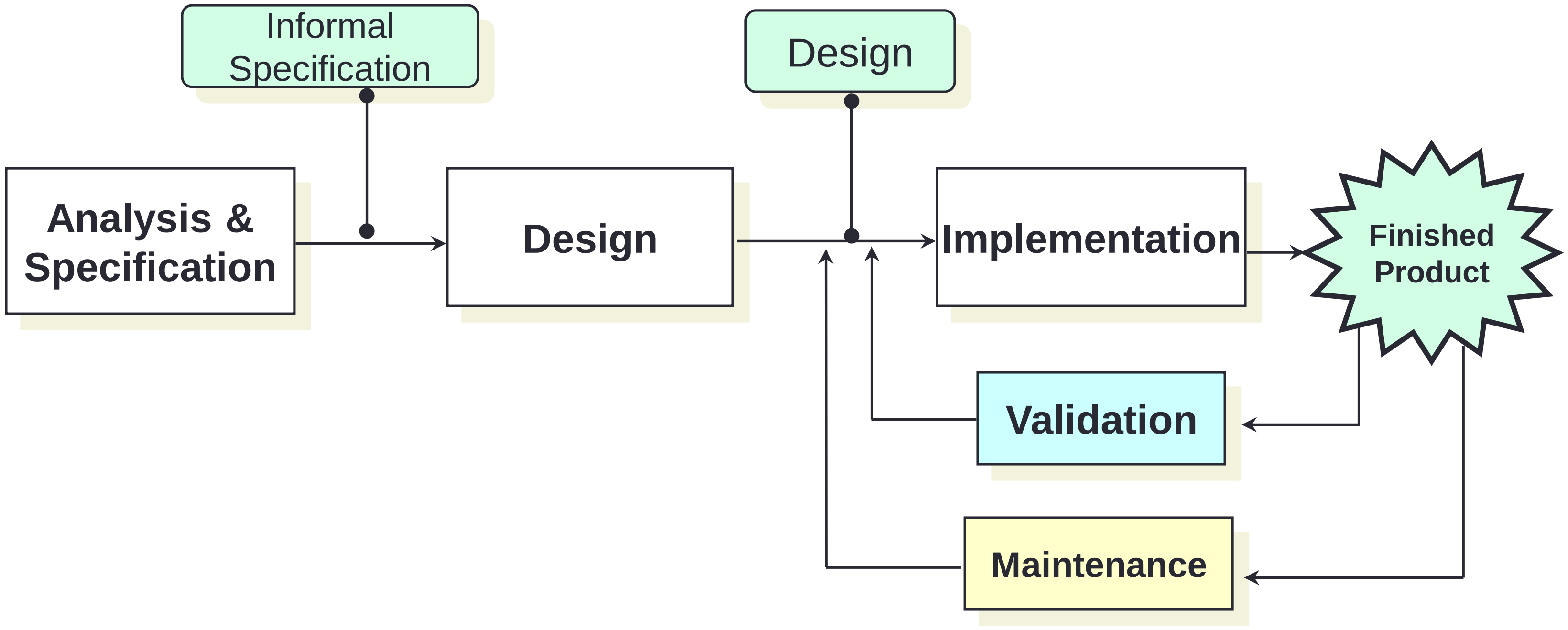


Classic or Waterfall



Classic or Waterfall

- In practice this model is "distorted" and all the validation and maintenance is performed on the source code.

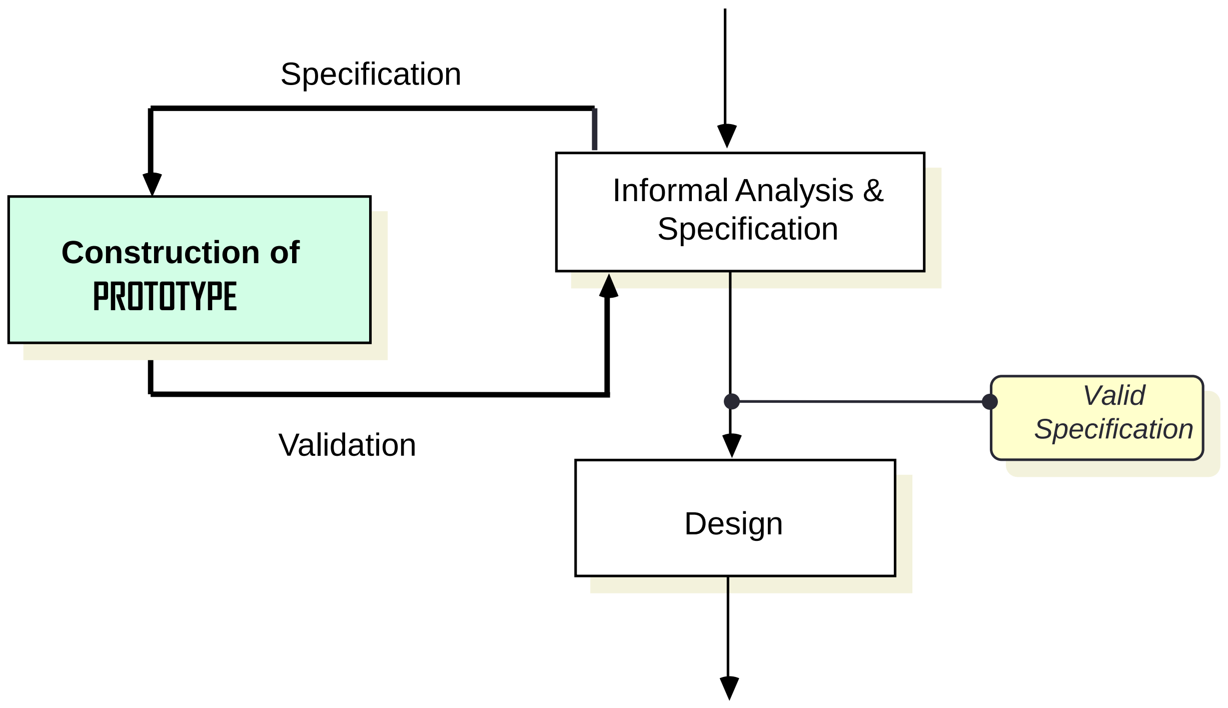


Classic Model with Prototyping

- Prototype: First version of a product in which only some features are integrated or all of them are featured but unfinished

- Types of prototypes:
  - <u>Vertical</u>: some functionality of the system is fully developed.
  - <u>Horizontal</u>: all views of the system are shown (simulated)

Classic Model with Prototyping



- It helps customers to clearly establish the requirements
- It helps developers to improve their products

Classic Model with Prototyping

- Criticism:
  - ☺ It reduces the risk of patching on the final product (code maintenance is not avoided)
  - ☺ It helps both customers and developers to understand the requirements
  - ☹ The customer sees a version of the final product (not assuming it is not robust and incomplete)
  - ☹ It requires an additional investment (the invested time may result in loosing market opportunity)
  - ☹ Bad decisions taken during a rapid development of the prototype are usually transferred to the final product

Automatic Code Generation

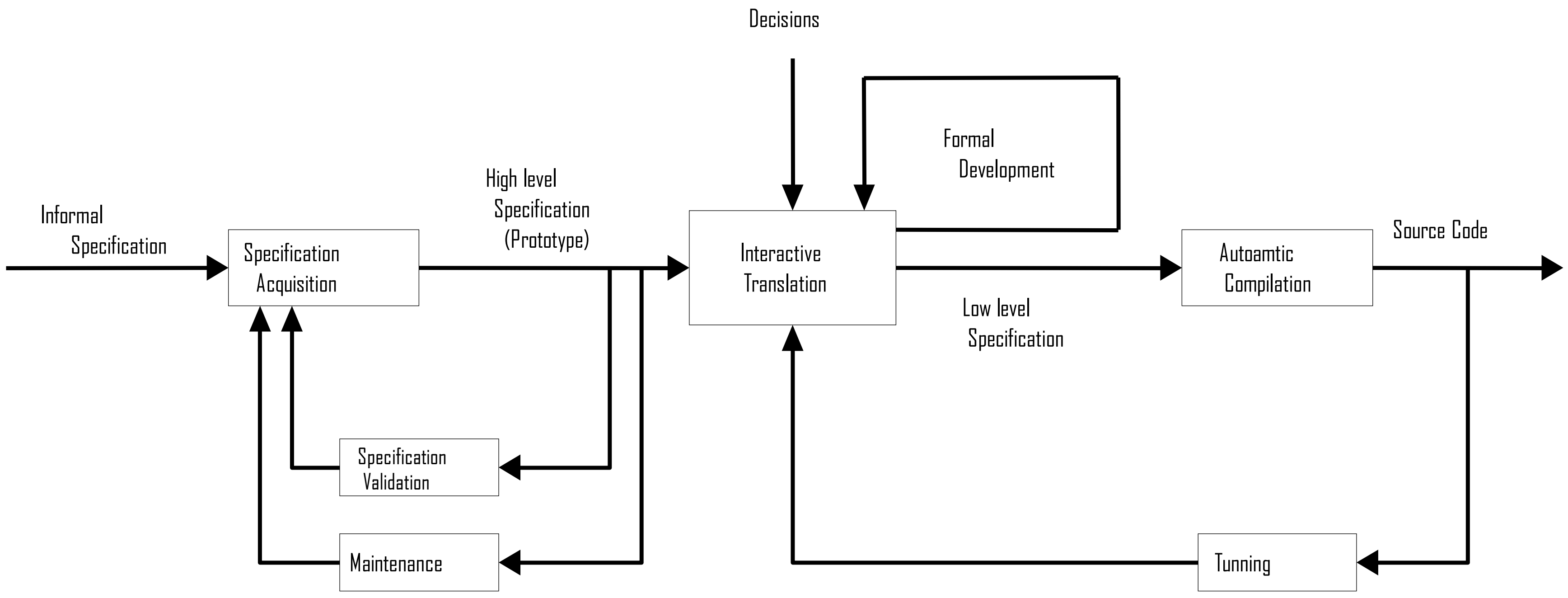
(R. Balzer, 1983)

- Goal

  Automatize the software development process

- Basic Features:
  - ✓ Use of formal specification languages
  - ✓ The specification is a prototype of the product
  - ✓ The requirements are discussed by running the specification
  - ✓ The application is derived semi-automatically

Automatic Code Generation Model



Automatic Code Generation Model

- Comparison

CLASSIC Prototyping	*AUTOMATIC GENERAT.*
Informal Specification	Formal specification
Non standard prototype	Standard prototype
Prototype manually built	The specification is the prototype
Prototype discarded	It evolves towards the final product
Manual implementation	Automatic Implementation
Code must be tested	No testing
Maintenance on the code	Maintenance on the specification

Automatic Code Generation

- Criticism

  ☺ It helps reducing human errors

  ☺ It reduces development costs

  ☹ It is difficult to use formal languages

➡ *It is the predecessor of MDE/MDA*

Evolutionary Development

- Adaptable to changing requirements

- More ellaborated versions are built at each iteration

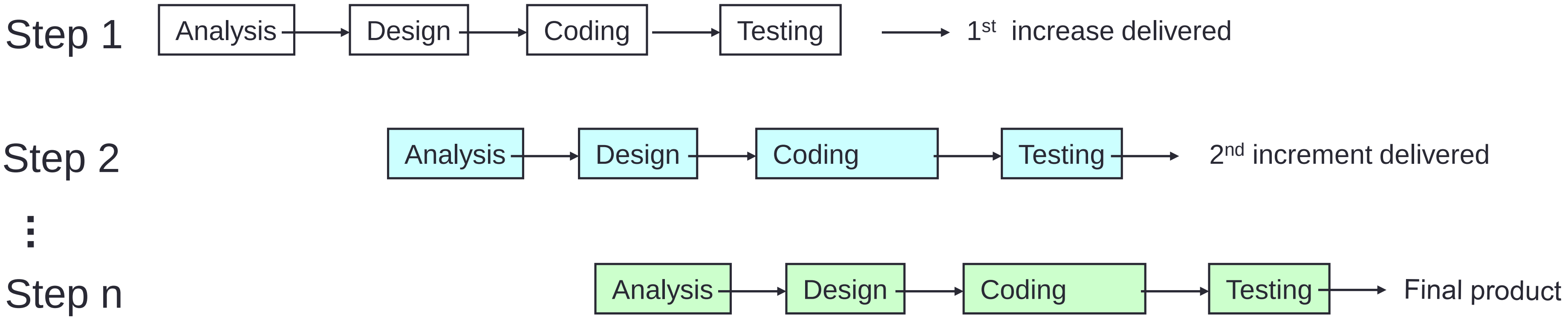
➡ Incremental Model

➡ Spiral Model

Incremental Model

(McDermind, 1983)

- Sequence of applications of the classical model
- Each iteration produces a delta of the product
- It ends when the final product is delivered



Incremental Model

- Criticism

☺Useful when not enough human resources for a complete deliverable

☺ Each deliverable may be evaluated by the customer ➔highly interactive

☹ Difficult to know the required increase for each iteration

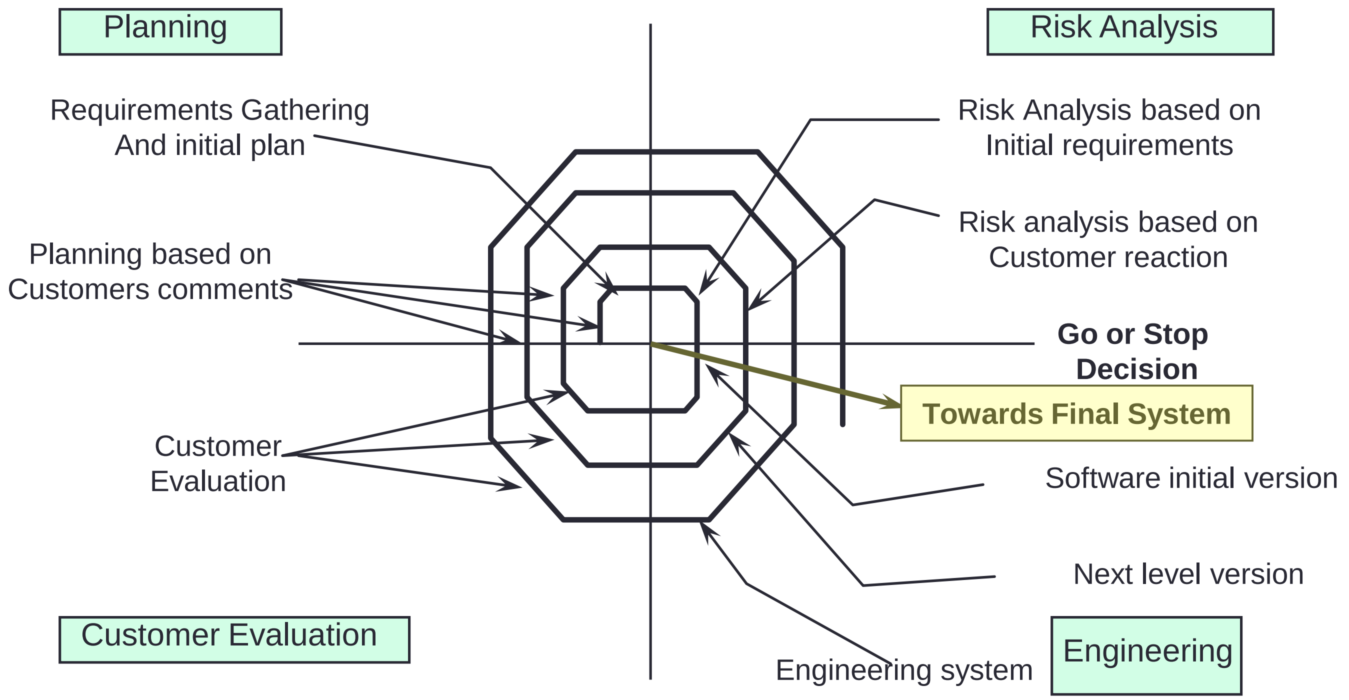
Spiral Model

(B. Boehm, 1988)

- Approach:
  - Iterative.
  - Interactive.
  - Evolutive

- It introduces risks analysis in the development process

Spiral Model

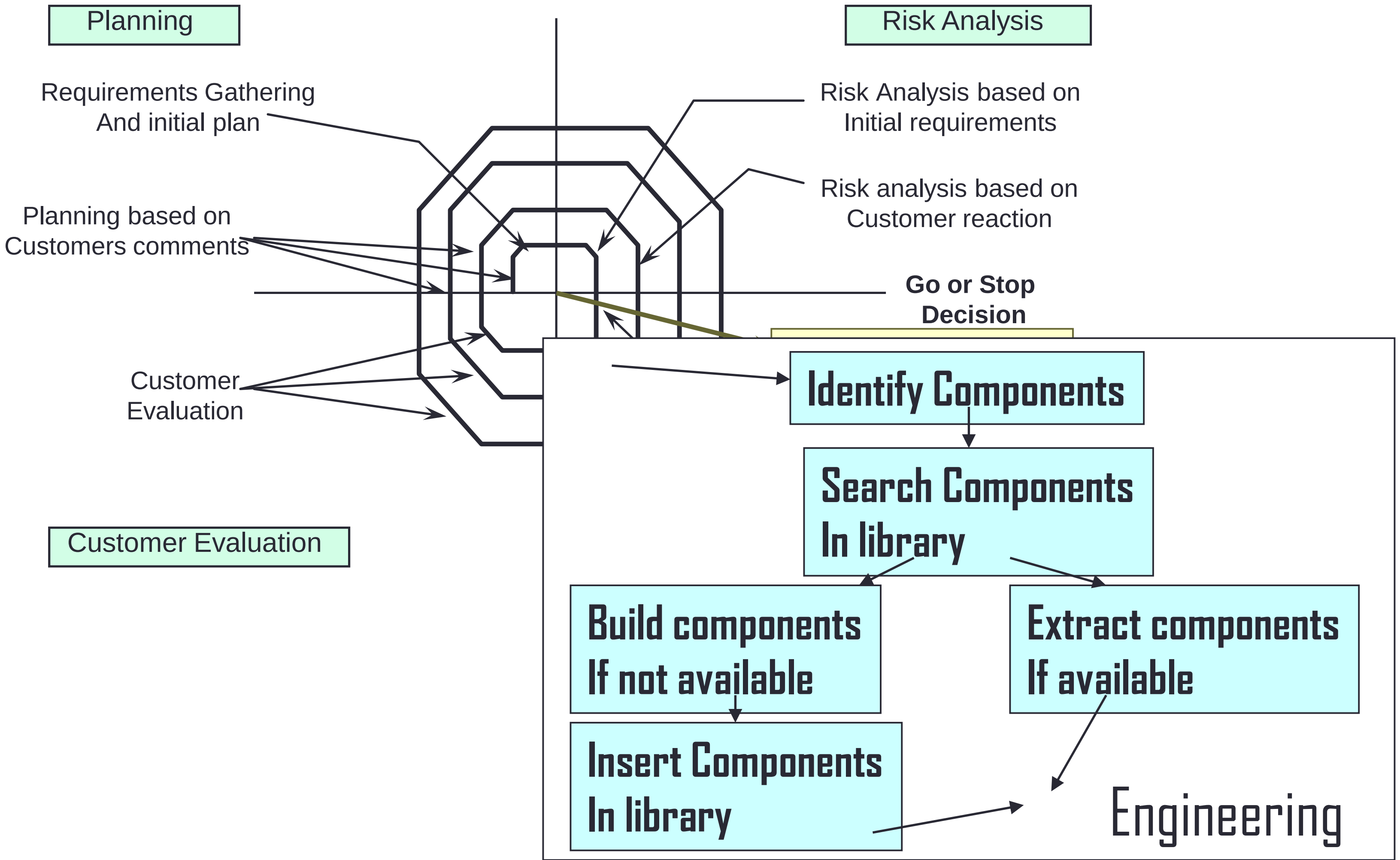


Spiral Model

- Criticism
  - ☺ Each time more complete versions of the product are obtained.
  - ☺ Each version is evaluated by the customer ➔Highly interactive
  - ☹ It is difficult to assess risks
  - ☹ Hard to guarantee path towards the final product

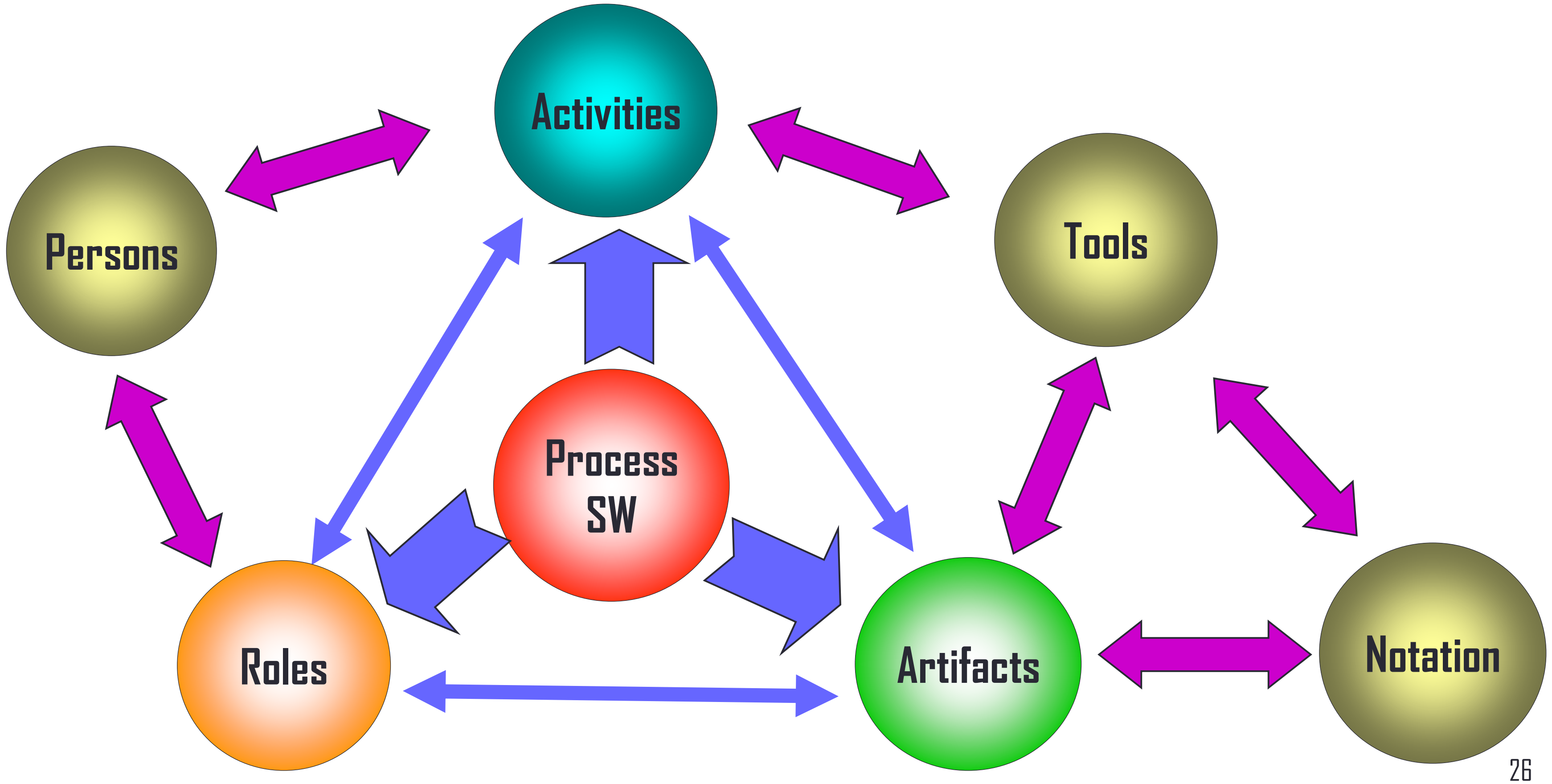
Components Assembly Model

- The engineering phase may be adapted to new requirements


Planning
Risk Analysis
Requirements Gathering And initial plan
Risk Analysis based on Initial requirements
Risk analysis based on Customer reaction
Planning based on Customers comments
Go or Stop Decision
Customer Evaluation
Customer Evaluation
Identify Components
Search Components In library
Build components If not available
Extract components If available
Insert Components In library
Engineering

Methodology

- In a software development project, the methodology defines: Who/ What / How / When



Methodology

- Defines an explicit process of software development

  (its goal is the formalization of activities related with the elaboration of information systems)

- This process must be:
  - Reproducible
  - Defined
  - Measurable with respect to performance
  - Subject to Optimizations
  - …

Methodology

There is no universal software methodology.

Structured methodologies

Object oriented methodologies **RUP**

Traditional methodologies ***vs.*** *Agile methodologies*

RUP **XP**

Agile Methodologies

Agile Methodologies appreciate:

- The individual and the interactions within the development team more than the activities and the tools
- The development of software that works rather than obtaining a good documentation $\Rightarrow$ Minimalistic approach wrt modelling and documentation of the system
- The collaboration with the customer rather than the negotiation of a contract
- The fast response to changes rather than following a strict planning

http:\\www.agilealliance.com

Agile Methodologies

Principles of Agile Methodologies (1/2)

1.- The main priority is to satisfy the customer with early and continuous releases of usable software.

2.- Welcome changes. Agile processes apply updates for the customer to remain competitive.

3.- Release the developed software frequently and with the shortest possible interval of time between releases

4.- Business people and developers work together as a team in a project

5.- Build project driven by personal motivations. Provide the environment that people need and trust them.

Agile Methodologies

Principles of Agile Methodologies (2/2)

6.- Face to face dialogue is the most efficient and effective method to communicate information within a development team

7.- Developed software is the first metric of progress

8.- Agile processes promote a bearable development. Funding entities, developers and users are capable of keeping a peaceful ambient

9.- The continuous attention to technical quality and good design increases agility

10.- Simplicity is key

11.- The best architectures, requirements and designs arise from the organization of the team

12.- At regular intervals, the team reflects about how to be more effective and how to synchronize and adjust their work.

Agile Methodologies

- Comparative

Agile Methodology	Non Agile Methodology
The customer is part of the Development team (*on-site*)	The customer interacts with the team By means of meetings
Small teams (< 10 members) Working at the same place	Large teams
Few artifacts	More artifacts
Few roles	More roles
Less emphasis on the architecture	The architecture is essential

Agile Methodologies

- Comparative

Agile Methodology	Non Agile Methodology
Heuristics	Rigurous
Tolerant with updates	Resistant to updates
Internally imposed (by the team)	Externally imposed
Less controlled process, with Few principles	Highly controlled process with many Policies and norms
No traditional contract or at least very flexible	There is a prefixed contract

Main Agile methodologies

- ⇨ Extreme Programming (XP) http://www.extremeprogramming.org
- ⇨ SCRUM https://www.scrum.org/
- ⇨ Feature-Driven Development (FDD) http://www.featuredrivendevelopment.com
  - ⇨ http://csis.pace.edu/~marchese/CS616/Agile/FDD/fdd.pdf
  - ⇨ https://apiumhub.com/tech-blog-barcelona/feature-driven-development/
- ⇨ Crystal Methods http://alistair.cockburn.us/Crystal+methodologies
  - ⇨ http://www.devx.com/architect/Article/32836/0/page/2
  - ⇨ https://activecollab.com/blog/project-management/crystal-methods
  - ⇨ https://www.researchgate.net/publication/234820806_Crystal_clear_a_human-powered_methodology_for_small_teams
- ⇨ Adaptive Development Software (ADS) http://www.adaptivesd.com
- ⇨ Dynamic Systems Development Method (DSDM) http://www.dsdm.org
  - ⇨ https://www.agilebusiness.org/what-is-dsdm
- ⇨ Lean Development (LD) http://www.poppendieck.com

ANNEX - Extreme Programming (XP)

Kent Beck, Ward Cunningham y Ron Jeffries

www.extremeprogramming.org

www.xprogramming.com

- Design for dynamic environments
- Ideal for small teams (<= 10 coders)
- Strongly oriented towards coding
- Emphasis on informal and verbal communication
- Other values: simplicity, feedback and courage

XP

Development Cycle

Stories, Iterations, Versions, Tasks and test cases

✓ The customer selects the **next version** to be built, choosing the **functional features** that he considers more valuable (known as **Stories**) from a set of possible stories, being informed about *costs* and the required *time* of their implementation.

✓ Coders **convert stories** into **tasks to be done** and then convert **tasks** into a **set of test cases** to demonstrate that the tasks have been completed.

✓ Working with a teammate, the coder **runs the test cases** and **updates the design (evolution)** trying to keep it simple.

XP

Laboratory

Planning

tests

Collective ownership

Small deliverables

Metaphore

40 hours weeks

Refactoring

Simple design

The customer always with the coder

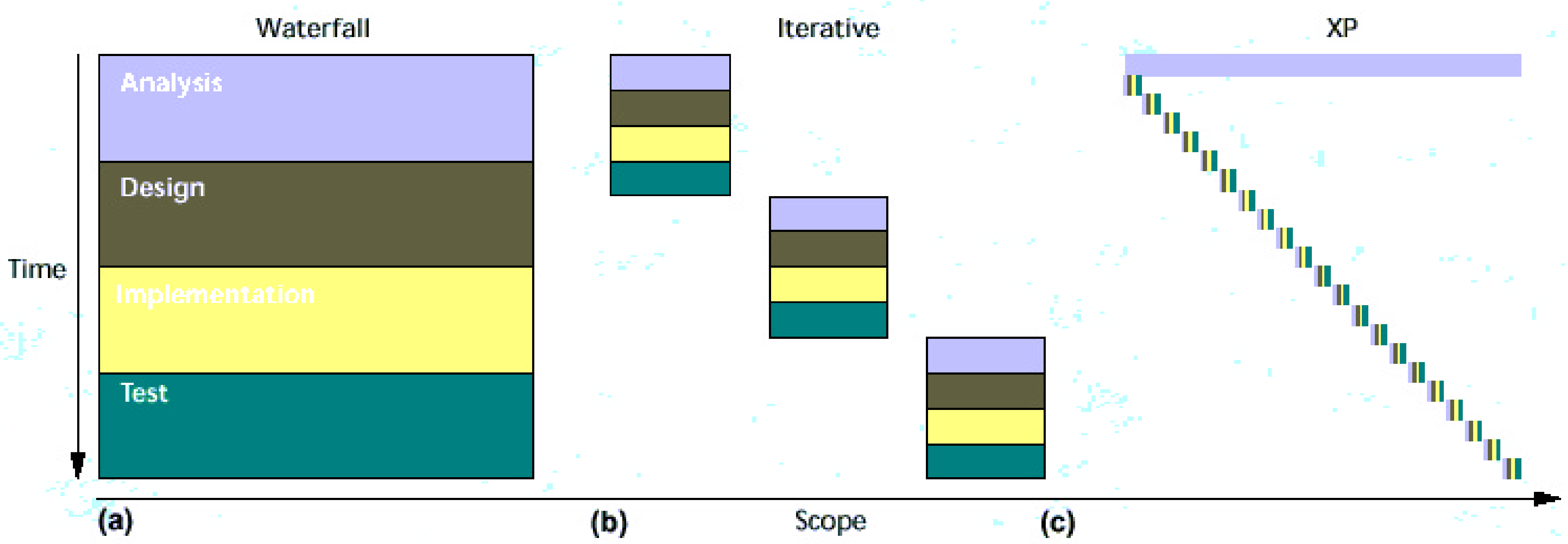
Continuous integration

Coding in pairs

Coding standards

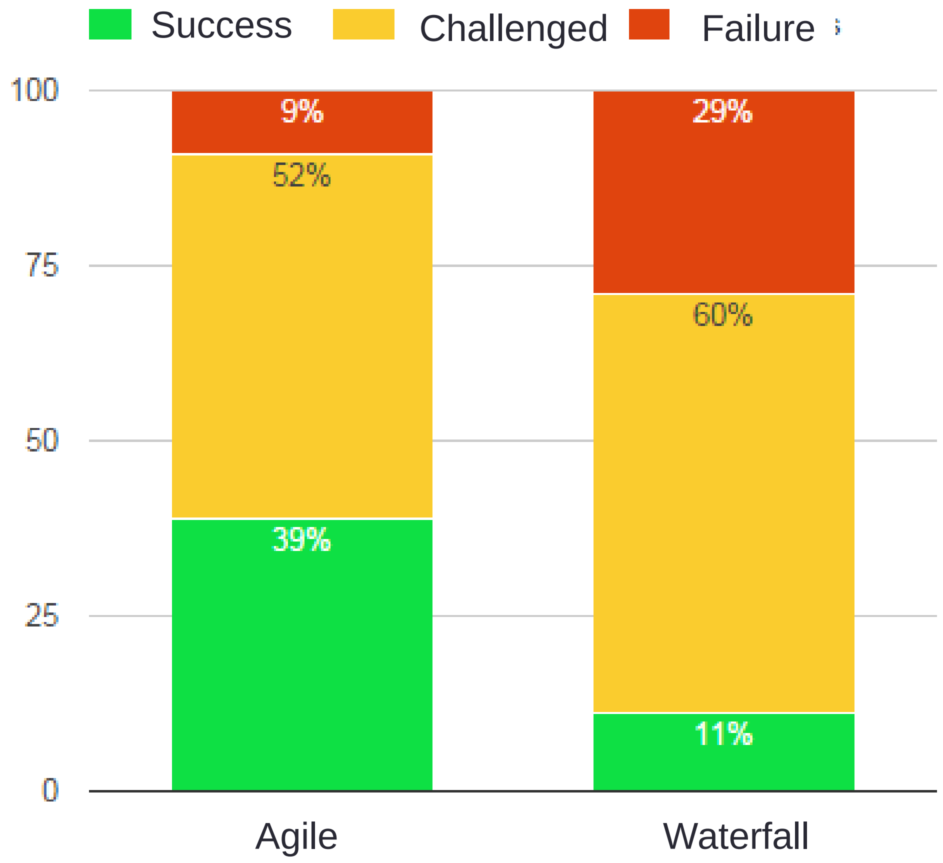
XP

Comparative

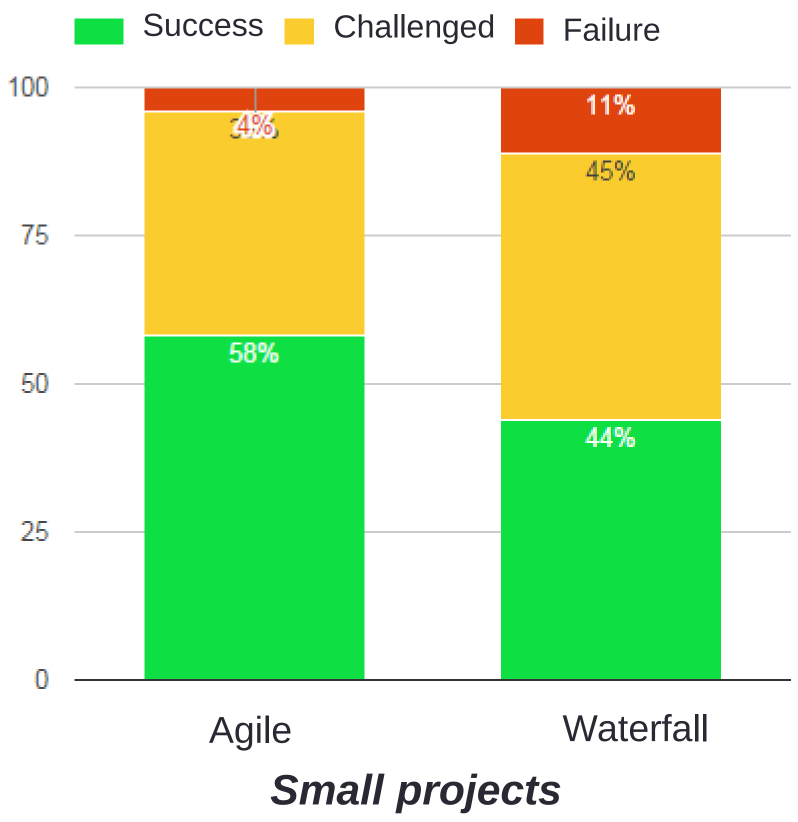


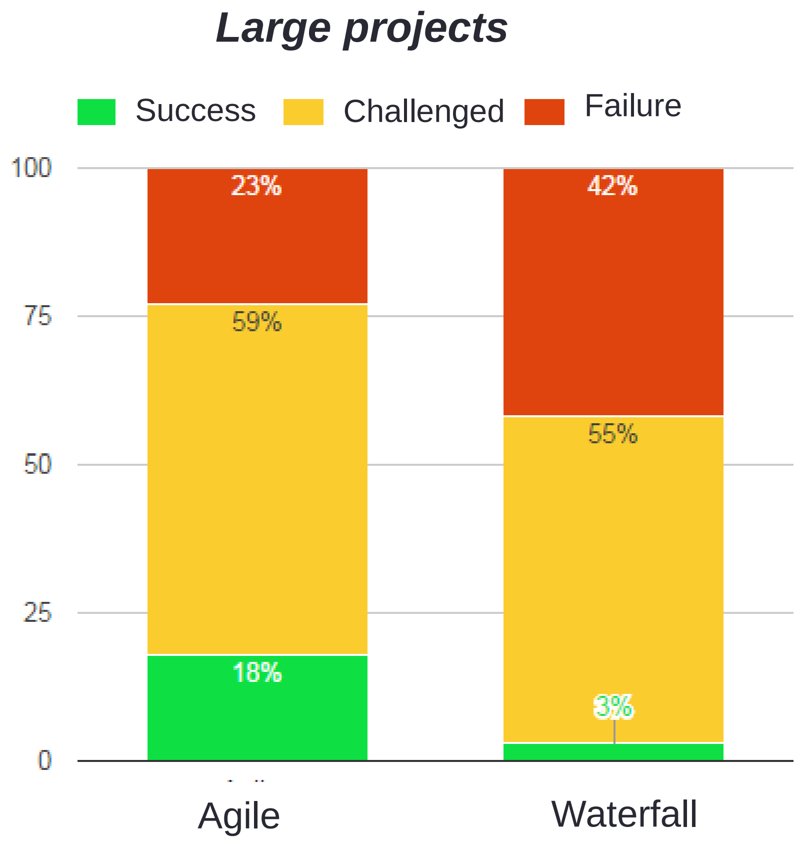
Agile vs. Waterfall

Success based on methodology
2011-2015



Agile vs. Waterfall





ANNEX - Rational Unified Process (RUP)

Software development process
(Rational – IBM)

Uses UML as modelling language

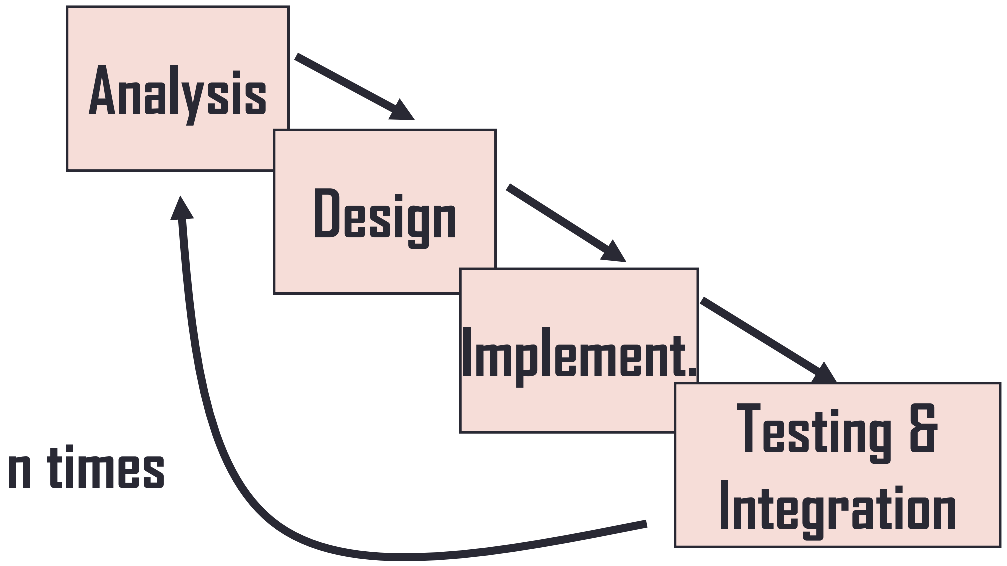
Features:

- *Use cases driven process*: from specification to maintenace
- *Iterative and incremental process:* iterations depending on the importance of use cases and the study of risks.
- *Architecture centered process*: reusable and serving as a guide towards the solution

RUP

- Iterative and Incremental

  Activities are performed in a mini-fall with a limited scope (the goals of the iteration)

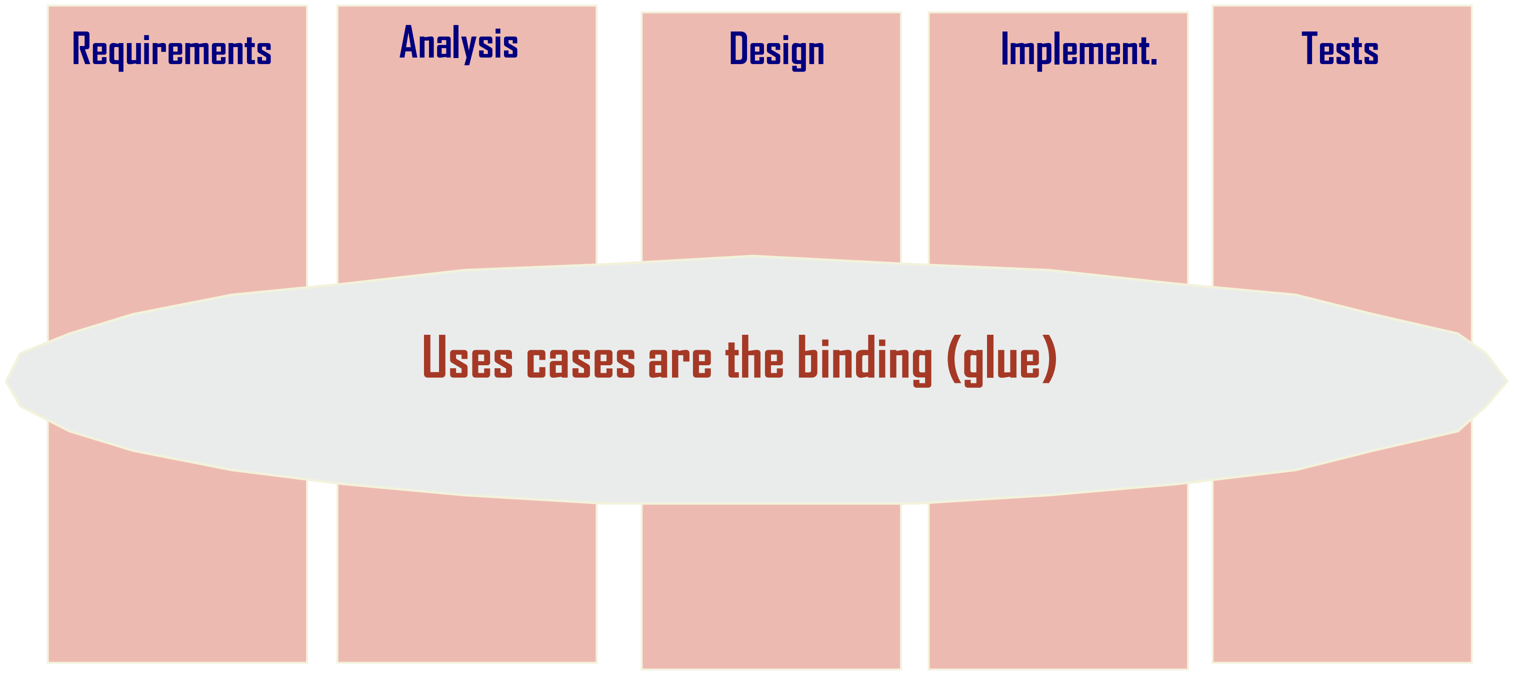


ACTIVITIES OF THE ITERATION

- Plan iteration (risks)
- Analysis of Use cases and Scenarios
- Design of Architectural choices
- Implementation
- Tests
- Integration
- Evaluation of release
- Preparation of release

RUP

- Use cases driven



Capture, clarify & validate use cases

Realize use cases

Verify whether use cases are satisfied

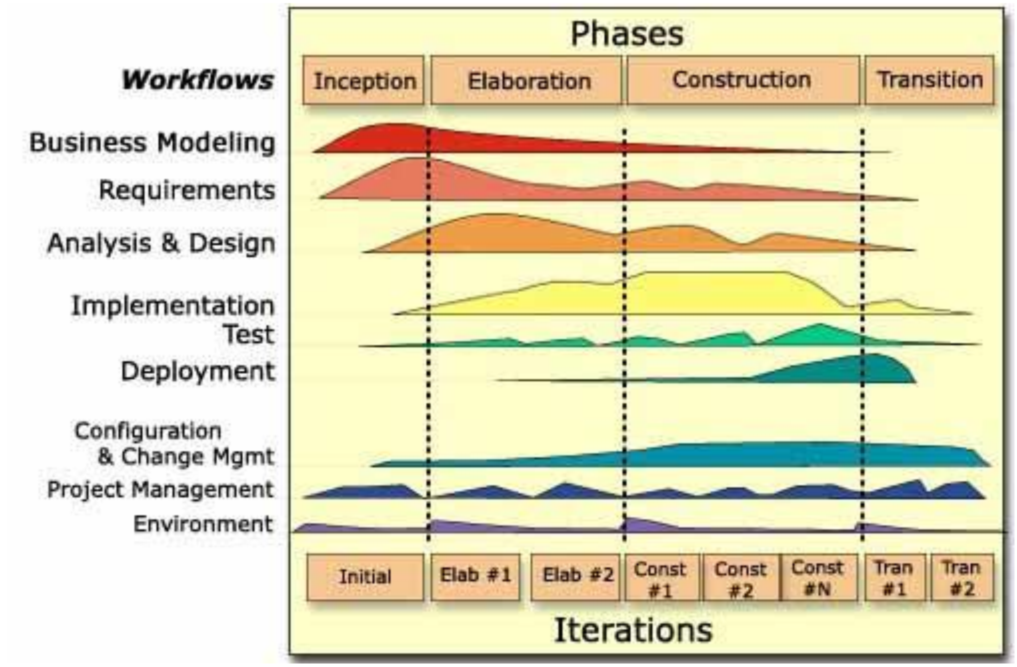
RUP

Dynamic View

Horizontal Axis: Time oriented organization

Static View

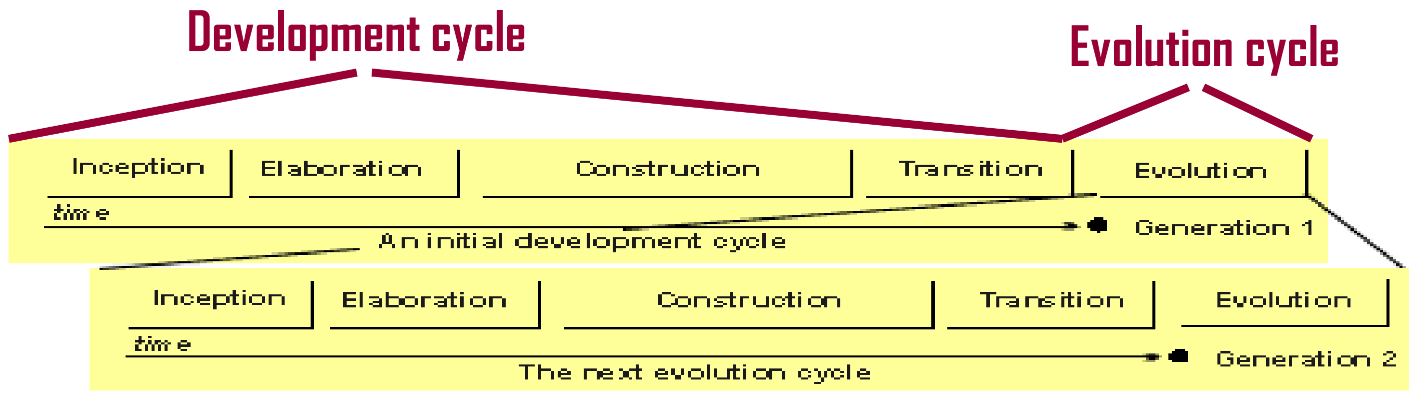
Vertical Axis: Content oriented organization

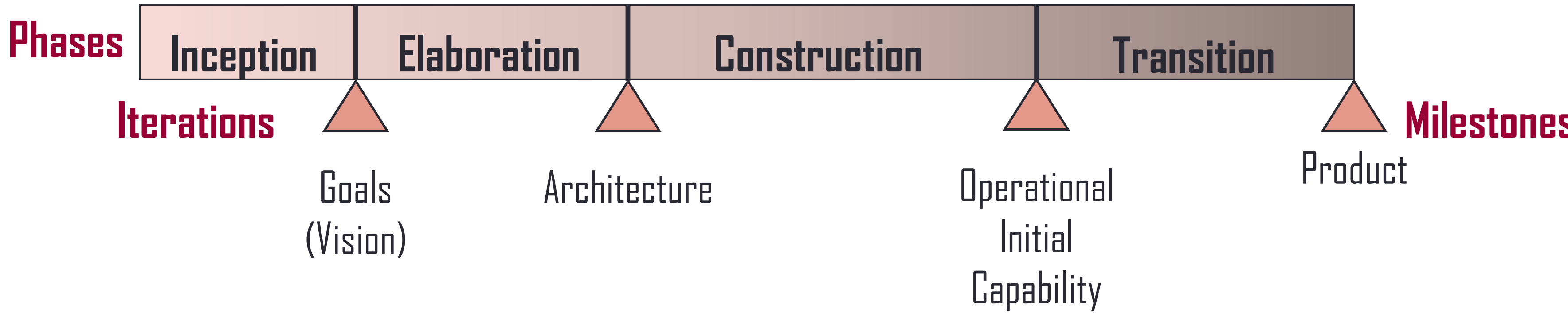


RUP

Dynamic View

- Cycles, Phases, Iterations and Milestones





RUP

Dynamic View

- Phases
  - *Inception(Opportunities Study)*
    - The scope and goals of the project are defined
    - The functionality and capabilities of the product are defined
  - *Elaboration*
    - The problem domain and the desired functionality are studied in depth
    - The basic architecture is defined
    - The project plan is defined according to the available resources

RUP

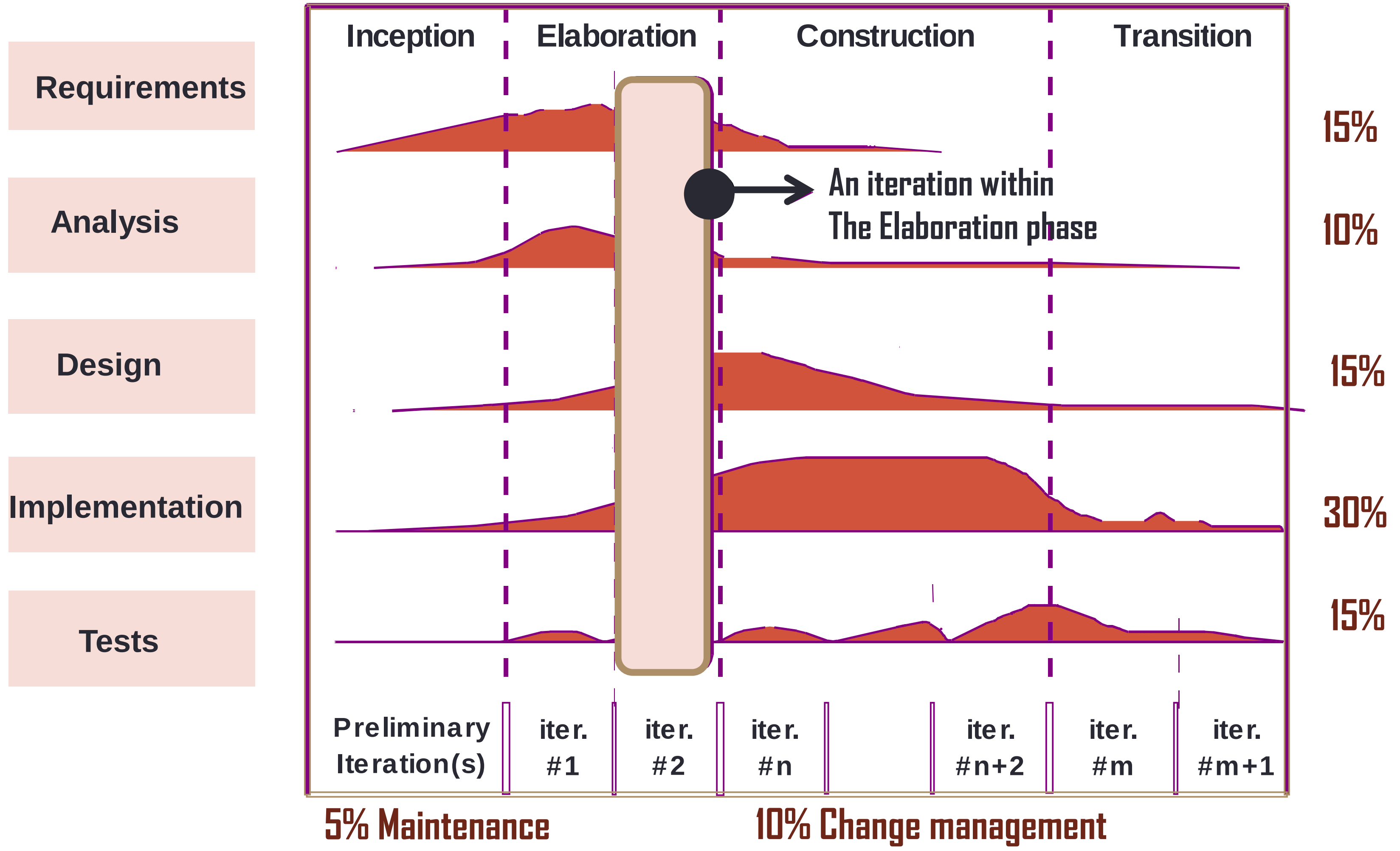
Dynamic View

- *Construction*
  - On each iteration analysis, design and implementation tasks are performed
  - The architecture is refined
  - An important part of the work is dedicated to coding and testing
  - The system and its use is documented
  - This phase provides a built product and a documentation

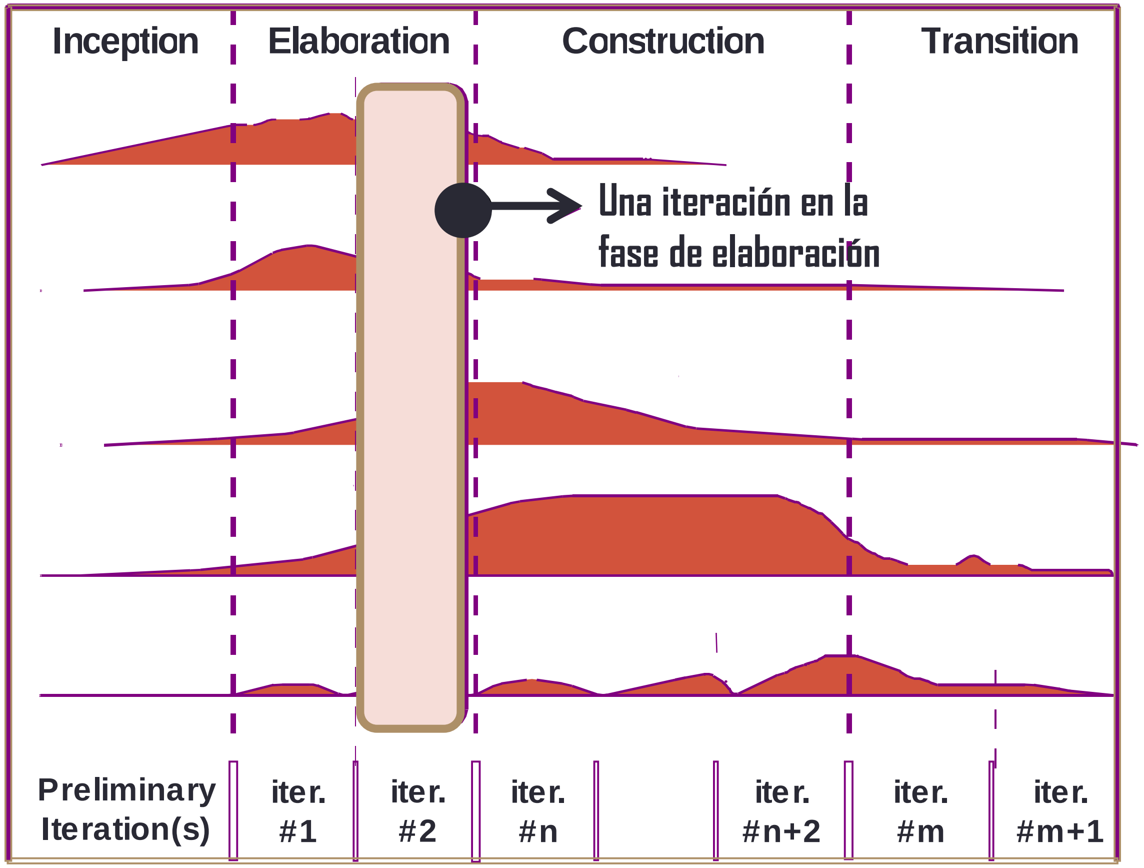
- *Transition*
  - The product is delivered to the user for its use
  - Marketing, packaging, installation, configuration, training, support and maintenance, …
  - User, installation,… guides are completed and refined

Dynamic View

RUP - *Distribution of **effort** with respect to activities*



RUP - *Distribution of **effort** wrt phases*



	Inception	Elaboration	Construction	Transition
Effort:	5%	20%	65%	10%
Duration:	10%	30%	50%	10%

RUP

Static View

- Workflows

Workflow	*Description*
Business Modelling	Business processes are modelled using business use cases
Requirements	Actors are defined that interact with the system and use cases are developed to model the requirements of the system
Analysis & Design	A design model is created using architectural models, component models, object models and interacion models.
Implementation	The different components of the system are structured and implemented. The automatic generation of code helps to speed up this process.
Tests	Testing is an iterative process that takes place simultaneously with the implementation. As soon as the implementation is finished the integration tests take place.
Deployment	A *release* (version) of the product is created, distributed to the users and installed in their workplace.

RUP

Static View

- Workflows

Workflow	*Description*
Configuration and Change Management	To manage changes in the system
Project Management	To manage the development of the system
Environments	Development of appropriate software development tools for development teams.