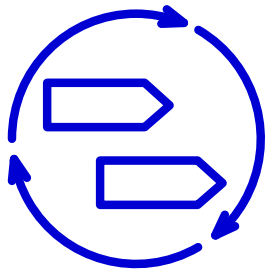
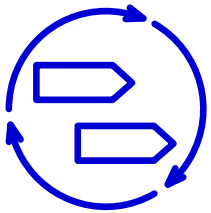
Requirements Engineering I

Chapter 5

Requirements Engineering Processes



Chapter roadmap



5.1 Influencing factors

What to consider

5.2 Process facets

The elements of an RE process

5.3 Configuring an RE process

Putting the elements together

5.4 Further RE process considerations

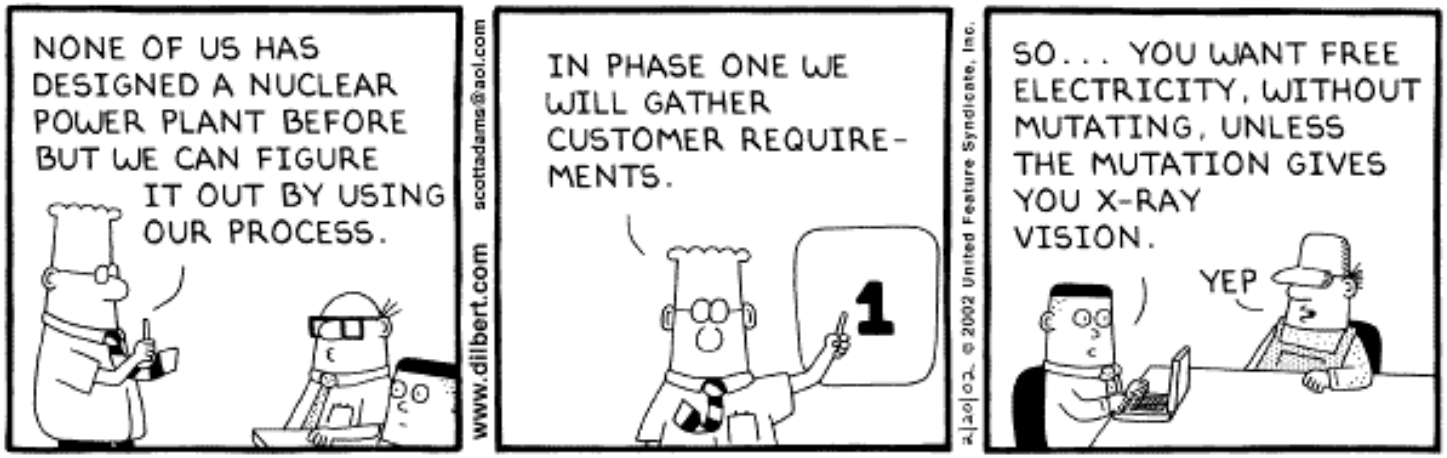
Looking at special cases

Process: What and why

[Armour 2004,
Glinz et al. 2024,
Reinertsen 1997, 2009]

DEFINITION. Process – A set of interrelated activities performed in a given order to process information or materials.

[Glinz 2024]



An RE process organizes how to carry out RE tasks, using appropriate practices and producing needed work products

The principal tasks

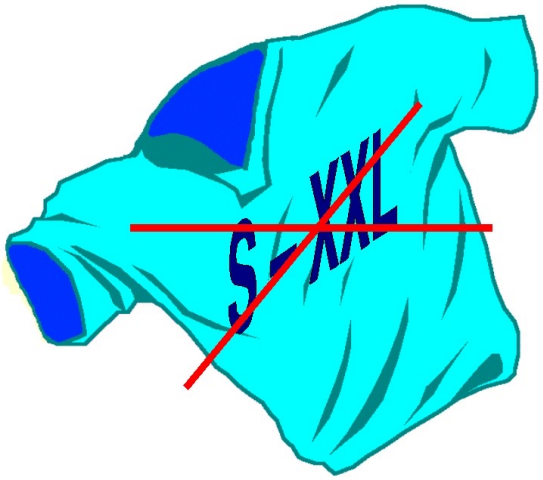
Requirements Specification

- Elicitation & Analysis
- Documentation
- Validation

Requirements Management

- Identification and metadata
- Requirements prioritization
- Change and release management
- Traceability

5.1 Influencing factors



There is no ‘one size fits all’ process

Many influencing factors:

- Overall process fit
- Development context
- Stakeholder availability and capability
- Shared understanding
- Complexity and criticality
- Constraints
- Time and budget available
- Volatility of requirements
- Experience of requirements engineers

For details see Glinz et al. 2024, Chapter 5.1

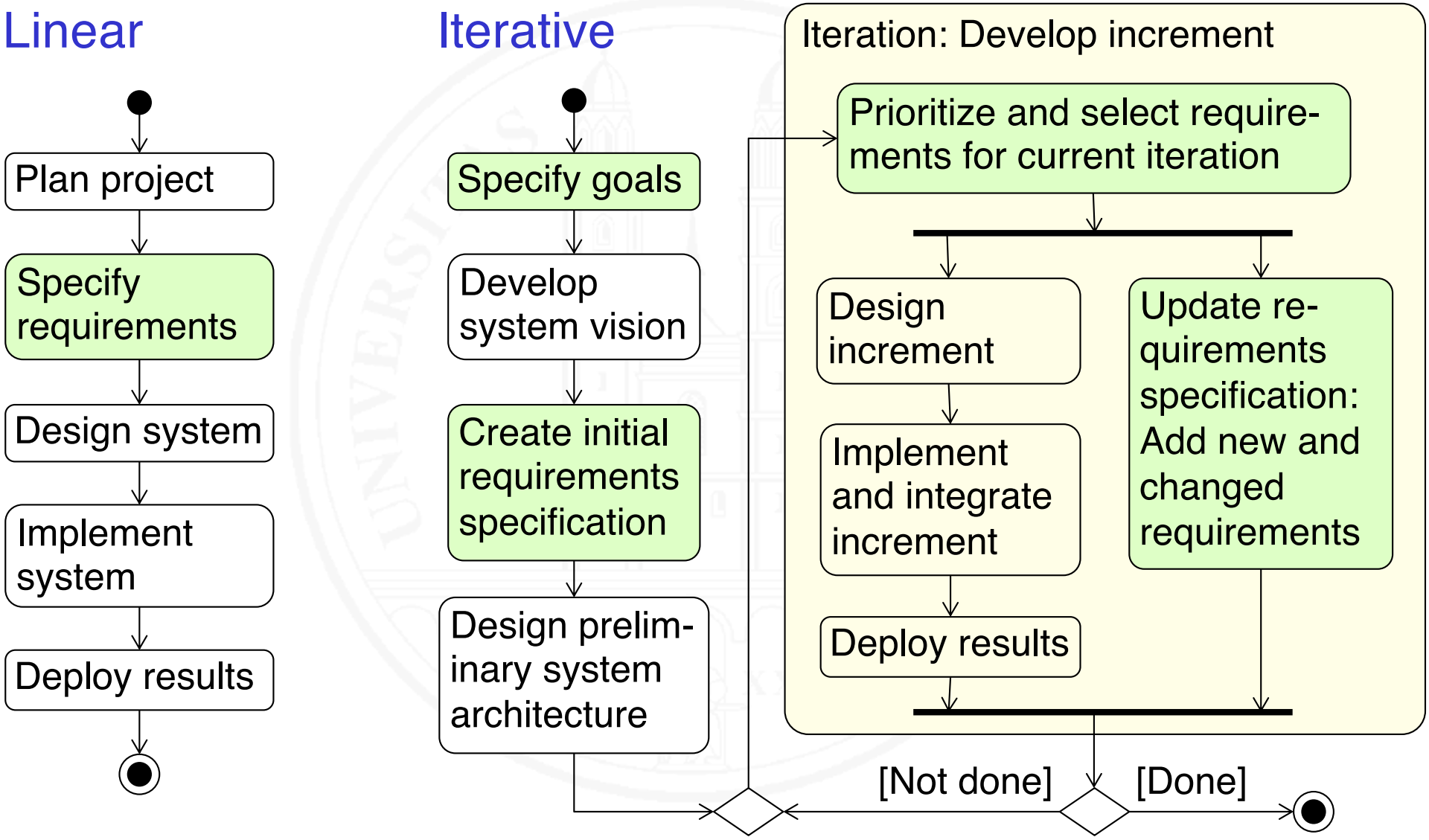
5.2 Process facets

There are three process facets, from which an RE process can be configured

- Time facet: Linear vs. Iterative
- Purpose facet: Prescriptive vs. Explorative vs. COTS-Driven
- Target facet: Customer-Specific vs. Market-Oriented

- Selection criteria indicate how to configure the process in each facet

Time facet: Process structure



Time facet: Linear

Requirements are specified up front in a single phase of the process

Selection criteria:

- System development process is plan-driven and mostly linear
- Stakeholders can specify their requirements up front
- Comprehensive requirements specification required as a contractual basis for outsourcing design and implementation
- Regulatory authorities require a requirements specification

Time facet: Iterative

Requirements are specified incrementally, starting with general goals and then adding or modifying requirements in every iteration

Selection criteria:

- System development process is iterative and agile
- Evolving requirements – not known up front
- Stakeholders are available such that short feedback loops established for mitigating risk
- Duration of project allows for more than 1-2 iterations
- Ability to change requirements easily is important

Mini-Exercise

Consider the chairlift access control case study.

Do you have sufficient information to decide whether a linear or an iterative RE process should be chosen for this project?

If yes, how would you decide?

If not, which additional information do you need for making an informed decision?

Purpose facet: Prescriptive

Requirements specification is a contract: All requirements are binding and must be implemented

Selection criteria:

- Customer requires fixed-price contract
- Functionality determines cost and deadlines
- Design and implementation tendered or outsourced

Purpose facet: Explorative

Only goals known, concrete requirements have to be explored

Selection criteria:

- Stakeholders only have a vague idea about their requirements
- Stakeholders strongly involved, provide continuous feedback
- Deadlines and cost take precedence over functionality
- Customer is satisfied with a framework contract
- Not a priori clear which requirements actually shall be implemented and in which order → Prioritization needed

Purpose facet: COTS-Driven

COTS-Driven

Requirements must reflect functionality of chosen COTS solution

Selection Criteria:

- System will be implemented with COTS software
- Only requirements not covered by the COTS solution shall be specified

COTS (Commercial Off The Shelf) – A system or component that is not developed, but bought as a standard product from an external supplier

Mini-Exercise

Consider the chairlift access control case study.

Do you have sufficient information to decide whether the RE process chosen for this project should be prescriptive, explorative or COTS-driven?

If yes, how would you decide?

If not, which additional information do you need for making an informed decision?

Target facet: Customer-Specific

System is ordered by a customer and developed by a supplier for this customer

Selection criteria:

- The system will be mainly used by the organization that has ordered the system and pays for its development.
- The important stakeholders are mainly associated with the customer's organization.
- Individual persons can be identified for the stakeholder roles.
- The customer wants a requirements specification that can serve as a contract.

Target facet: Market-Oriented

System is developed as a product or service for a market

Selection criteria:

- Developing organization (or one of its clients) intends to sell the system as a product or service in some market segment
- Prospective users not individually identifiable
- Requirements engineers have to design the requirements so that they match the envisaged needs of the targeted users
- Product owners, marketing people, digital designers and system architects are primary stakeholders

Mini-Exercise

Consider the chairlift access control case study.

Do you have sufficient information to decide whether the RE process chosen for this project should be customer-specific or market-oriented?

If yes, how would you decide?

If not, which additional information do you need for making an informed decision?

Hints and caveats

- Linear RE processes only work if a sophisticated process for changing requirements is in place
- Linear RE processes imply long feedback loops: intensive validation of requirements must be performed
- Market-oriented RE processes crucially depend on fast feedback from pilot users for validating whether the product will actually satisfy needs of the targeted user segment
- In an agile setting, an iterative and explorative RE process fits best

Facet combinations

- *Linear* and *prescriptive* are frequently chosen together
- *Explorative* processes are typically also *iterative*
- *Market-Oriented* does not combine well with *Linear* and *Prescriptive*

5.3 Configuring an RE process

1. Analyze the influencing factors
2. Assess the facet criteria
3. Configure
   - Select one of the subsequent typical configurations where appropriate
   - Otherwise choose what is most appropriate with respect to value and risk
4. Determine main work products to be produced
5. Select appropriate practices for the tasks to be performed according to the chosen process

Typical RE process configurations

Participatory: Iterative & Explorative & Customer-Specific

- Main application case
  Supplier and customer closely collaborate; customer stakeholders strongly involved both in specification and development processes
- Typical work products
  Product backlog with user stories and/or task descriptions, vision, prototypes, use cases, various models
- Typical information flow
  Continuous interaction between stakeholders, product owners, requirements engineers, and developers

Typical RE process configurations – 2

Contractual: Typically Linear (sometimes Iterative) & Prescriptive & Customer-Specific

- Main application case
  Specification constitutes contractual basis for development of a system by people not involved in the specification and with little stakeholder interaction after the requirements phase
- Typical work products
  Classic system requirements specification, consisting of textual requirements and models.
- Typical information flow
  Primarily from stakeholders to requirements engineers

Typical RE process configurations – 3

Product-oriented: Iterative & Explorative & Market-Oriented

- Main application case
  An organization specifies and develops software in order to sell/distribute it as a product or service
- Typical work products
  Product backlog with user stories and/or task descriptions, vision, prototypes, user feedback, use cases, various models
- Typical information flow
  Interaction between product owner, marketing, requirements engineers, digital designers, and developers plus feedback from customers/users

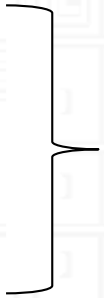
Typical RE process configurations – 4

COTS-Aware: [Iterative | Linear] & COTS-Driven & Customer-Specific

- Main application case:
  The requirements specification is part of a project where the solution is mainly implemented by buying and configuring COTS
- Typical work products:
  Process models describing the alignment of business processes and the COTS solution, partial requirements specification, covering what is not provided by the COTS solution
- Typical information flow:
  Primarily from stakeholders and COTS solution experts to requirements engineers

5.4 Further RE process considerations

- What if none of the typical process configurations fits?
  - Try to tailor the configuration with the closest fit
  - Get help from an RE process expert for building a process from scratch
- RE in agile development?
- Is there something like an "ideal" RE process?



See next slides

RE processes in agile development

The minimum is more than the empty set

Short feedback cycles are key

For small to medium, single-team projects:

- Goals and vision established upfront
- Requirements loosely specified as stories (with details captured in acceptance criteria)
- Using prototypes (both exploratory and evolutionary) for validating the vision
- Customer or product owner prioritizes requirements at the beginning of each iteration

RE processes in agile development – 2

For scaled, multi-team projects:

- Configure an iterative and explorative process
- with work products that allow the coordination of multiple agile teams

An “ideal” RE process

How would an RE process look in the best of all worlds?

- Useful as a thought experiment: separating the essence of the process from accidental stuff
- Can serve as a benchmark for real RE processes: how far are we away from the “ideal” process?

Characteristics of an “ideal” RE process

- Strongly interactive: *iterative* and *explorative*
- Close and intensive collaboration between
  - Stakeholders (know the domain and the problem)
  - Requirements engineers (know how to specify)
- Very short feedback cycles
- Risk-aware and feasibility-aware
  - Technical risks/feasibility
  - Deadline risks/feasibility
- Careful negotiation / resolution of conflicting requirements
- Focus on establishing shared understanding
- Strives for innovation