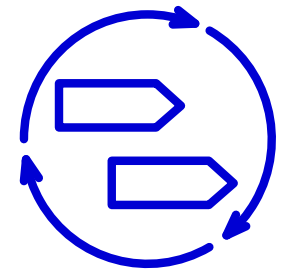


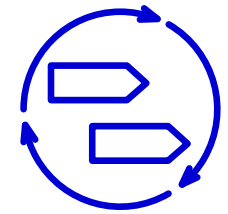
Requirements Engineering I

Chapter 5

Requirements Engineering Processes



Chapter roadmap



5.1

Influencing factors
What to consider

5.4

Further RE process
considerations
Looking at special cases

5.2

Process facets
The elements of an RE
process

5.3

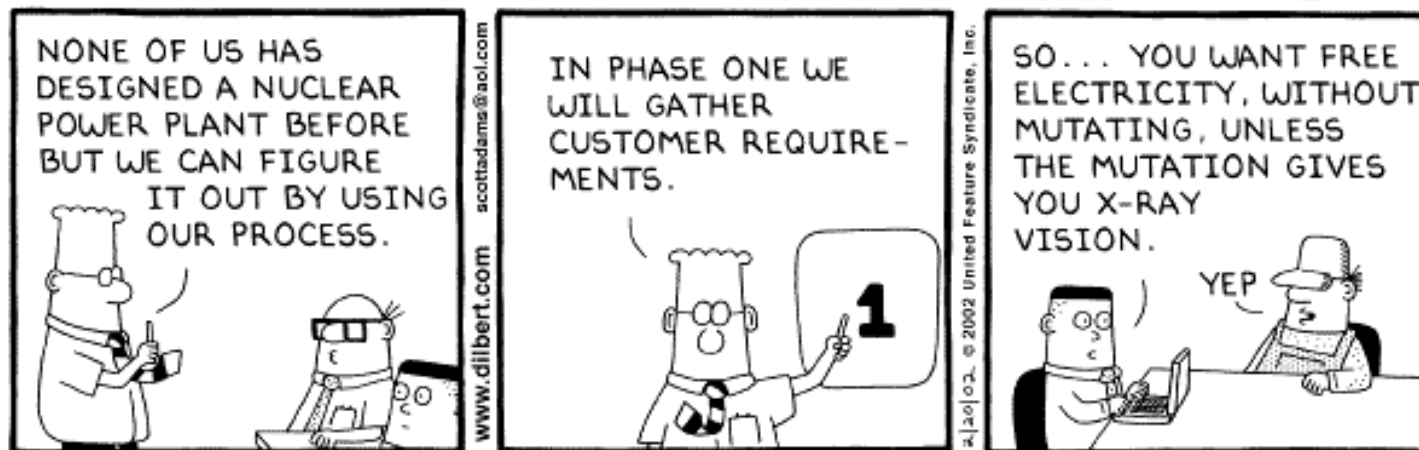
Configuring an RE process
Putting the elements together

Process: What and why

[Armour 2004,
Glinz et al. 2022,
Reinertsen 1997, 2009]

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

[Glinz 2020]



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**

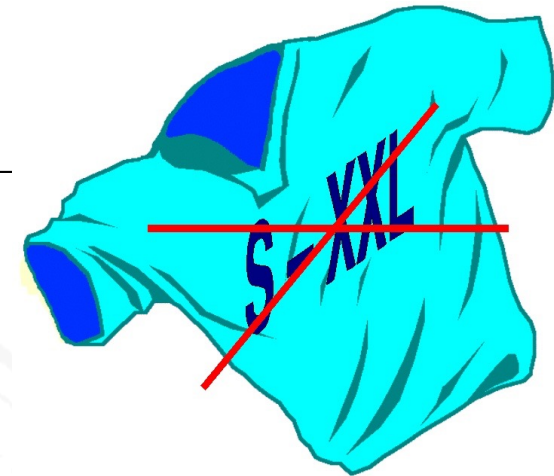
- Identification and metadata
- Requirements prioritization
- Change and release management
- Traceability

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. 2022,
Chapter 5.1

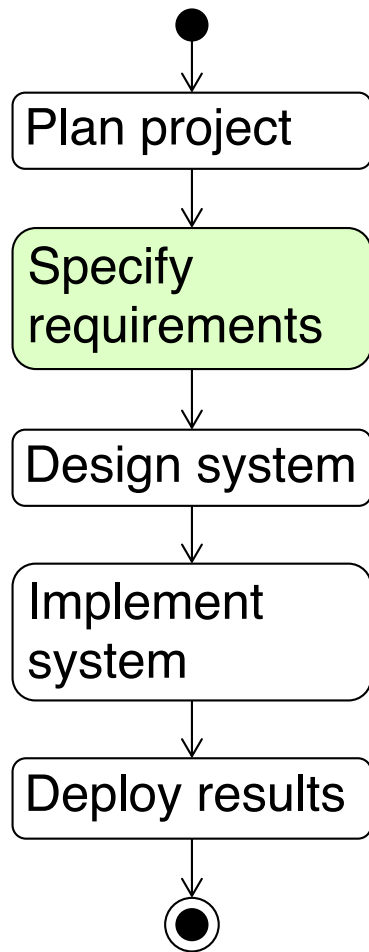
5.2 Process facets

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

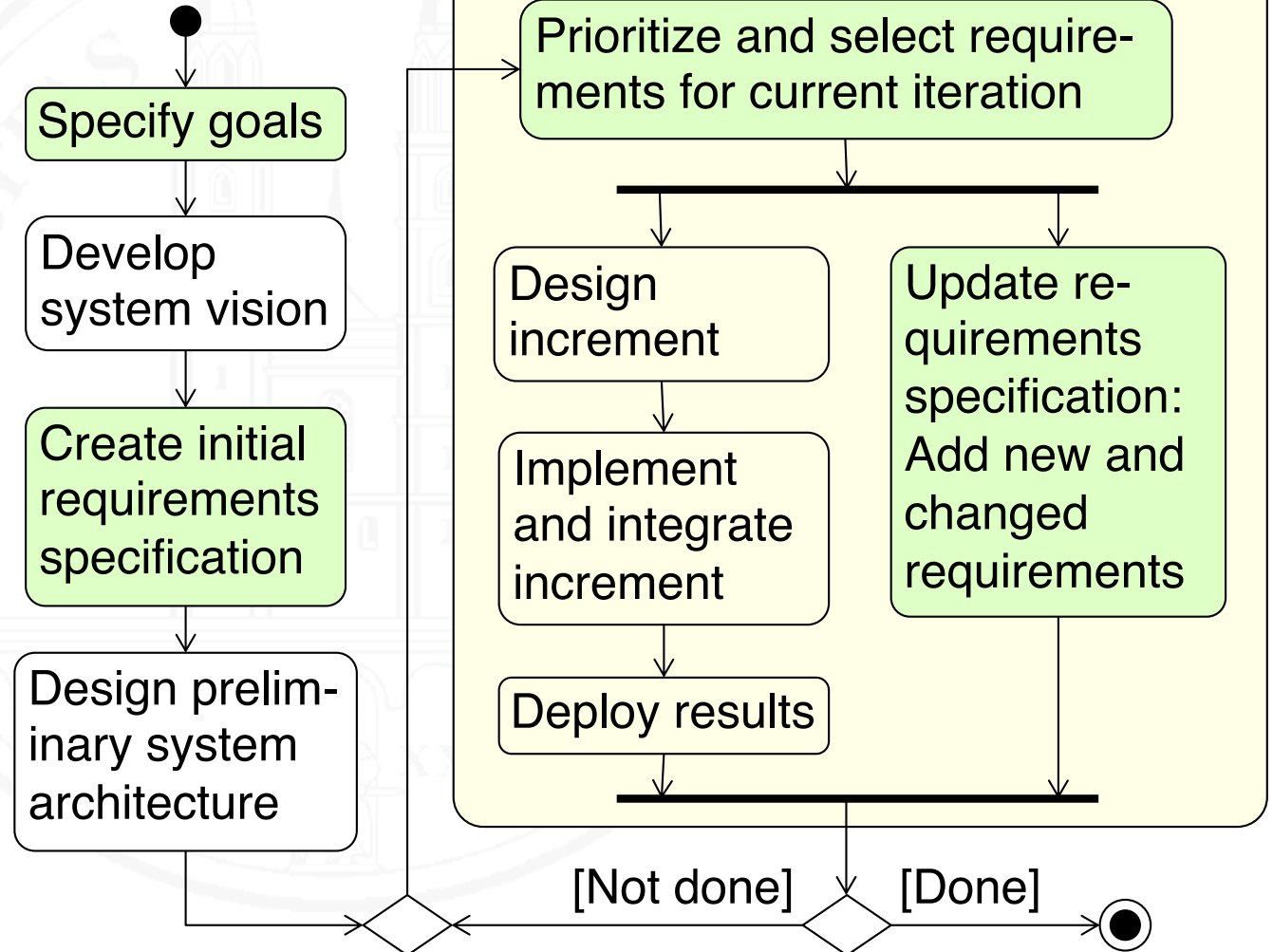
- **Time** facet: Linear vs. Iterative
- **Purpose** facet: Prescriptive vs. Explorative vs. COTS-Driven
- **Target** facet: Customer-Specific vs. Market-Oriented
- **Selection criteria** indicate how to configure the process in each facet

Time facet: Process structure

Linear



Iterative



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?

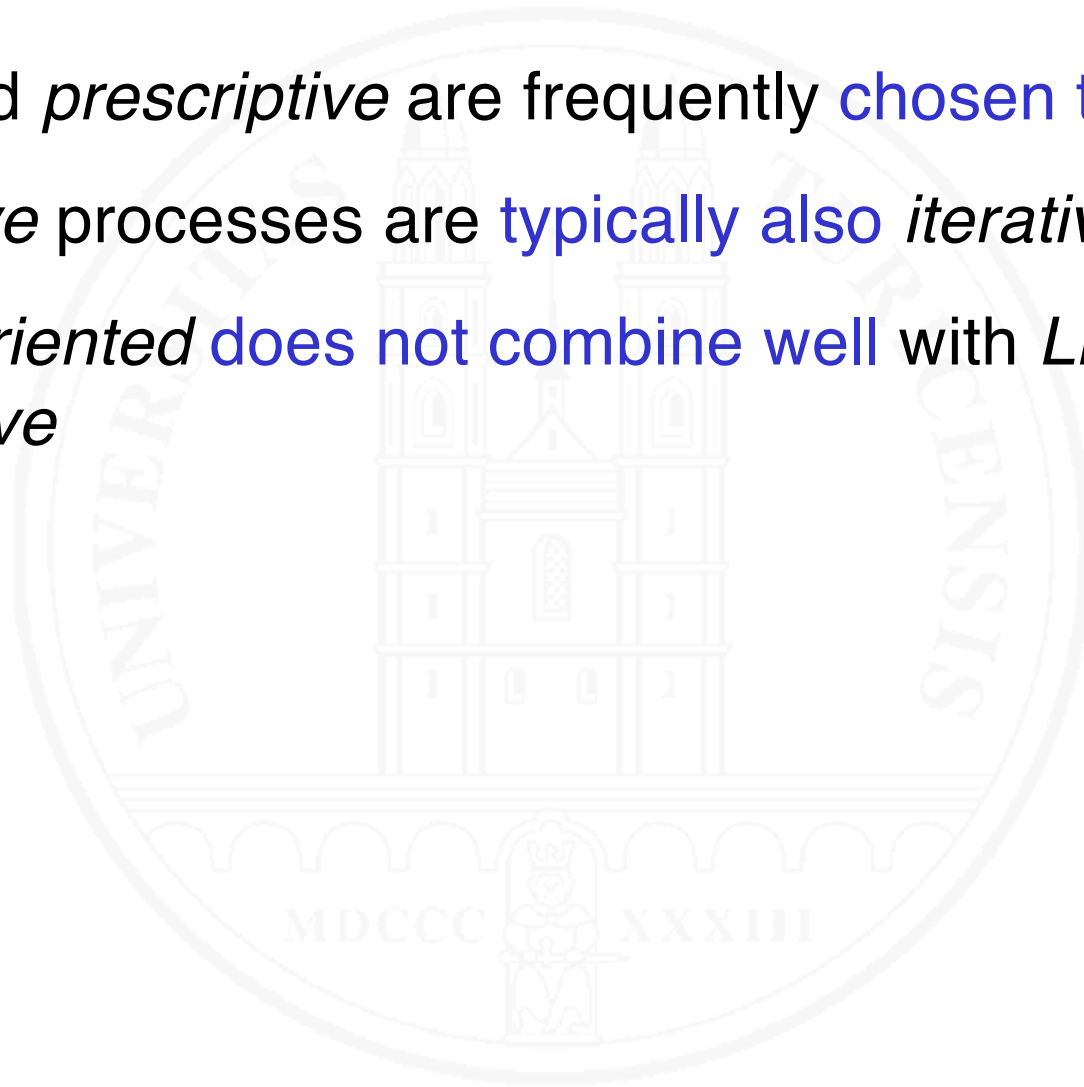
If not, which additional information do you need for making an informed decision?

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

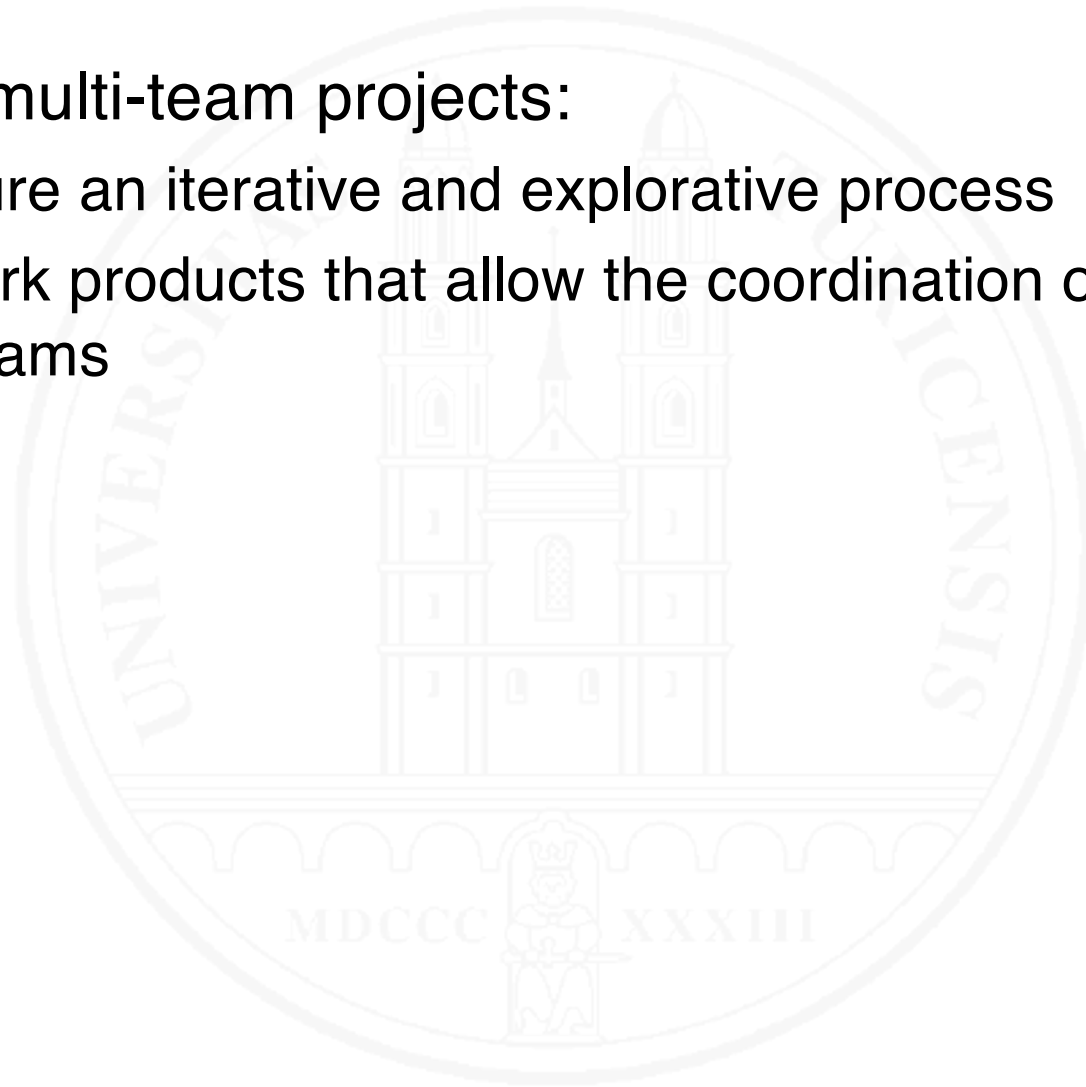
For small to medium, single-team projects:

- 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**