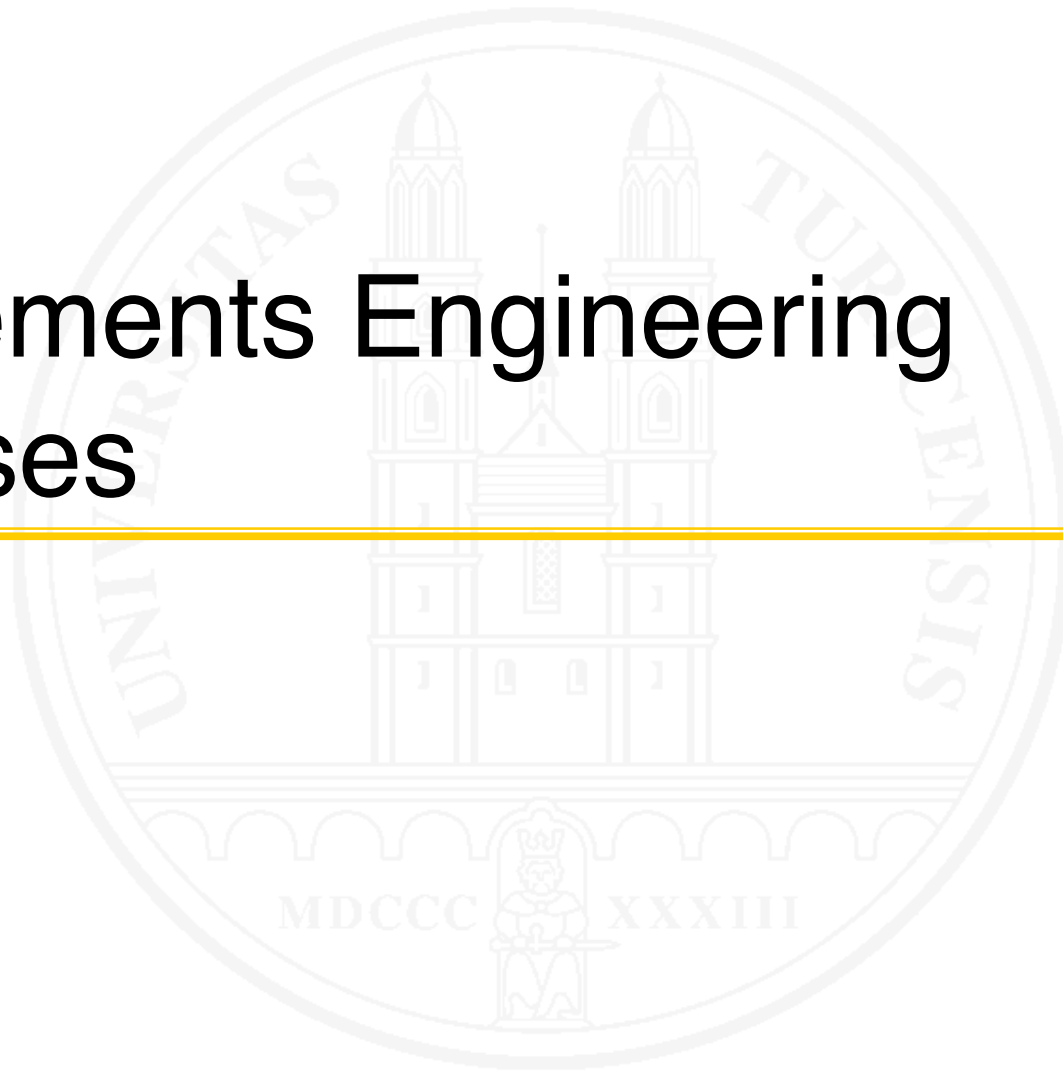


Requirements Engineering I

Chapter 5

Requirements Engineering Processes

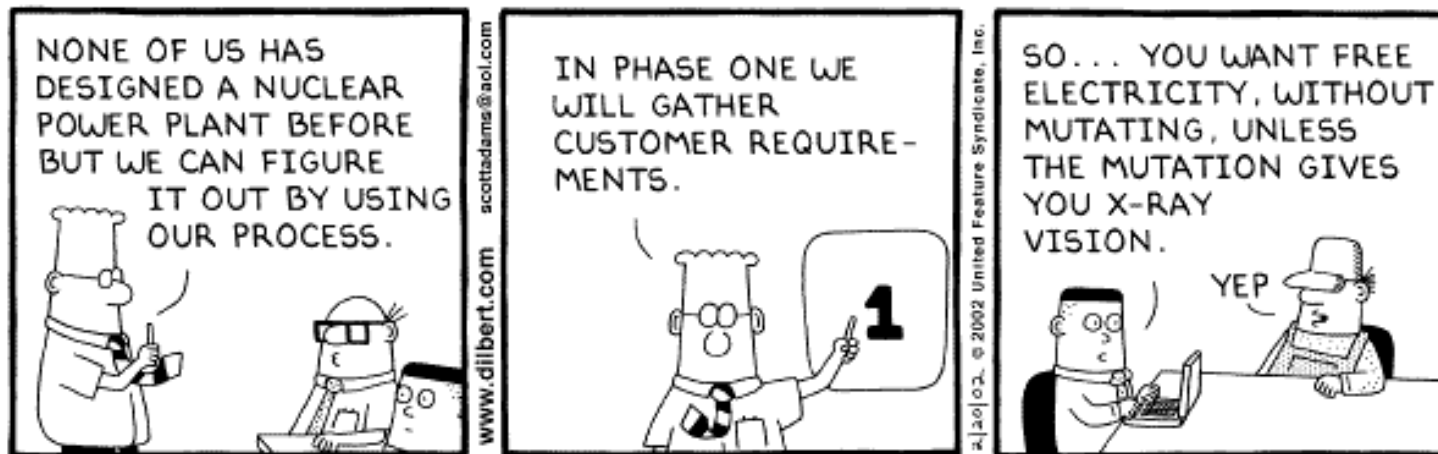


Process: What and why

[Armour 2004,
Glinz et al. 2020,
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

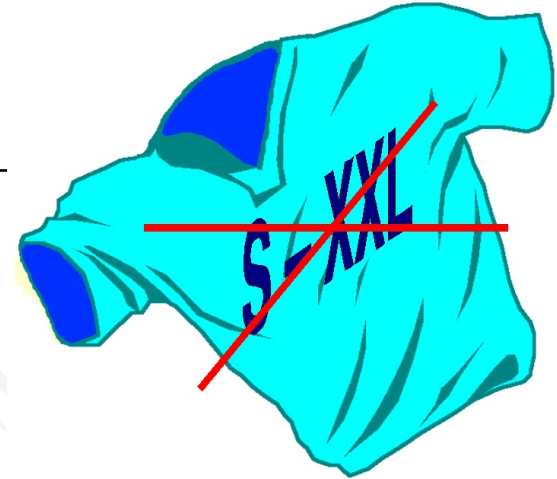
Requirements Specification

- Elicitation & Analysis
- Documentation
- Validation

Requirements Management

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

No 'one size fits all' process



Some 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
- Tailor the process from some principal configuration options and a rich set of RE practices

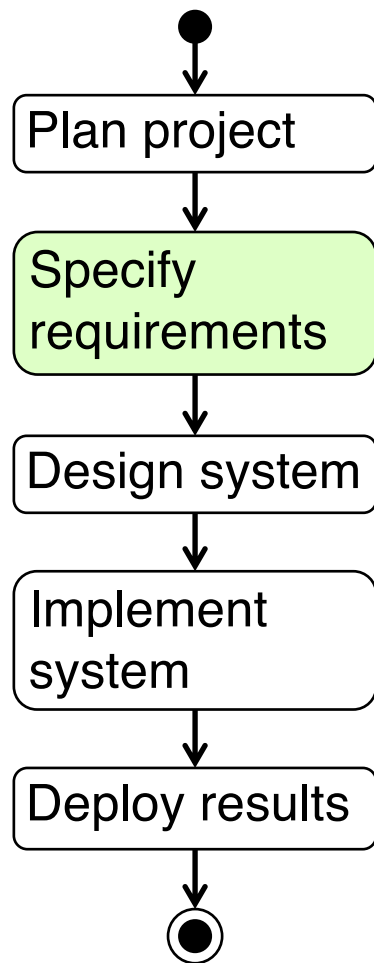
Process facets

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

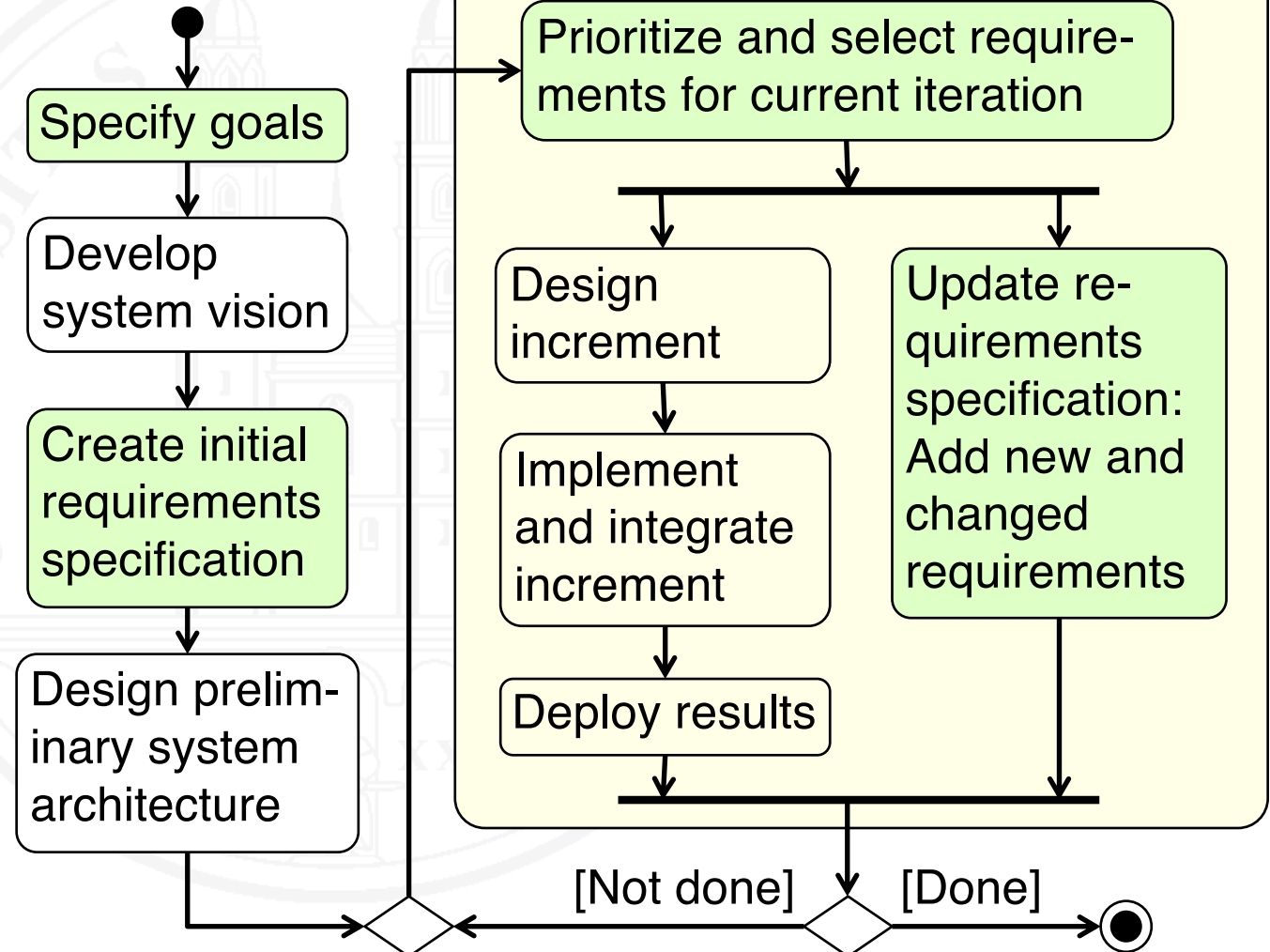
- **Time** facet: Linear vs. Iterative
- **Purpose** facet: Prescriptive vs. Explorative vs. COTS-Driven
- **Target** facet: Customer-Specific vs. Market-Oriented
- **Selection criteria** indicate how to configure the process in each facet

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

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

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:

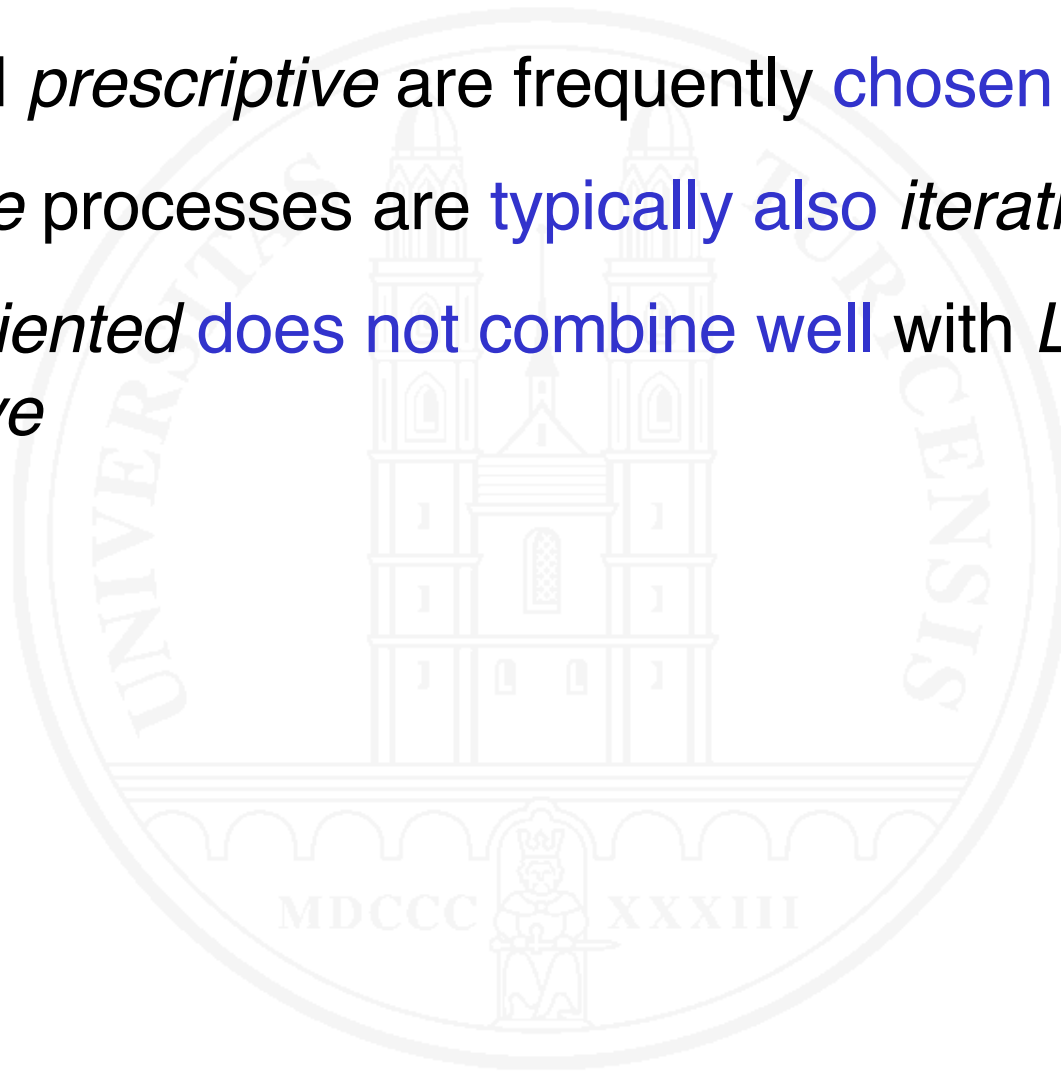
- Developing organization (or one of its clients) intends to sell the system as a **product** or **service** in some **market segment**
- Prospective users **not individually identifiable**
- Requirements engineers have to **design** the requirements so that they match the **envisaged needs** of the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

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*



How to configure 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
- **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
- **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

Agile requirements process

Pushes **incrementality** and **exploration** to the extreme

- **Fixed-length iterations** of 1-6 weeks
- **Product owner** or **customer** representative always **available** and has power to make immediate **decisions**
- Only **goals** and **vision** established **upfront**
- Requirements **loosely specified** as **stories** (with details captured in **acceptance criteria**)
- **Use cases** or other means used for providing **structure & context**
- At the beginning of each iteration
 - **Customer/product owner prioritizes** requirements
 - **Developers select** what to implement in that iteration
- **Short feedback cycle** from requirements to deployed system

Characteristics of an “ideal” RE process

- Strongly **interactive**
- **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**