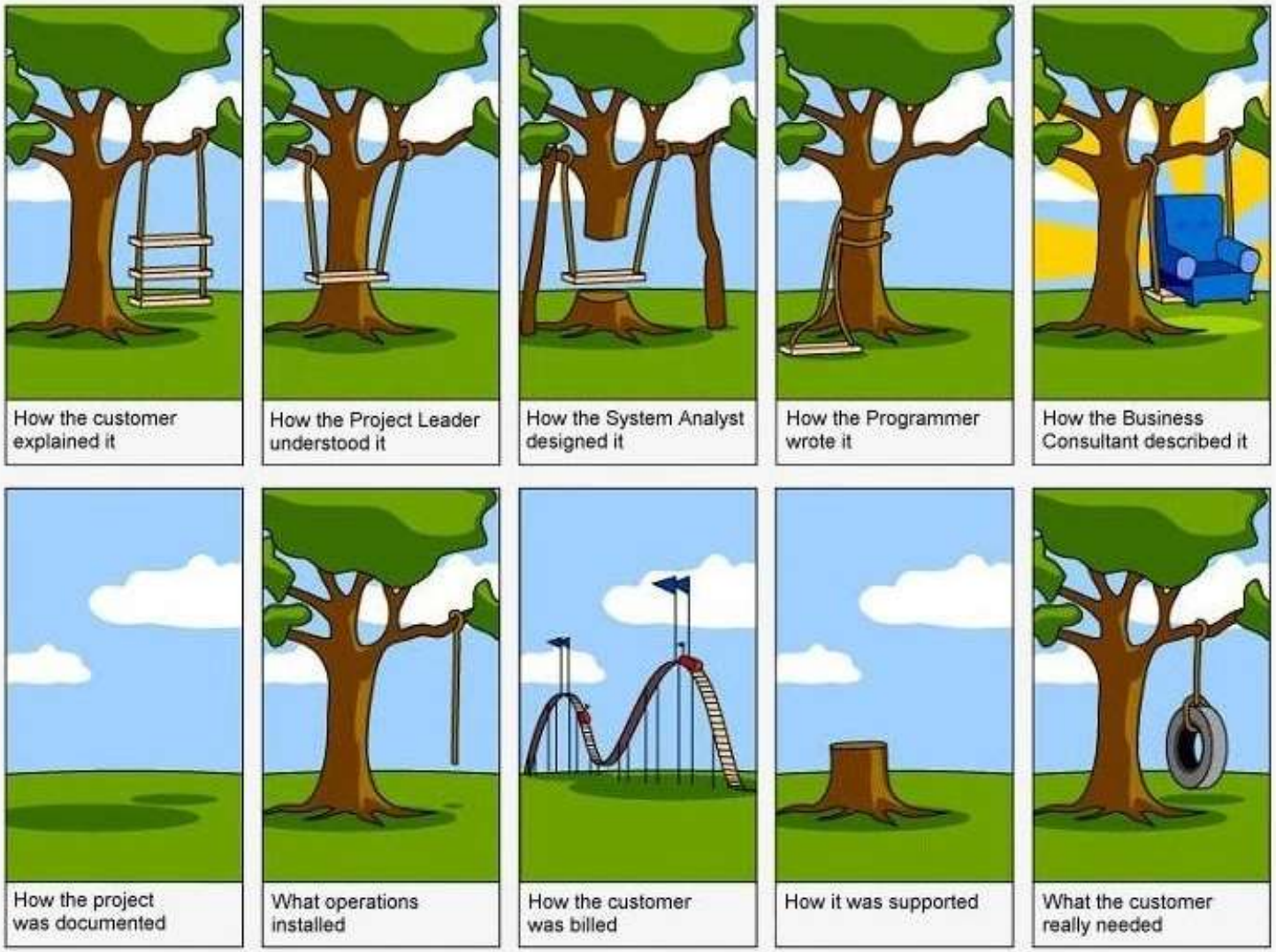


REQUIREMENTS ENGINEERING 1/2

Prof. Dr. Norbert Frick

COURS INFORMATION UPDATE

Lecture Date	Lecture Schedule	Exercise Date (MS Teams Meetings)	Deliverables (due 23:59)
16.04.2025	Introduction to the course **(online, VoD)**	Bonus exercise	22.04.
23.04.2025	IT Strategy/ Strategic & Operational IT Management	25.04.	29.04.
30.04.2025	Architecture Management	02.05.	06.05.
07.05.2025	Business Architecture **(online, VoD)**	09.05.	13.05.
14.05.2025	Requirements Engineering 1/2	16.05.	20.05.
21.05.2025	IT Outsourcing **(Guest lecture)**	23.05.	27.05.
28.05.2025	Requirements Engineering 2/2	30.05.	03.06.
04.06.2025	Application Architecture	06.06.	17.06.
11.06.2025	**NO LECTURE!!!**	no exercise	---
18.06.2025	IT Service Management **(online, VoD)**	20.06.	01.07.
25.06.2025	**NO LECTURE!!!**	no exercise	---
02.07.2025	IT Security **(Guest lecture)**	05.07.	09.07.
09.07.2025	IT Project & Program Management	11.07.	15.07.
16.07.2025	Recap & Exam preparation	no exercise	---
13.08.2025	**EXAM** ***(10:00-11:30, rooms tbd)***		
tbd	**RETRY EXAM** ***(??:00-??:00, room tbd)***		

INTERNATIONAL REQUIREMENTS ENGINEERING BOARD

Source: https://www.compliance-technologies.com/DS/ireb-cpre-handbook-for-requirements-management-advanced-level-en-v1.1.pdf, Last access: 06.06.2025

DEFINITIONS 1/3

Requirement

- a thing that is needed or wanted

Source: https://languages.oup.com/google-dictionary-en, Last access: 06.06.2025

- a singular documented physical or functional need that a particular design, product or process aims to satisfy

Source: https://en.wikipedia.org/wiki/Requirement, Last access: 06.06.2025

Requirement according to IREB

- A need perceived by a stakeholder
- A capability or property that a system shall have
- A documented representation of a need, capability or property

Glinz et al. (2020)

DEFINITIONS 2/3

We define requirements management as part of requirements engineering.

Requirements engineering is a systematic and disciplined approach to the specification and management of requirements with the goal of understanding the stakeholders' desires and needs and minimizing the risk of delivering a system that does not meet these desires and needs

- Knowing the relevant requirements, establishing consensus among the stakeholders about the requirements, documenting the requirements in compliance with given standards, and managing the requirements systematically
- Understanding and documenting the stakeholders' desires and needs
- Specifying and managing requirements to minimize the risk that the system that does not meet the stakeholders' desires and needs

Bühne & Herrmann. (2015) Glinz et al. (2020)

DEFINITIONS 3/3

Requirements management: the process of managing existing requirements and requirements-based artifacts. In particular, this includes documenting, changing, and tracing requirements. It also includes managing the requirements engineering process, which means planning, controlling, and checking the requirements engineering process. Bühne & Herrmann. (2015)

WHY REQUIREMENTS ENGINEERING? 1/2

Adequate Requirements Engineering (RE) adds value to the process of developing a system:

- RE minimizes the risk of failure or costly modifications in later development stages. The early detection and correction of wrong or missing requirements is much cheaper than the correction of errors and rework caused by missing or wrong requirements in later development stages or even after deployment of a system.
- RE eases the intellectual complexity involved in understanding the problem that a system is supposed to solve and reflecting on potential solutions.
- RE provides a proper basis for estimating development effort and cost.
- RE is a prerequisite for testing the system properly.

Glinz et al. (2020)

WHY REQUIREMENTS ENGINEERING? 2/2

Typical symptoms of inadequate RE are missing, unclear, or wrong requirements due to:

- Development teams rushing right into implementing a system due to schedule pressure
- Communication problems between parties involved—in particular, between stakeholders and system developers and among the stakeholders themselves
- The assumption that the requirements are self-evident, which is wrong in most cases
- People conducting RE activities without having adequate education and skills

Glinz et al. (2020)

REQUIREMENTS: WHERE?

Requirements Engineering can be applied to requirements for any kind of system. However, the dominant application case for RE today involves **systems** in which software plays a major role.

Such systems consist of **software components**, **physical elements** (technical products, computing hardware, devices, sensors, etc.), and **organizational elements** (persons, positions, business processes, legal and compliance issues, etc.).

Systems that contain **both software and physical components** are called **cyberphysical systems**. Systems that span **software, hardware, people, and organizational aspects** are called **socio-technical systems**.

Glinz et al. (2020)

SORTS OF REQUIREMENTS

System requirements describe how a system shall work and behave—as observed at the interface between the system and its environment—so that the system satisfies its stakeholders' desires and needs. In the case of pure software systems, we speak of software requirements.

- **Stakeholder requirements** express stakeholders' desires and needs that shall be satisfied by building a system, seen from the stakeholders' perspective.
- **User requirements** are a subset of the stakeholder requirements. They cover the desires and needs of the users of a system.
- **Domain requirements** specify required domain properties of a socio-technical or cyber-physical system.
- **Business requirements** focus on the business goals, objectives, and needs of an organization that shall be achieved by employing a system (or a collection of systems). Glinz et al. (2020)

NINE FUNDAMENTAL PRINCIPLES OF RE

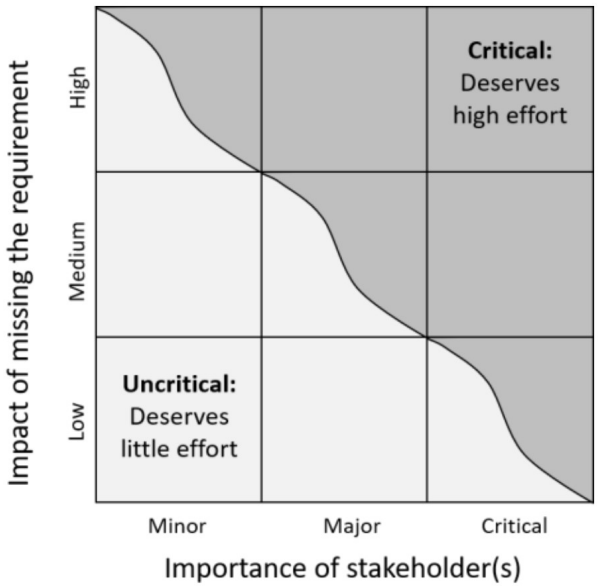
1	*Value orientation*: Requirements are a means to an end, not an end in itself
2	*Stakeholders*: RE is about satisfying the stakeholders' desires and needs
3	*Shared understanding*: Successful systems development is impossible without a common basis
4	*Context*: Systems cannot be understood in isolation
5	*Problem, requirement, solution*: An inevitably intertwined triple
6	*Validation*: Non-validated requirements are useless
7	*Evolution*: Changing requirements are no accident, but the normal case
8	*Innovation*: More of the same is not enough
9	*Systematic and disciplined work*: We can't do without in RE

Glinz et al. (2020)

PRINCIPLES OF RE - VALUE ORIENTATION

The following influencing factors should be considered:

- Effort needed to specify the requirement
- Distinctiveness of the requirement (how much it contributes to the success of the overall system)
- Degree of shared understanding between stakeholders and developers and among stakeholders
- Existence of reference systems (that can serve as a specification by example)
- Length of feedback cycle (the time between getting a requirement wrong and detecting the error)
- Kind of customer-supplier relationship
- Regulatory compliance required



Glinz et al. (2020)

PRINCIPLES OF RE - STAKEHOLDERS

It makes sense to classify the stakeholders into three categories with respect to the degree of influence that a stakeholder has on the success of the system:

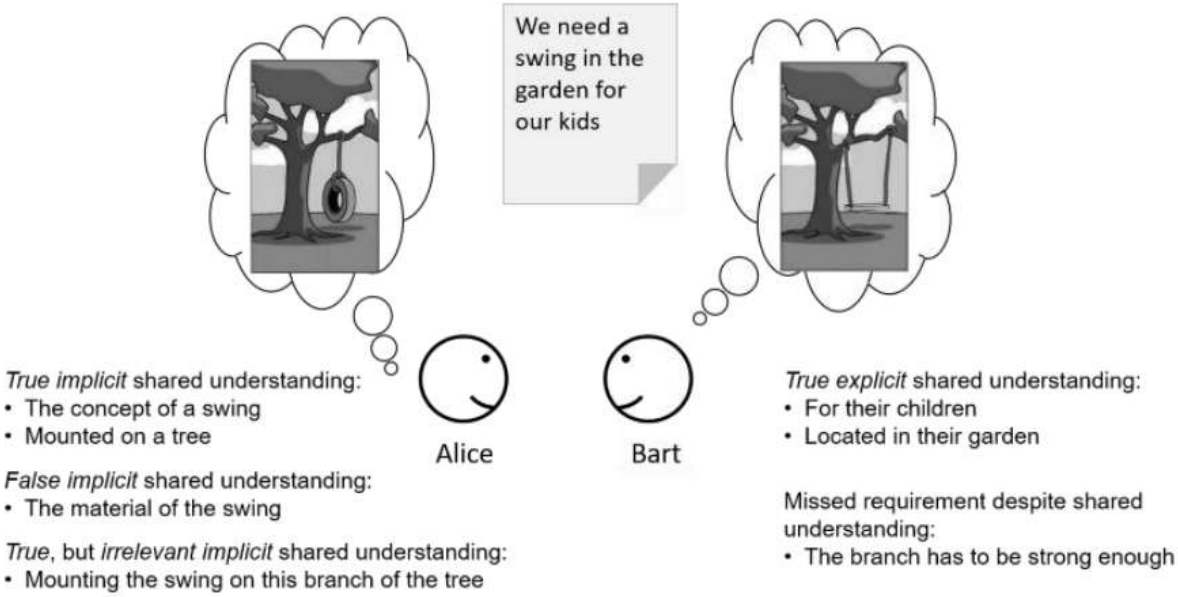
- Critical: not considering these stakeholders will result in severe problems and probably make the system fail or render it useless.
- Major: not considering these stakeholders will have an adverse impact on the success of the system but not make it fail.
- Minor: not considering these stakeholders will have no or minor influence on the success of the system

Glinz et al. (2020)

PRINCIPLES OF RE - SHARED UNDERSTANDING

We distinguish between two forms of shared understanding:

- Explicit shared understanding is achieved through carefully elicited, documented, and agreed requirements. This is the primary goal of RE in plan-driven processes.
- Implicit shared understanding is based on shared knowledge about needs, visions, context, etc. In agile RE, when requirements are not fully specified in writing, reliance on implicit shared understanding is key.



Enablers

- Domain knowledge
- Domain-specific standards
- Previous successful collaboration
- Existence of reference systems known by all people involved
- Shared culture and values
- Informed (not blind!) mutual trust

Obstacles

- Geographic distance
- Supplier-customer relationship guided by mutual distrust
- Outsourcing
- Regulatory constraints
- Large and diverse teams
- High turnover among the people involved

Glinz et al. (2020)

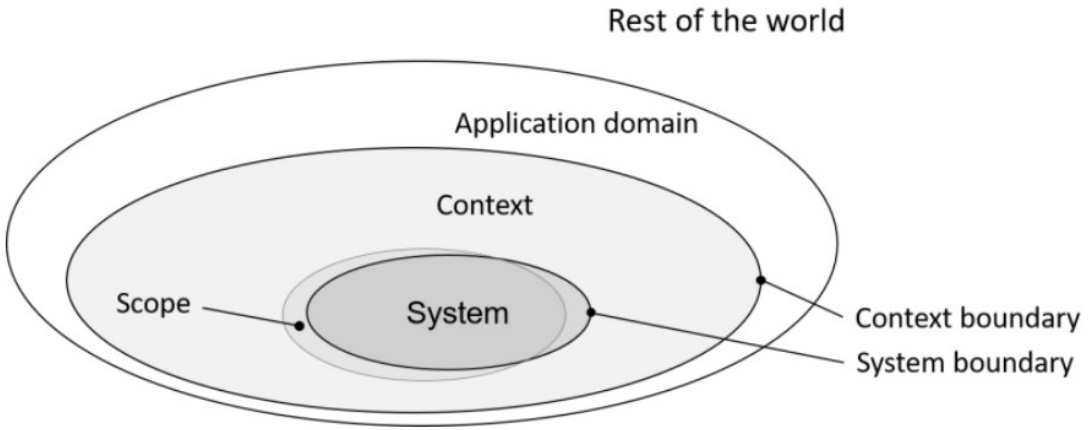
PRINCIPLES OF RE - CONTEXT

Context - The part of a system's environment being relevant for understanding the system and its requirements

Context boundary - The boundary between the context of a system and those parts of the application domain that are irrelevant for the system and its requirements

System boundary - The boundary between a system and its surrounding context

Scope - The range of things that can be shaped and designed when developing a system



Glinz et al. (2020)

PRINCIPLES OF RE - PROBLEM, REQUIREMENT, SOLUTION

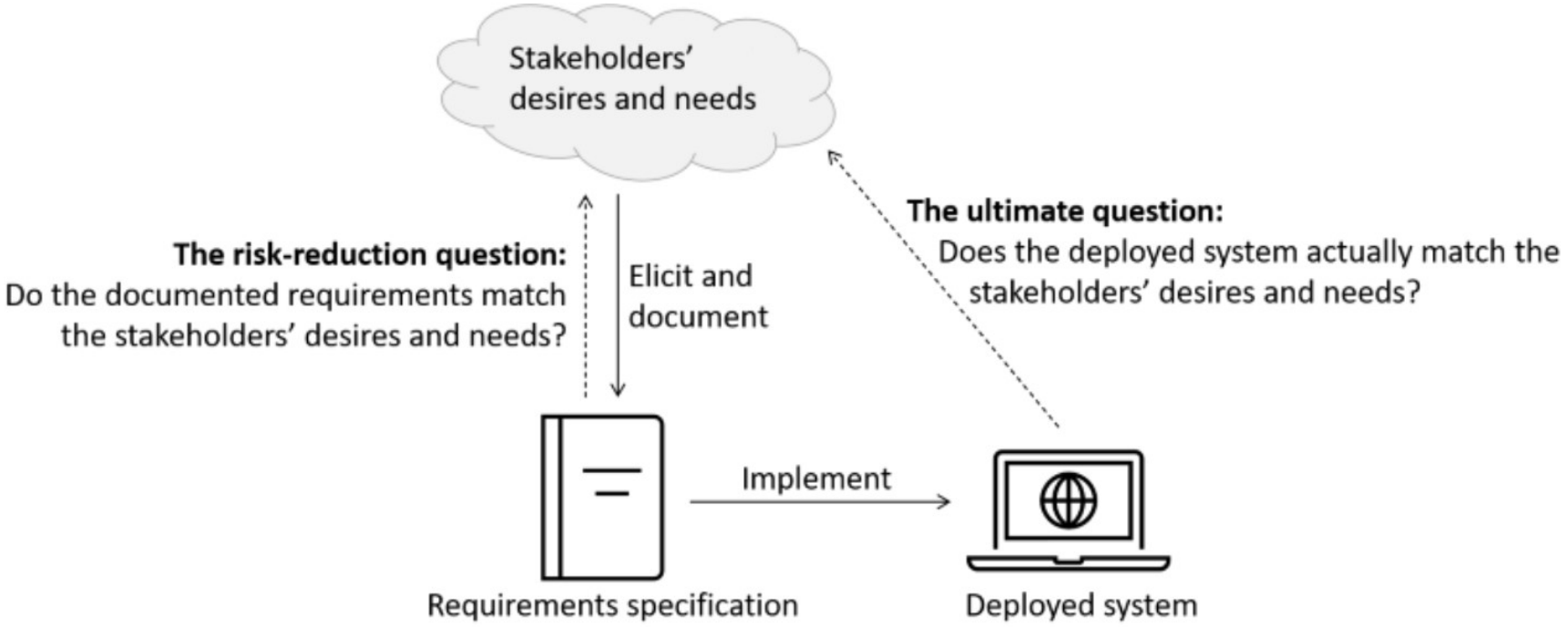
Problems, requirements, and solutions can be intertwined in many ways:

- Hierarchical intertwinement: when developing large systems with a multilevel hierarchy of subsystems and components, high-level requirements lead to high-level design decisions, which in turn inform lower-level requirements that lead to lower-level design decisions, etc.
- Technical feasibility: specifying non-feasible requirements is a waste of effort; however, it may only be possible to assess the feasibility of a requirement when exploring technical solutions.
- Validation: prototypes, which are a powerful means for validating requirements, constitute partial solutions of the problem.
- Solution bias: different stakeholders may envisage different solutions for a given problem, with the consequence that they specify different, conflicting requirements for that problem.

Glinz et al. (2020)

PRINCIPLES OF RE - VALIDATION

Validation - The process of confirming that an item (a system, a work product, or a part thereof) matches its stakeholders' needs



Glinz et al. (2020)

PRINCIPLES OF RE - EVOLUTION

There are many reasons that lead to requests to change a requirement or a set of requirements for a system, for example:

- Changed business processes
- Competitors launching new products or services
- Clients changing their priorities or opinions
- Changes in technology
- Feedback from system users asking for new or changed features
- Detection of errors in requirements or detection of faulty domain assumptions

Glinz et al. (2020)

PRINCIPLES OF RE - INNOVATION

Giving stakeholders exactly what they want means missing out on the opportunity of doing things better than before

Case: The most frequently used report is a table with 18 columns, which is about twice as wide as the screen when displayed on the agents' laptop computers. Viewing this report thus requires a lot of scrolling. The stakeholders therefore want to be able to zoom in the report, using plus and minus buttons on the screen.

What would you do?

Glinz et al. (2020)

PRINCIPLES OF RE - SYSTEMATIC AND DISCIPLINED WORK

Agility and flexibility are not valid excuses for an unsystematic, ad hoc style of work in RE.

Systematic and disciplined work means that Requirements Engineers:

- Configure an RE process that is well suited for the problem at hand and fits well with the process used for developing the system
- From the set of RE practices and work products available, select those that are best suited for the given problem, context, and working environment
- Do not always use the same process, practices, and work products
- Do not reuse processes and practices from past successful RE work without reflection

Glinz et al. (2020)

LITERATURE

- Bühne, S., & Herrmann, A. (2015). Requirements Management according to the IREB Standard.
- Glinz, M., van Loenhoud, H., Staal, S., & Bühne, S. (2020). Handbook for the CPRE Foundation Level according to the IREB Standard. International Requirements Engineering Board.