

Requirement Engineering

Lecture 3: Requirements Elicitation

Prof. Dr. Benjamin Leiding
Anant Sujatanagarjuna

General Requirements Engineering Process Overview

	Requirements Engineering				
	Requirements Analysis			Requirements Management	
Elicitation	Negotiation	Documentation	Validation	Change Management	Tracing

Lecture 3: Requirements Elicitation

Content

- 1 Getting the Right Information is Tricky
- 2 Requirement Sources
- 3 Elicitation Techniques
- 4 Assistance/Support Techniques



GETTING THE RIGHT INFORMATION IS TRICKY

Getting the Right Information is Tricky

Requirements Engineering = Communication

- In Software Engineering (SE) we can assume that there exists prior documentation → ***But not in Requirements Engineering***

Getting the Right Information is Tricky

Requirements Engineering = Communication

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- In the beginning requirements are
 - unknown
 - unconscious
 - Misunderstood
- Furthermore there are different opinions about the requirements (in general at least one per stakeholder)

Getting the Right Information is Tricky

Requirements Engineering = Communication

- In Software Engineering (SE) we can assume that there exists prior documentation → ***But not in Requirements Engineering***
- In the beginning requirements are
 - unknown
 - unconscious
 - Misunderstood
- Furthermore there are different opinions about the requirements (in general at least one per stakeholder)
 - Acquisition of information as part of the requirements engineering activity is called **Elicitation**

Getting the Right Information is Tricky

Objectives of the Elicitation Phase

Why do we need to elicit information?

- Knowledge acquisition (Elicitation, Acquisition)
 - About involved persons and objectives
 - Current state
 - Expectations
 - Domain

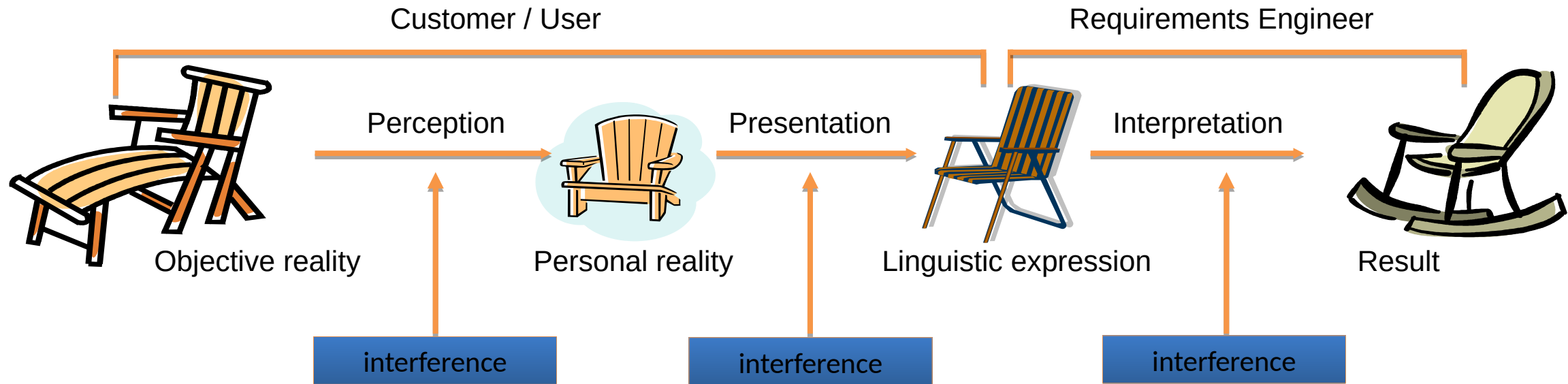
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Getting the Right Information is Tricky

Communication Problems

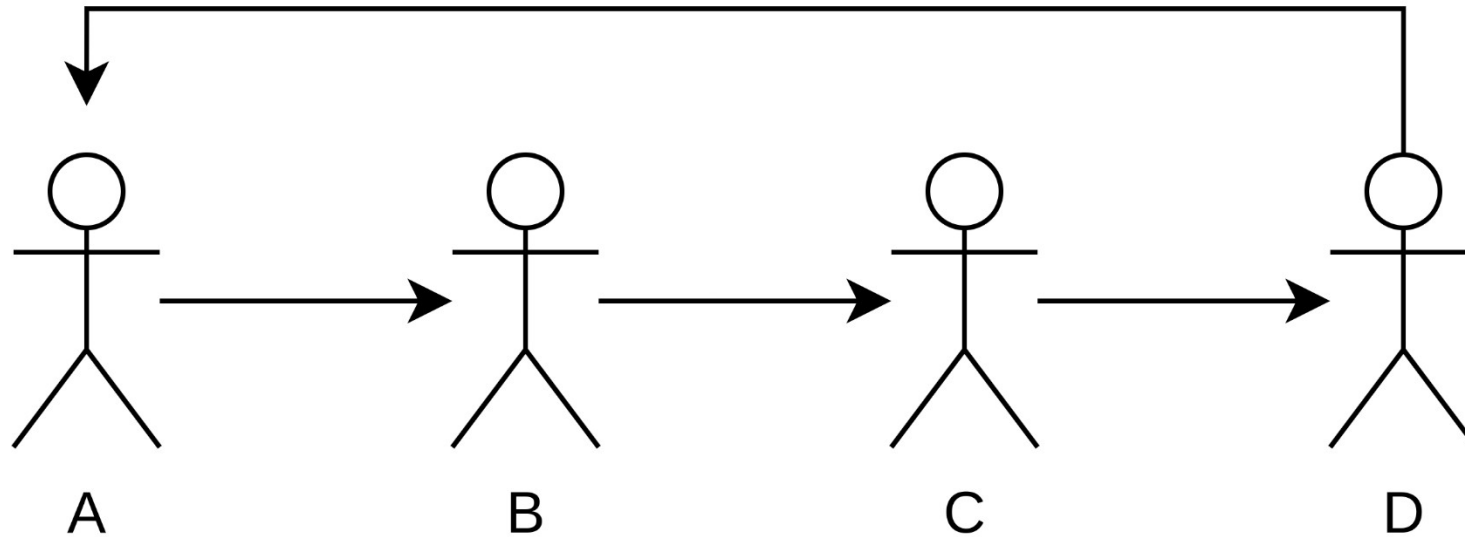
Communication happens via speech

- Representation of experiences → perceptions)
- Communication of personal reality → presentation) Conflicts



Getting the Right Information is Tricky

Communication Problems - Telephone Game



Youtube → [Link](#)

Getting the Right Information is Tricky

Communication Problems

- Consideration of all stakeholders
- Communication
 - Stakeholders can not describe abstractly what they are doing, why they are doing it, nor what they need to be able to do things.
 - Requests are much too general
- Presentation of new possibilities and their consequences
 - Stakeholder like to keep their existing approaches
 - It is difficult to invent new approaches

Getting the Right Information is Tricky

Communication Problems

- Conflicts
 - Cause of power struggles
 - Cause of opposition against changes
- Priorities
 - Stakeholders want too much
- Changes
 - Stakeholders always add new ideas



REQUIREMENT SOURCES

Requirement Sources

Sources

Three kinds of requirement sources:

- Stakeholders
 - People or organizations that influence the requirements of a system → users, operators, architects, testers, ...
- Documents
 - Contain important information that can provide requirements → e.g., standards, legal documents, requirements documents, error reports of legacy systems, ...
- Systems in operation
 - Legacy/predecessor systems or computer systems

Requirement Sources

Type of Knowledge to Gain

- Previous functions
 - e.g. secretary organized meetings
- Problems
 - e.g. status of the organization is not recognizable for everyone, takes too long
- Objectives for new functions / systems
 - e.g. transparent organization, faster
- Factors of success
 - e.g. organizing a typical meeting within one day
- Basic system architecture (how much components, partitioning)
 - e.g. install software for every employee

Requirement Sources

Type of Knowledge to Gain

- Realistic Solutions
 - ⋈ e.g. System is gathering data, people are solving problems
- Consequences and risks
 - ⋈ e.g. too little freedom of decision for participants

Requirement Sources

Typical Stakeholders

- Customer
 - Actual and potential customers
 - Project leader
 - Business manager
- User
 - Old and new users

Requirement Sources

Typical Stakeholders

- Developer
 - Product marketing
 - Project leader
 - Technical leader
 - Architect / Designer
 - Developer
 - Tester
 - Legal Department

- Maybe in different locations, maybe in competing divisions

Requirement Sources

Significance of Stakeholders

- Stakeholders are the main source of requirements
- Missing stakeholders → Missing requirements
 - Leads to change requests
 - Retroactive changes are expensive
- Not all stakeholders are equally important
 - The stakeholders also require prioritization → **Never tell them!**
 - Maintain checklists of all stakeholders

Requirement Sources

Maintenance of Stakeholder Data

- Use tables and spreadsheets to handle stakeholder data
- For each stakeholder, maintain at least:
 - The name
 - The function
 - Additional personal and contact data
 - Temporal and spatial availability during the project progress
 - Relevance of the stakeholder
 - Area and extent of expertise of the stakeholder
 - Goals in interests regarding the project

Requirement Sources

Handling Stakeholders Throughout the Project

- Continuous exchange of information
 - Periodic status updates
 - Continuous involvement turns stakeholders from affected by the project into collaborators
 - Principally affected stakeholders vs. well-integrated, jointly responsible stakeholders
- Lack of attention may lead to overcritical stakeholders
 - However, stakeholders might not be motivated from the beginning → e.g., they like the existing legacy system
- Requirements engineer supports project management with convincing stakeholders of the benefit of a project

Requirement Sources

Agreement with Stakeholders

- Formal agreements with stakeholders are often useful
 - Avoid misunderstandings and disputes regarding competence
- Such agreements should include
 - Tasks
 - Responsibilities
 - Managerial authority
 - Individual goals
 - Communication paths
 - Feedback loops

Requirement Sources

Agreement with Stakeholders

- Can be informal (“shaking hands”) or formal with written documents
 - Should be signed of by the management

Requirement Sources

Tasks of the Requirements Engineer

- Speaks language of the stakeholders
- Becomes thoroughly familiar with the application domain
- Creates a requirements document
- Is able to get work results across
- Maintains a respectful relationship with any stakeholder
- Presents ideas and alternatives as well as realizations
- Allows stakeholders to demand properties that make the
- system user-friendly and simple.
- Ensures that the system satisfies the functional and qualitative demands of the stakeholders

Requirement Sources

Tasks of the Stakeholder

- Introduce the requirements engineer into the application domain
- Supply the requirements engineer with requirements
- Documents requirements assiduously
- Make timely decisions
- Respect the requirements engineer's estimates of costs and feasibility
- Prioritize requirements

Requirement Sources

Tasks of the Stakeholder

- Inspect requirements that the requirements engineer documents, such as prototypes, etc.
- Communicate changes in the requirements immediately
- Adhere to the predetermined change process
- Respect the requirements engineering process that has been instated



ELICITATION TECHNIQUES

Elicitation Techniques

Overview

- Support the identification of the conscious, unconscious, and subconscious requirements
 - No universal method!
 - Elicitation techniques must match the project
- Factors for choosing a technique are
 - The distinction between conscious, unconscious and subconscious requirements
 - Time and budget constraints
 - Availability of stakeholders
 - Experience with a particular technique
 - Chances and risks of the project
- Combination of different techniques minimizes risks

Elicitation Techniques

Overview

Survey Techniques	Creativity Techniques	Document-centric Techniques	Observation Techniques	Support Techniques
Interviews	Brainstorming	System Archaeology	Field Observation	Mind Mapping
Questionnaires	Brainstorming Paradox	Perspective-based Reading	Apprenticing	Workshops
	Change of Perspective	Reuse		CRC Cards
	Analogy Technique			Audio and Video Recording
				Use Case Modeling
				Prototypes

Elicitation Techniques

Aquisition Techniques



p = possible
g = good
v = very good

Things to elicit Techniques	Present work Present problems Critical issues/goals	Future system ideas Realistic possibilities Consequences & Risks	Commitment Conflict resolution	Requirements Priorities Completeness
Stakeholder analysis	g v	p p	g g	p
(Group) interview	v v g	p		p
Observation	v g			p g
Task demo	v v g			p g
Document studies	v g			p g
Questionnaires	g g p			
Brainstorm		v		p
Focus groups	v v	v	g p	p v
UI Workshops	p	v g p	g p v	
Prototyping		p v g	g	v g
Pilot experiments	p	v v	v	g g g
Similar companies	p g	v v v		g
Suppliers	p p	g v g		g
Negotiation	p g	p p p	v v	g v
Risk Analysis	g	g v		p
Cost/benefit	g v	p p v	p	v
Goal-domain analysis	g v	g p v	g p	g g v
Domain-requirements	p g	p		v g g

Elicitation Techniques

The most common / important techniques

- Interview
 - More time consuming
 - Requires explicit integration of standpoints
 - Allows better adaptation on background of the interviewed person and interests of the interviewee

- Observations
 - Most complicated technique
 - Least impact of presumptions

Elicitation Techniques

The most common / important techniques

- Workshop
 - Frequently used technique
 - Relative little expenditure of time
 - Fundamental for team creation
 - Creates new ideas (→ Vision workshop)
 - Problems with social structures, focus on hot spots

- Other techniques may be used in addition

Elicitation Techniques

Survey Techniques

- The requirements engineer asks questions, the stakeholders answer
 - Driven by the requirements engineer
 - Possible that stakeholder concerns are missed
- Used for eliciting explicit knowledge
 - Conscious requirements
- Assumptions:
 - All respondents are capable of explicitly expressing their knowledge
 - All respondents are committed to invest time and effort

Elicitation Techniques

Survey Techniques - Interviews

- Can be employed during the entire development
- Requirements engineer prepares questions beforehand
 - Might be the same for multiple stakeholders
- Questions that arise during the interview can be discussed immediately
 - Clever questions may uncover subconscious requirements
- Experienced interviewers
 - control the course of the conversation
 - commit themselves to each stakeholder
 - inquire about specific aspects
- Drawback of interviews: very time-consuming

Elicitation Techniques

Survey Techniques – Interviews

- Preparation
 - Analysis of documents (e.g. scenarios, previous work documents)
 - Prepare questions (with at least one domain expert)

- Performance
 - Two interviewers if possible (Analyst; Transcript writer)
 - Single or multiple person interviews
 - Maybe recording on tape

- Analysis
 - Analysis / Summary of answers
 - Feedback to participants

Elicitation Techniques

Survey Techniques – Prepare an Interview

- Purpose → Define the purpose of the interview explicitly
- Participants (interviewees)
 - Invite participants, taking the object of the interview into account
 - Communicate with participants (invitation, purpose and background)
- Location → Select a suitable location for the interview
- Questions
 - Prepare open and closed questions, where possible with a specific context (with at least one domain expert)
 - Avoid leading questions
- Interviewer → Make yourself familiar with the participants and their terminology

Elicitation Techniques

Survey Techniques – Conduct an Interview

- Introduction
 - What is the interview good for?
 - What will happen with the answers?

- The questionnaire
 - Start general, progress to more specific issues
 - Mixture of open and closed questions
 - Active listening! (esp. paraphrasing)
 - Ensure non-verbal communication
 - Prevent typical mistakes:
 - Deviation from topic
 - Answers too general
 - Uneasy atmosphere (noise, interruptions, etc.)

Elicitation Techniques

Survey Techniques – Conduct an Interview

- Finish
 - Comment on the first impression
 - Outline further activities
 - Thank the interviewed person
 - Interviewed person has the final say

Elicitation Techniques

Survey Techniques – Post-processing the Interview

- Write a protocol of the interview
- Document explicitly gained requirements
- Revise your models and scenarios used for the interview
- Make a to-do-List of the remaining questions
- Further communication with the interviewed persons
 - Give them your results, so they can check and confirm them
 - Identify conflicts between the requirements
 - Try to resolve identified conflicts

Elicitation Techniques

Survey Techniques – Questionnaires

- Only viable option for a large number of participants
 - Cheap and time efficient in comparison to interviews
 - May use online questionnaire
- Can use different kinds of questions
 - Open questions → What do you think is the most important feature of the new system?
 - Closed questions → Do you think the new system requires a GUI?
 - Closed questions better suited for less experienced stakeholders

Elicitation Techniques

Survey Techniques – Questionnaires

- Drawbacks
 - Only for eliciting requirements known or conjectured → Not able to pose additional question due to feedback
 - No immediate feedback → Forgotten or badly phrased questions possible

Elicitation Techniques

Overview

Survey Techniques	Creativity Techniques	Document-centric Techniques	Observation Techniques	Support Techniques
Interviews	Brainstorming	System Archaeology	Field Observation	Mind Mapping
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				Prototypes

Elicitation Techniques

Creativity Techniques

- Well-suited for:
 - Outlining an initial vision of a system
 - Developing innovative requirements
 - Eliciting excitement factors

- Not well-suited for getting fine-grained requirements
 - Techniques yield general ideas about possible requirements, not specifics
 - Especially unsuited for complex charting of system behavior

Elicitation Techniques

Creativity Techniques – Brainstorming

- Fixed timeframe
- Usually in groups of 5 to 10 people

- Moderator documents ideas without discussing, judging, or commenting on them
 - Participants expand and modify ideas to add new ones
- Once the ideas are collected, they are discussed
 - Each idea is subjected to thorough analysis

- Especially effective if different stakeholders are involved

Elicitation Techniques

Creativity Techniques – Brainstorming

- Large number of ideas can be collected in a short amount of time
- People can expand on ideas collaboratively
- Unbiased collection allows new ideas and solutions to pop up
- Effectiveness depends on the group dynamics
 - Varied levels of dominance effectively reduce number of participants
 - Other techniques better suited → 6-3-5 method: six participants, three ideas each, fivefold hand-off

Elicitation Techniques

Creativity Techniques – Brainstorming Paradox

- Variant of brainstorming
- Collects events that must not occur, instead of ideas
- Develops measures to prevent the events
- Well-suited for the early identification of risks and countermeasures
- Same advantages and drawbacks as brainstorming

Elicitation Techniques

Creativity Techniques – Change of Perspective

- Involved people change their perspective
- Most popular: Six Thinking Hats → Approach a problem from six different perspectives
 - Information: what is available
 - Emotions: intuitive reactions
 - Discernment: logical analysis of reasons to be cautious

Elicitation Techniques

Creativity Techniques – Change of Perspective

- Optimistic response: logically identifying benefits
 - Creativity: provocation and investigation
 - Ordered: overview over processes, “big picture”
- Solutions approach the problems from different standpoints
- Stakeholders convinced of their opinion are persuaded to adopt a different point of view



Elicitation Techniques

Creativity Techniques – Analogy Technique

- Provide an analogy for the system or a partial problem
 - Discuss the analogy instead of the system
 - Draw conclusions for the real system based on the analogy
- Assumes that each participant is capable of analogous thinking
- Can be applied in the open or covertly
 - Covert application
 - Only the requirements engineer knows the relationship to the real system
 - Participants only know the analogy
 - Requirements engineer responsible to map everything back to the real world
 - Open application → Everybody knows the relationship to the real system

Elicitation Techniques

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Elicitation Techniques

Document-centric Techniques

- Reuse of solutions and experiences made with existing systems
- Used when a legacy system is replaced
 - Make sure that the new system covers all important features of the legacy system
- Should be combined with other techniques
 - Validation of the elicited requirements
 - Discovery of new requirements impossible

Elicitation Techniques

Document-centric Techniques

Document analysis is an important part of requirements elicitation

Typical types of documents:

- Development documents (of current or earlier systems)
- Standards & Norms
- Compliance (legal information)

Elicitation Techniques

Document-centric Techniques – System Archaeology

- Extracts information from documentation or implementations of existing systems
 - Legacy systems or competitor's system
- Can recover lost knowledge about system logic
 - System logic is elicited anew
- Yields large amount of detailed requirements

Elicitation Techniques

Document-centric Techniques – Reuse

- Assumption:
 - Documented requirements are available
 - The requirements have a high quality
- Such requirements do not have to be reelicited
- Instead → just reuse the existing requirements
 - Saves costs and time!

Elicitation Techniques

Document-centric Techniques – Perspective-based Reading



- Analyzes documents from a certain perspective → e.g., implementer or tester
- All aspects not related to the perspective are ignored
- Allows analysis focused on particular aspects
- Can separate technology-related or implementation- related aspects from operational aspects

Elicitation Techniques

Document-centric Techniques – Prepare Perspective-based Reading



- Define goals and expected results
- Define perspectives based on the goals
- Pick documents based on the defined perspectives and goal
- Choose stakeholders matching the perspectives to do the reading

Elicitation Techniques

Document-centric Techniques – Conduct Perspective-based Reading



- The two methods to conduct perspective-based reading are *sequenced reading* and *top-down reading*.
- Sequenced reading
 - The whole documents are read with the defined perspectives
- Top-down reading
 - The documents must have structuring means (table of contents, index, list of figures etc.)
 - Only relevant text passages found with the structuring means and the perspective are read

Elicitation Techniques

Document-centric Techniques – Post-process Perspective-based Reading

- Documenting the requirements
 - Document the gained requirements
 - Ensure the traceability between the requirements and the text passages

Elicitation Techniques

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Elicitation Techniques

Observation Techniques

- Observation of stakeholders during their work
 - Instead of a stakeholder or domain expert describing their work
 - Active demonstration or passive observation both possible
- Requirements engineer documents all steps
 - Elicits the business process
 - Observes mistakes, risks, and open questions
 - Question the existing process in order to determine how the process should look like
 - Avoids documenting an outdated or suboptimal process
- Well-suited to obtain dissatisfiers
- Not well-suited for the development of new requirements

Elicitation Techniques

Observation Techniques – Field Observation

- Requirements engineer is on location
- Observes and documents processes
 - May be supported by video and audio recordings
- Well-suited for requirements and processes that are difficult to describe verbally
 - Instead, they are simply shown

Elicitation Techniques

Observation Techniques – Prepare Observation

- Purpose
 - Decide on the purpose of the observation
- Object
 - Decide on the object of the observation
- Work results
 - Define the planned work results

Elicitation Techniques

Observation Techniques – Conduct Observation

- Ethnographic observation
 - The observer works together with the stakeholders over a longer time
 - During this time the observer watches the stakeholders to learn and understand their mode of operation and procedure
 - If possible, the observer does these operations independently
- Direct observation
 - The observer watches the stakeholders, analyses their operations and asks comprehension questions
 - Also systems can be observed through observation of their usage

Elicitation Techniques

Observation Techniques – Conduct Observation

- Guideline for an observation
 - Gain the trust of the observed stakeholders
 - Pay attention to details
 - Write down your expressions immediately
 - Check the objectivity of your documentation
 - Check the authenticity of the observed activities

- Forms of documentation
 - Writing
 - Audio recording
 - Video recording

Elicitation Techniques

Observation Techniques – Post-process Observation

- Post process the records
- Link the records of your observation with the gained requirements
- Adjust your results together with the participating stakeholders (for example with an interview or a workshop)

Elicitation Techniques

Observation Techniques - Ethnography / Observations

Observation of stakeholders in their environment:

- Can be done by observer, camera or computer monitoring
- Objectives are:
 - Identify fundamental knowledge, that nobody is going to mention (implicit knowledge)
 - Find hidden requirements / causes
 - Get a better understanding for the real situation on the side of the requirements engineers
- Disadvantages:
 - Large amounts of irrelevant data
 - Time consuming
 - Rare events may be eventually disregarded

Elicitation Techniques



Observation Techniques – Apprenticing

- The requirements engineer actively learns and performs the procedures of the stakeholders
 - Like an apprentice
 - Encouraged to question unclear and complex procedures
- Allows the elicitation of requirements the stakeholders take for granted
- Reverses the balance of power between the requirements engineer and the domain specialist



ASSISTANCE / SUPPORT TECHNIQUES

Elicitation Techniques

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Assistance / Support Techniques

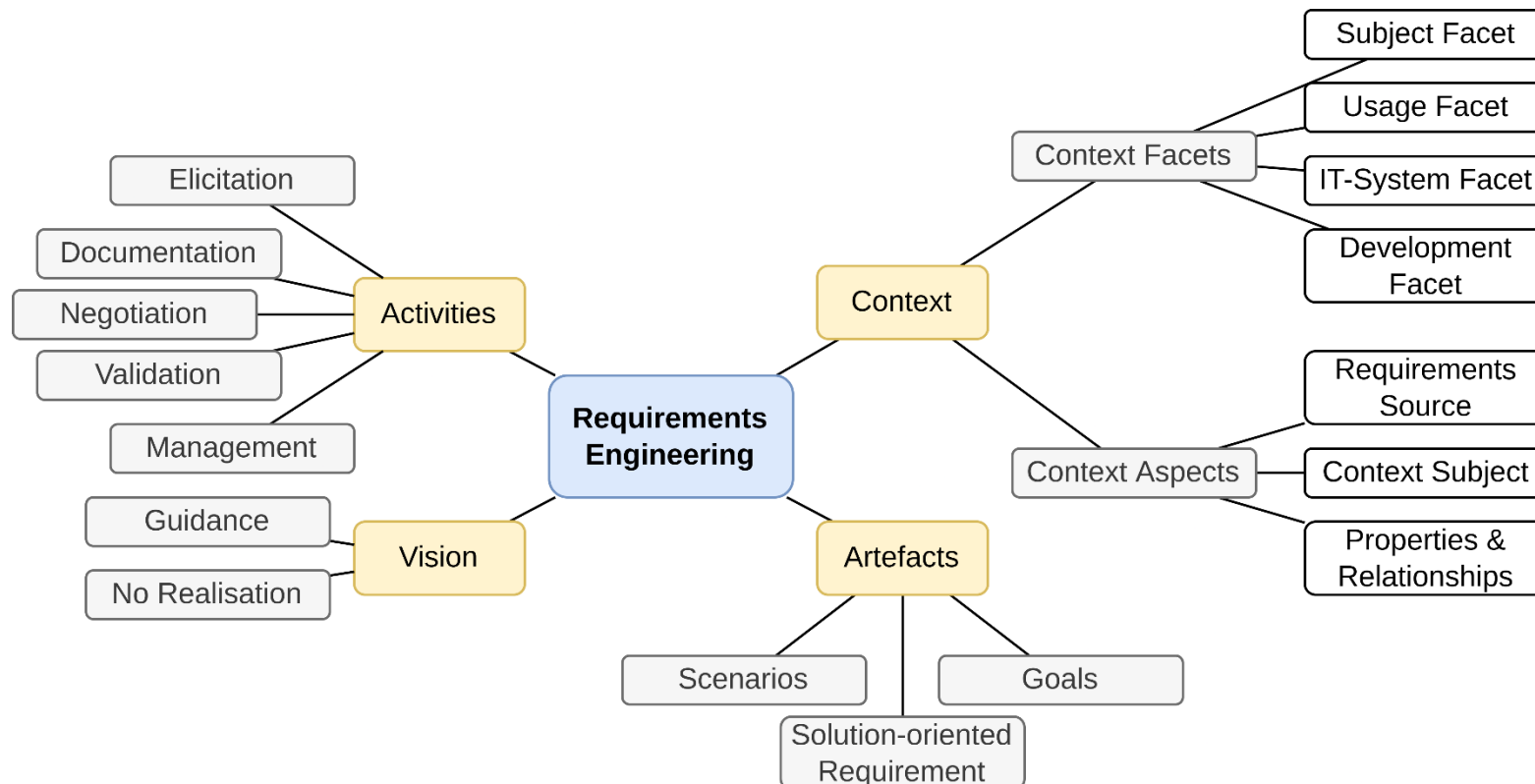
Support Techniques

- Support the previously presented elicitation techniques
- General techniques not only related to requirements
- Not every support technique is suitable for every elicitation technique
 - Should improve the efficiency, balance out weakness, or prevent pitfalls of a technique

Assistance / Support Techniques

Support Techniques – Mind Mapping

- Graphical representation
 - Shows relationships and interdependencies between terms



Assistance / Support Techniques

Support Techniques – Workshop

- Joint meeting of requirements engineer and stakeholders
- Use meeting to elaborate on goals
 - May also go into details
- Example:
 - Use a workshop to design the user interfaces

Assistance / Support Techniques

Support Techniques – Prepare Workshop

- Objective
 - Define the objective of the workshop explicitly

- Work results and procedure
 - Decide the work results explicitly
 - Define the procedure to gain and develop the work results
 - Combine them to an agenda
 - Plan regular breaks

Assistance / Support Techniques

Support Techniques – Prepare Workshop

- Participants
 - Choose the participants based on the work results
 - Make sure your selection of participants is representative
 - Invite the participants early enough
 - Agree with the participants upon the work results

Assistance / Support Techniques

Support Techniques – Prepare Workshop

- Location
 - Ensure the location has enough room for the participants
 - Provide the proper atmosphere
 - Organize technical equipment (whiteboard, projector etc.)

- Moderator and transcript writer
 - Invite an external moderator and an external transcript writer

Assistance / Support Techniques

Support Techniques – Conduct Workshop

- Introduction
 - Present the workshops object and work results
 - Give the participants the opportunity to discuss them
 - Explain the procedure
 - Set the discussion rules explicitly
 - Let the participants vote on the application of these rules one by one

- Working part
 - Make sure that the participants adhere to the agenda and the discussion rules
 - Protocol the results
 - Document and identify conflicts and try to solve them
 - Document decisions explicitly

Assistance / Support Techniques

Support Techniques – Conduct Workshop

- **Finish**
 - Be sure to gather all remaining topics
 - Define the further procedure for each remaining topic
 - Allow your participants to give a feedback about the workshop (participants have the last word)
 - Thank the participants for their attendance

Assistance / Support Techniques

Support Techniques – Post-processing Workshop

- Consolidate the work results
- Ask the participants for their approval of the transcript
- Let each participant approve on the consolidated work results

Assistance / Support Techniques

Support Techniques – Prototypes for Illustrations

- Well-suited to illustrate requirements
- Allows clarification of vague requirements
- Consequences of new or changed requirements can be identified
- Mostly used for user interface prototypes

Assistance / Support Techniques

Support Techniques – Prototypes

Prototypes can be very different:

- Paper prototypes
 - e.g. for graphical user interfaces

- “Wizard of Oz” Prototype
 - Development of a graphical user interface (GUI), but input will be sent directly to an operator, who is simulating the systems behavior and who produces the appropriate output.

- Software prototypes
 - e.g. realized in Visual Basic (throw-away prototypes)



Assistance / Support Techniques

Support Techniques – Focus Group

Special form of workshop (6-10 participants)

- Start with problems
 - e.g. map collection, flipchart
 - Collect reasons
- Then focus on optimal solution
 - But not only opposites of the problems
 - Collect reasons, too
- Then group the issues
 - Should be about 40 issues
- Then priorities
 - e.g. distribute 10 points
 - e.g. in groups according to stakeholder roles
- Finish with a review of the results



Assistance / Support Techniques

Support Techniques – CRC Cards

- CRC = Class Responsibility Collaboration
- Denote context aspects and their attributes on index cards
- Formulate requirements based on the cards

Assistance / Support Techniques



Support Techniques – Audio and Video Recordings

- Recordings as substitute for actual contact with the stakeholders
 - If the stakeholders are not available
 - The budget is tight
 - The system is highly critical
- Especially useful for field observations
- Stakeholders might feel supervised
 - Changes behavior
 - Might refuse to participate

Assistance / Support Techniques

Support Techniques – Modeling Action Sequences



- Use cases are the external view of how the system will be used
 - Have a trigger event
 - Have an expected result

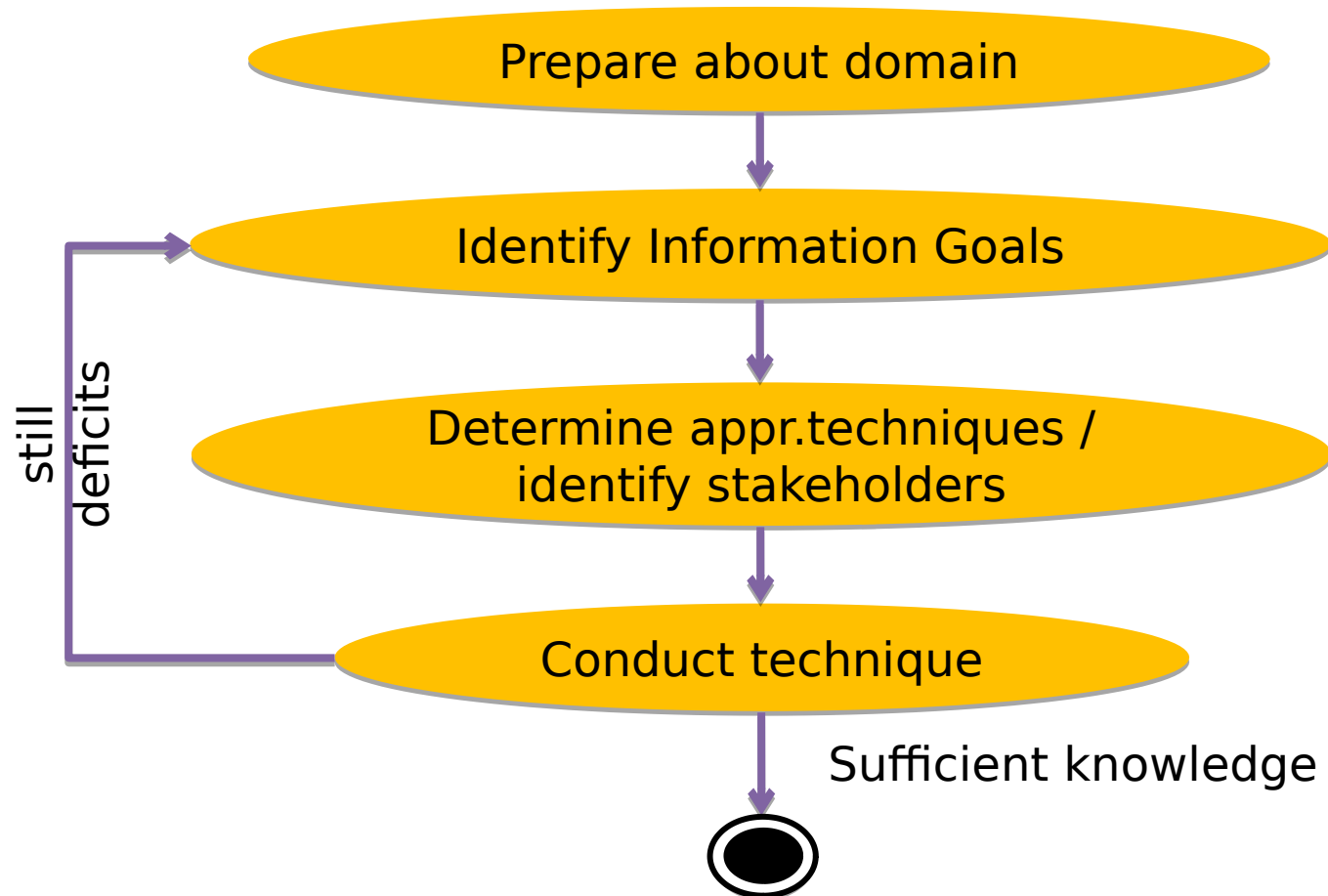
- Describe functionality that the system must support



SUMMARY

Summary

Planning Requirement Elicitation



Not shown:

- Application of analysis techniques
- Often overlapping and parallel activities

Summary

- Elicitation is a core activity of requirements engineering
 - Without good elicitation, requirements will be wrong or missing
- Stakeholders, documents and existing systems as requirements sources
 - Missing a source leads to missing the requirements of the source
- Many techniques for requirements elicitation
 - Not every technique is good in every scenario
 - Select the techniques depending on the project
 - Usually, a combination of multiple techniques yields the best results

Questions?