Requirement Engineering

Lecture 3: Requirements Elicitation

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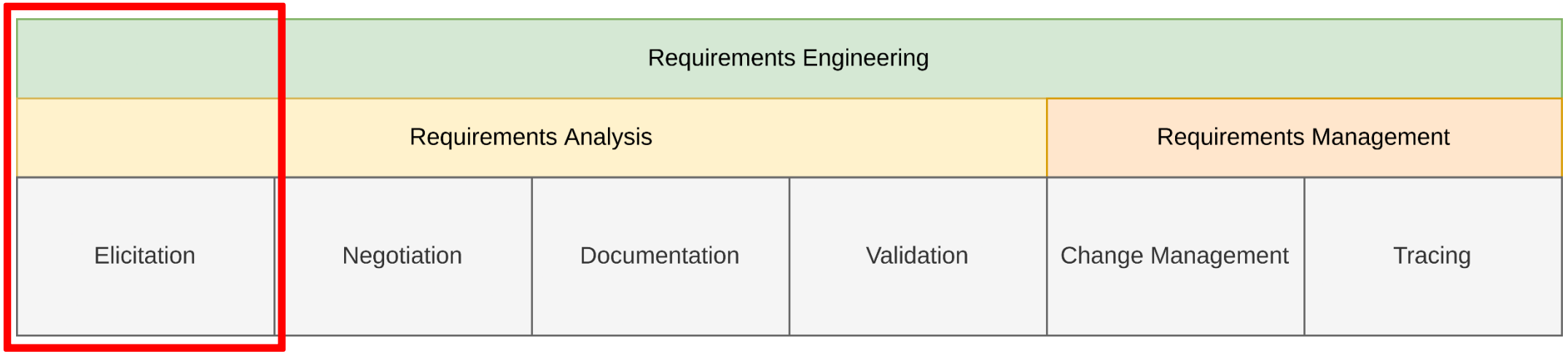
General Requirements Engineering Process

Overview



Lecture 3: Requirements Elicitation

Content

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

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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

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  - unknown
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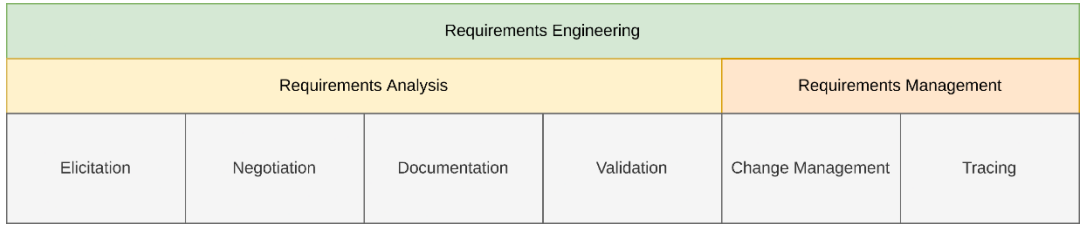
→ Acquisition of information as part of the requirements engineering activity is called **Elicitation**

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

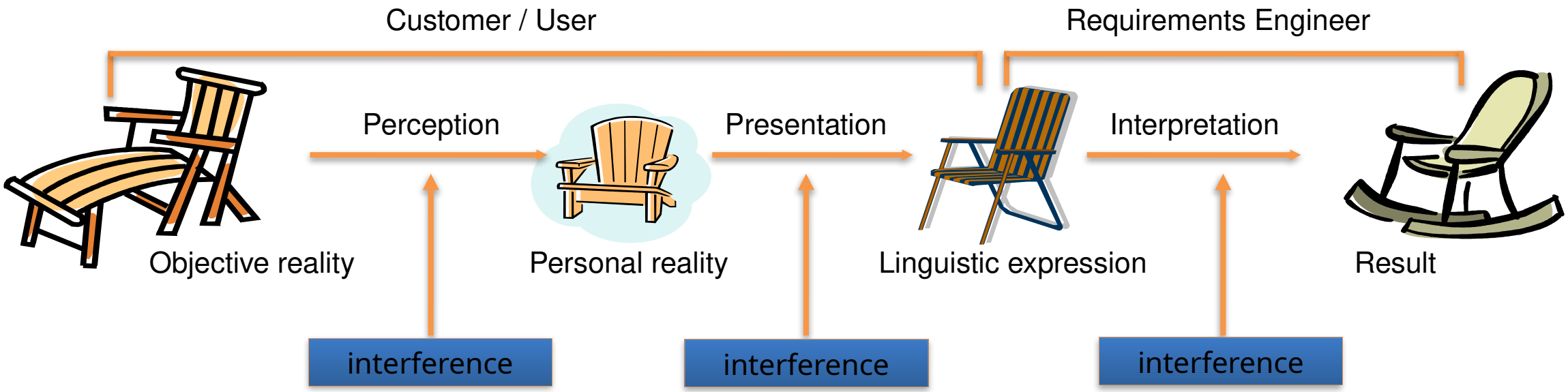


Getting the Right Information is Tricky

Communication Problems

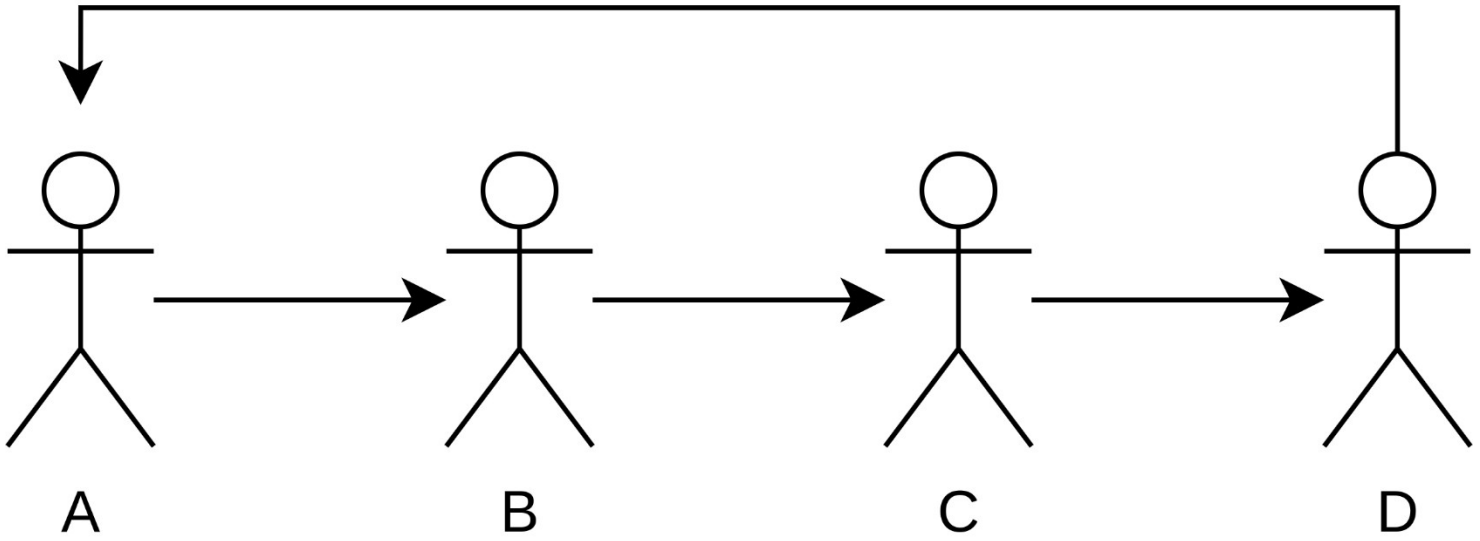
Communication happens via speech

- 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

Techniques \ Things to elicit	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

p = possible
g = good
v = very good

Based on S. Lauesen (2002) – Software Requirements – Styles and Techniques

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

A.M. Hickey, A.M. Davis (2003) – Elicitation Technique Selection: How do Experts do it?

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

A.M. Hickey, A.M. Davis (2003) – Elicitation Technique Selection: How do Experts do it?

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

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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 – Field Observation / Preparation

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

Elicitation Techniques

Observation Techniques – Field Observation / Conducting

- 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 – Field Observation / Conducting

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 – Field Observation / Post-processing

- 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 – 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

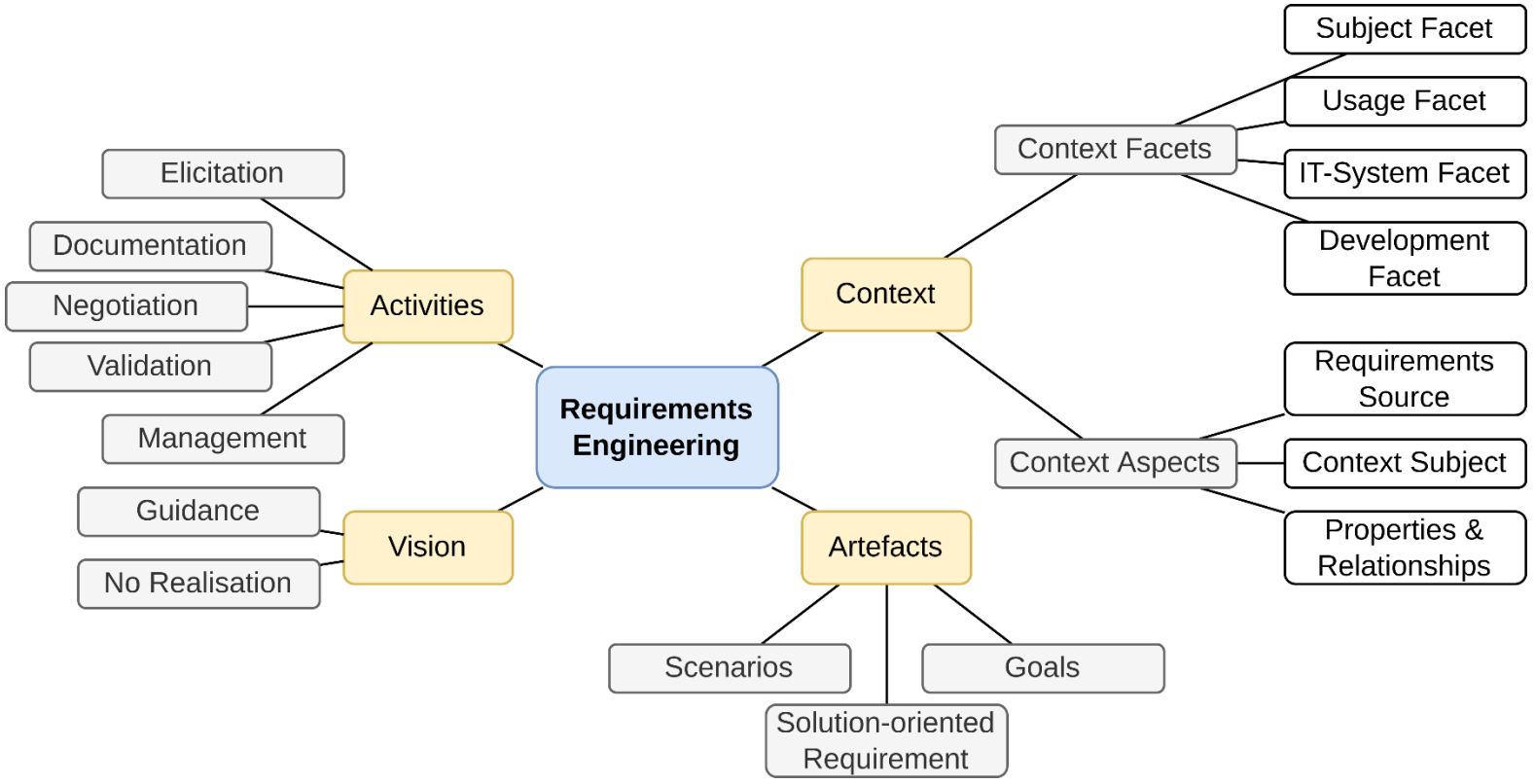
Support Techniques

- 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



Based on K. Pohl (2010) – Requirements Engineering – Fundamentals, Principles and Techniques

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

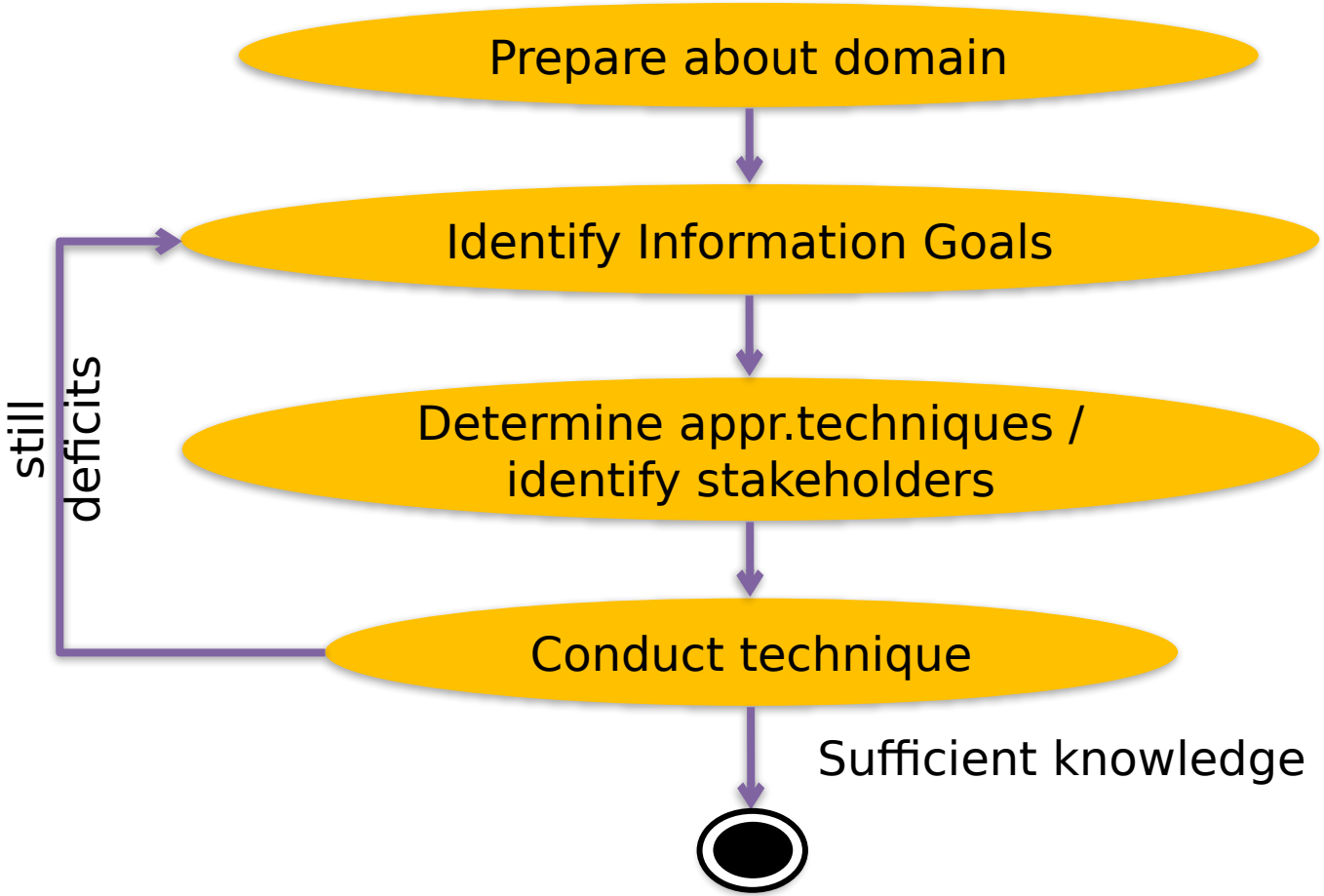
Support Techniques – Modeling Action Sequences

- 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?