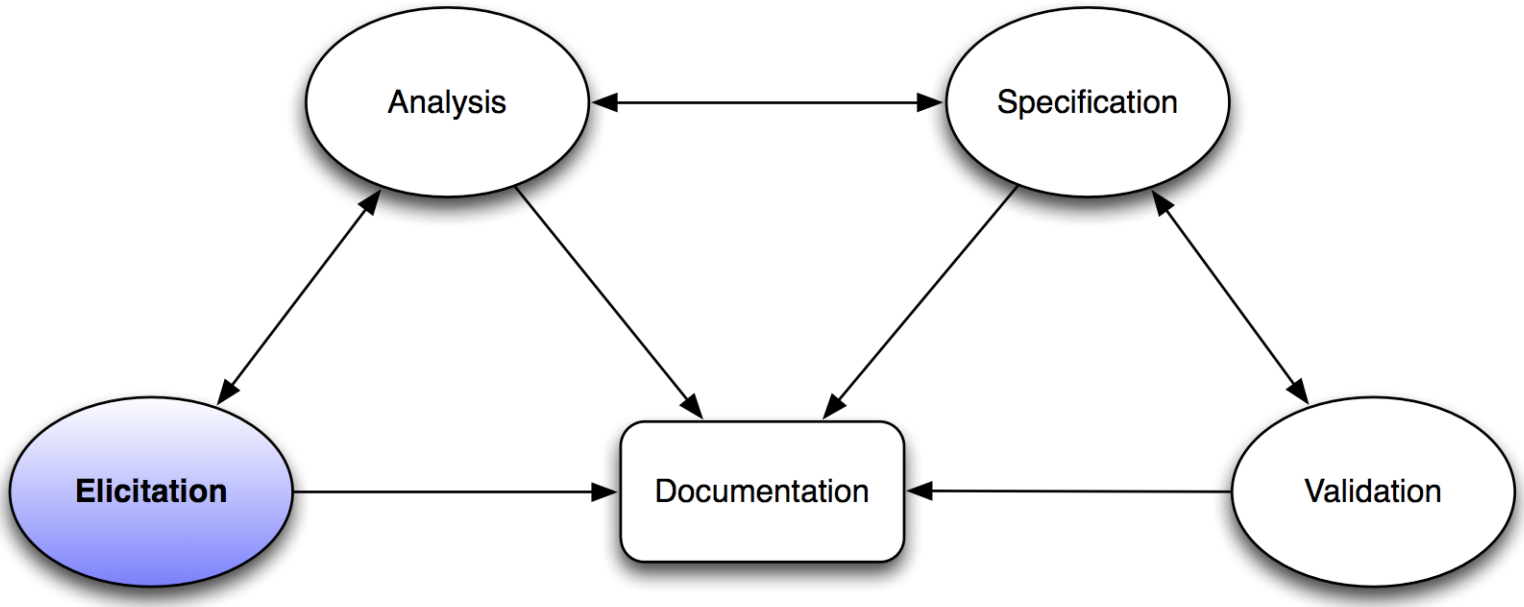
Requirements Elicitation

- Context
- Process
- Techniques

Where Are We in the Module?



Problem Domain

- Recall that the Problem Domain is where we wish to understand from stakeholders what it is the system should do
- The RE process starts in the Problem Domain
  - It may be started strategically – e.g. Apple's plans for the iPhone from here to 2025
  - It may be started tactically – e.g. BlackBerry's Playbook tablet
  - It may be something more simple: "Hey wouldn't it be cool if we could do …"

Problem Domain (2)

- Is it about "What should the system do?"
- No! It is about what the purpose of that system is …
  - If we jump to "what should the system do?" we have immediately moved down from understanding the problem to prescribing a solution
- The question is not "what should the system do?" the question is "what would you like to do?"

What do we need in the problem domain?

- We need something that all stakeholders can understand
- We must choose models and descriptions that we can validate with the stakeholders
- Stakeholders can be varied in who they are and what they understand

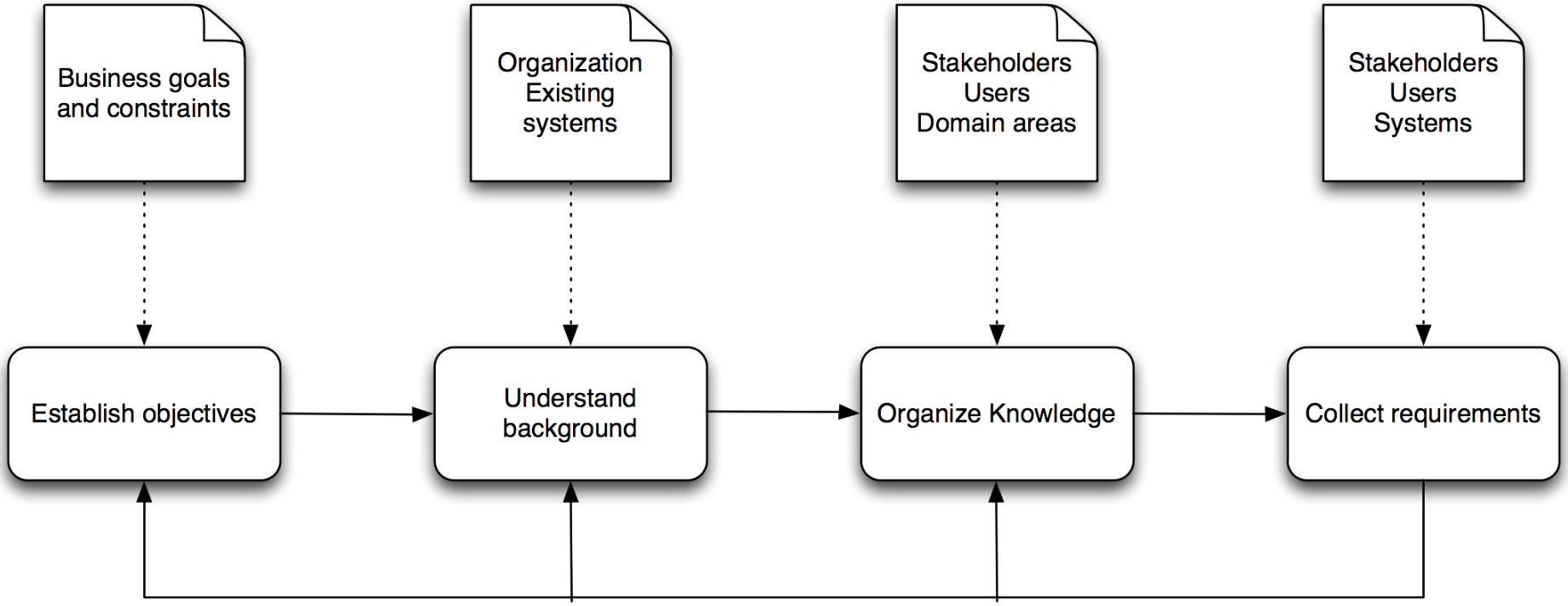
Context of Requirements Elicitation

- Start at a problem that needs solving, e.g.,
  - A new business opportunity
  - Dissatisfaction with the current state of affairs
- Collect sufficient information to
  - Identify the problem boundaries (What problem?)
  - Understand the problem domain (Where is the problem?)
  - Identify the stakeholders (Whose problem?)
  - Identify the stakeholders' goals (Why is problem interesting?)
  - Visualise some scenarios (How might software system help?)
  - Identify constraints (When does problem need solving?)
  - Identify feasibility & risk (What might prevent us solving it?)
- Become an expert in the problem domain

Stakeholders & Requirements Analyst

- Stakeholders:
  - Source of knowledge about the work
  - Visionaries of what the work should be
  - Evaluators of requirements analyst's ideas for the product
- Requirements analyst:
  - Translator of stakeholders' input into product specification
  - Visionary of a new or better product
    - Observe and learn from stakeholders
    - Interpret stakeholders' work
    - Invent new or better ways to do the work
    - Record the results in requirements documents, analysis models, …
- Techniques are needed for eliciting requirements

An Idealised Elicitation Process



IceBreaker: A Case Study

- Overview:

[Case study taken from Robertson and Robertson 1999]

  - IceBreaker uses various data to predict when ice will form on roads
  - It then schedules and dispatches trucks to treat the roads with de-icing material before the roads become dangerous

Background Information

- Background (provided by the customer):

  "Roads freeze in winter and icy conditions cause road accidents that kill people. We need to be able to predict when a road is likely to freeze so that our depot can schedule a de-icing truck in time to prevent the road from freezing. We expect a new system will provide more accurate predictions of icy conditions by using thermal maps of the district and the road temperatures from weather stations installed in the roads, in addition to the weather forecasts. This will lead to more timely de-icing treatment than at present which will reduce road accidents. We also want to eliminate indiscriminate treatment of roads which wastes de-icing compounds and causes environmental damage."

Step 1: Establishing Objectives

- General goals of the business
  - "The Highways Department is responsible for maintaining all the roads in its county. One of its most critical tasks is to keep the roads free of ice during winter when icy conditions are likely to cause accidents."
- Outline description of the problem
  - The customer statement seen before
- Purpose of the system
  - "To accurately forecast road freezing times and dispatch de-icing trucks."
  - Advantage: "To reduce road accidents by forecasting icy road conditions."
  - Measurement: "Accidents attributed to ice shall be no more than 15% of the total number of accidents during winter."
- Constraints, e.g., budget, schedule, interoperability, …

System Boundary

- What is being developed?
  - Only the software …
  - A database for storing weather information
  - An algorithm for scheduling de-icing trucks
  - … or also the hardware
  - Weather stations and de-icing trucks
  - … or perhaps other services as well
  - Weather forecasts
- Knowing the boundary is important
  - To identify the right stakeholders
  - To correctly estimate the development costs and risks
  - To decide on how to proceed

Step 2: Understanding the Background

- The organisation where the system is to be installed
  - Organisational structure
  - E.g., do neighbouring Highway Departments interact?
- The application domain of the system
  - De-icing of roads (how, when, how much, how often, …)
  - Scheduling of de-icing trucks
- Existing systems which may be replaced
  - Weaknesses and strengths
  - E.g., current procedure for scheduling de-icing trucks

Step 3: Organising Knowledge

- Identify stakeholders
  - Roles in the organisation
  - Client: Saltworks Systems
    - Represented by Mr Mack Andrews, Chief Executive
  - Customer: North Yorkshire County Highways Department
    - Represented by Jane Torville, Director
- Discover the organisation's priorities
  - "Safety first"
- Analyse domain knowledge
  - Existing system documentation, textbook information, …

  (filter out the irrelevant parts)

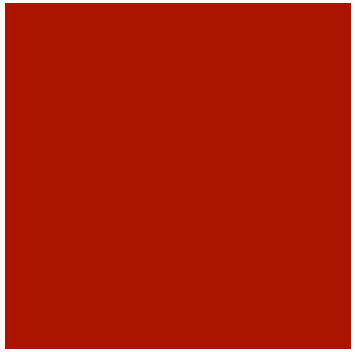
Acquiring Knowledge of Requirements

- Reading documents
  - User manuals, e.g., manuals of weather stations to be used
  - Supporting literature, e.g., journal article on "*Cost-Effective Snow and Ice Control in the 21st Century*"
- Accessing people's knowledge via
  - Interviews, questionnaires, …
  - … see "elicitation techniques" to be discussed later
- Observing phenomena
  - Objects
  - People's behaviour

Types of Knowledge

- Behaviour
  - Can be observed
- Process
  - Can be discovered from documentation, or
  - Is explicitly known
- Data
  - Information
    - Some information is explicitly known
    - Some is tacit knowledge
  - Tacit knowledge creates problems for elicitation

Non-Tacit and Tacit Knowledge



- Non-tacit (explicit) knowledge - "I know that I know it"
- Semi-tacit knowledge - can be accessed
  - Taken-for-granted
    - Assumed that everyone knows it
  - Recognised knowledge
    - Cannot be recalled, but …
    - … can be recognised
  - Working memory
    - Short-term information - may be an important part of processes
- Tacit knowledge - "I don't know that I know it"
  - Compiled knowledge
    - Once known, but now too habitual to be recalled
  - Implicit knowledge
    - Never consciously learnt

Step 4: Collecting Requirements

- Traditional elicitation techniques
  - Background reading
  - Interviews
  - Questionnaires/surveys
  - Observing behaviour
  - Reusing requirements
- Collaborative elicitation techniques
  - Brainstorming
- Model-based elicitation techniques
  - Scenario-based techniques, use cases

Background Reading

- Familiarisation with the organisation being investigated
- Sources of information:
  - Company reports, organisation charts, policy manuals, …
  - Job descriptions
  - Documentation of existing system
- Advantages:
  - Getting an understanding of the organisation
  - Helps preparing for more efficient meetings with people who work in the organisation
- Disadvantages:
  - Time-consuming
  - Lots of irrelevant details

Interviews

- Types of interviews:
  - Closed interviews, with a pre-defined set of questions
  - Open interviews, with no pre-defined agenda
- Good for eliciting non-tacit knowledge:
  - General description of work
  - Explicit procedures
  - Difficulties faced
  - Critical incident reporting
- Not useful for:
  - Concealed knowledge
    - Where actual practices deviate from laid-down procedures
  - Tacit knowledge (critical incident technique helps with this)
  - Domain knowledge
    - Terminology may be unfamiliar to interviewer
    - Knowledge that is taken for granted (semi-tacit)

Interviewing Tips

- Start off by setting the interviewee at ease
  - E.g., talk about the English weather
- Ask whether recording the interview is possible
  - To be able to recall all details
- Ask simple questions first
  - E.g., "How long have you worked in your present position?"
- Follow-up interesting leads
  - E.g., "Could we pursue what you just said a little further"
- Ask open-ended questions last
  - E.g., "Is there anything else you would like to add?"

[Easterbrook 2003]

Questionnaires

- Pay attention to:

[adapted from Goguen and Linde 1993, p.154]

- Choosing adequate sample size and selection
- Avoiding ambiguous questions
  - Not everyone is answering the same question
- Avoiding leading questions
  - People naturally tend to answer what you are asking about
- Avoiding loaded questions (*plurium interrogationum*)
  - Questions that presupposed conditions "Is your brother in the army?"
- Avoiding open-ended questions
  - Very hard to analyse
- Prototyping and testing questionnaires before using them!

Questionnaires

- Advantages:
  - Quickly collect information from large numbers of people
  - Can collect some qualitative data
  - Can collect attitudes, beliefs, characteristics, …
- Disadvantages:
  - Presupposed categories provide little context
  - Time consuming to examine, clean and analyse
  - Time consuming to construct (requires high precision when compared to other methods)
  - Little room for users to convey their needs

Observing Behaviour

- Techniques:
  - Direct observation of work practices, or even apprenticeship
  - Recording work practices (video) and analysing the record (discourse analysis etc.)
  - Spending an extended time in the environment, until accepted as part of the workplace (ethnography)
- Good for:
  - Understanding behaviour that is difficult to describe
  - Understanding how people behave, not how they say they do
- Difficulties:
  - Time-consuming
  - Does not directly address requirements
  - May not pick up exceptions

Brainstorming

- A quick method for generating new ideas
- Technique:
  - Invite participants from a wide range of disciplines and a broad range of experiences
  - Be imaginative and generate as many ideas as possible
  - Evaluate ideas after the meeting, not during the meeting
- Advantages:
  - Focus on creativity
  - Quick
- Disadvantages:
  - Many ideas might turn out to be “rubbish”
  - Many half-formed ideas (need further investigation)

Written Scenarios

- Developed using descriptions by the user of particular kinds of interaction with the system
  - Description of system state before entering the scenario
  - Normal flow of events
  - Exceptions
  - Description of system state after completion of the scenario
- Now part of UML (sort of): Use Cases
- Advantages:
  - Ensures requirements analyst understands work processes
  - Considers exceptions
- Disadvantage:
  - Time-consuming

Limitation of Scenario Techniques

A scenario described by a user:

- Describes "what" by demonstrating "how"
- Does not fully explore possibilities
  - Explains what she/he does already, or
  - Is constrained by inability to imagine new possibilities
    - E.g., arising from new technologies
- Does not bring out the rationale behind a scenario
  - The user may not know
- Ambiguous role of users
  - If a user is invited to the scenario "dinner", is she/he the guest or the turkey?

Scenario-based Design Method

- Designed by John M. Carroll and Mary Beth Rosson for usability analysis of systems; can be valuable for requirements elicitation
- Takes advantage of problems experienced by users to evolve new solutions for systems
  - Analysis - Problem scenarios
    - Some requirements at this stage
  - Design - Activity scenarios; Information design Scenarios; Interaction design scenarios
    - Some requirements at this stage (even though it is called "design")
  - Prototypes/evaluations - usability specifications
- For more information see Usability Engineering: Scenario-Based Development of Human Computer Interaction by Rosson and Carroll

Summary

- Requirements elicitation is a complex area
  - Not all knowledge is in one place
  - A deep business understanding is important
  - Conflict between requirements is normal
- No single elicitation method will bring out both
  - High-level goals, and
  - Detail
- Different techniques needed for eliciting different information

Reading

- Hull, et al. (2011) Chapter 5
- Kotonya and Sommerville (1998) Chapter 3