System context

- Subject facet
- Usage facet
- IT system facet
- Development facet

Core activities

- Documentation
- Elicitation
- Negotiation

Requirements artefacts

- Goals
- Scenarios
- Solution oriented requirements

Validation

Management
Achieve progress in the **specification dimension** by eliciting new requirements as well as detailed information about existing requirements

- Elicit all requirements at the level of detail for the system to be developed
“Requirements Lifecycle”

Source: Adapted from Pohl, CAISE 1993

Specification

complete
fair
vague

Representation

informal
semi-formal
formal

common view

personal view
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• Where do we start?
• Stakeholders
• Requirements elicitation technique

• Prof. Steve Easterbrook, Requirements engineering course, University of Toronto
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• Where do we start?
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Requirements Elicitation

• **Starting point**
  – Some notion that there is a “problem” that needs solving
    • e.g. dissatisfaction with the current state of affairs
    • e.g. a new business opportunity
    • e.g. a potential saving of cost, time, resource usage, etc.

  – A requirements analyst is an **agent of change**
Requirements Elicitation

The requirements analyst must:

- identify the “problem”/”opportunity“
  - Which problem needs to be solved? (identify problem Boundaries)
  - Where is the problem? (understand the Context/Problem Domain)
  - Whose problem is it? (identify Stakeholders)
  - Why does it need solving? (identify the stakeholders’ Goals)
  - How might a software system help? (collect some Scenarios)
  - When does it need solving? (identify Development Constraints)
  - What might prevent us solving it? (identify Feasibility and Risk)

- and become an expert in the problem domain
  - although ignorance is important too -- “the intelligent ignoramus”
Where do we start?

• **Identify the problem**
  – what is the objective of the project?
  – the “vision” of those who are pushing for it?
    • e.g., “Meeting scheduling is too costly right now”

• **Scope the problem**
  – given the vision, how much do we tackle?
    • e.g. “Build a system that schedules meetings”, …or…
    • e.g. “Build a system that maintains people’s calendars” …or…

• **Identify solution scenarios**
  – given the problem, what is the appropriate business process for solving it?
    • e.g. “Anyone who wants to schedule a meeting goes to the secretary, gives details and the secretary handles the rest”, …or…

• **Scope the solution**
  – Given a business process, what parts should be automated, and how?
    • e.g. “Computer takes in scheduling request details, outputs a solution” …or…
    • e.g. “Solution arrived at interactively by secretary and computer” …or…
Identifying the Problem

• **Vague problem stated by the customer:**
  - E.g. university textbook store:
    • Manager wants to computerize the book order forms filled out by instructors;
  - E.g. A large insurance company:
    • Claims manager wants to cut down the average time it takes to process an insurance claim from 2 months to 2 weeks
  - E.g. A telecommunications company:
    • CIO wants to integrate the billing system with customer record systems of several affiliates, so there is only one billing system...
  - E.g. Large Government Aerospace Agency:
    • The president wants to send a manned mission to Mars by the year 2020

• **Often you only see symptoms rather than causes:**
  - E.g. “Ontario patients needing X-ray scans have to wait for months”
British Planes

https://en.wikipedia.org/wiki/Abraham_Wald
• The holes in the returning aircraft represent areas where a bomber could take damage and still return home safely

• The Navy should reinforce the areas where the returning aircraft were unscathed, since those were the areas that, if hit, would cause the plane to be lost
Difficulties of Elicitation

• **Thin spread of domain knowledge**
  – The knowledge might be distributed across many sources
    • It is rarely available in an explicit form (i.e. not written down)
    – There will be conflicts between knowledge from different sources
      • Remember the principle of complementarity!

• **Tacit knowledge (The “say-do” problem)**
  – People find it hard to describe knowledge they regularly use

• **Limited Observability**
  – The problem owners might be too busy coping with the current system
  – Presence of an observer may change the problem
    • E.g. Probe Effect; Hawthorne Effect

• **Bias**
  – People may not be free to tell you what you need to know
  – People may not want to tell you what you need to know
    • The outcome will affect them, so they may try to influence you (hidden agendas)
Example

• Loan approval department in a large bank
  – The analyst is trying to elicit the rules and procedures for approving a loan

• Why this might be difficult:
  – Implicit knowledge:
    • There is no document in which the rules for approving loans are written down
  – Conflicting information:
    • Different bank staff have different ideas about what the rules are
  – Say-do problem:
    • The loan approval process described to you by the loan approval officers is quite
different from your observations of what they actually do
  – Probe effect:
    • The loan approval process used by the officers while you are observing is
different from the one they normally use
  – Bias:
    • The loan approval officers fear that your job is to computerize their jobs out of
existence, so they are deliberately emphasizing the need for case-by-case
discretion (to convince you it has to be done by a human!)
Bias

• What is bias?
  – Bias only exists in relation to some reference point
    • can there ever be “no bias”? 
  – All views of reality are filtered
  – All decision making is based partly on personal values

• Types of bias:
  – Motivational bias
    • expert makes accommodations to please the interviewer or some other audience 
  – Observational bias
    • Limitations on our ability to accurately observe the world
  – Cognitive bias
    • Mistakes in use of statistics, estimation, memory, etc.
  – Notational bias
    • Terms used to describe a problem may affect our understanding of it

Examples of Bias

– Social pressure
  response to verbal and non-verbal cues from interviewer
– Group think
  response to reactions of other experts
– Impression management
  response to imagined reactions of managers, clients,…
– Wishful thinking
  response to hopes or possible gains.
– Appropriation
  Selective interpretation to support current beliefs.
– Misrepresentation
  expert cannot accurately fit a response into the requested response mode
– Anchoring
  contradictory data ignored once initial solution is available
– Inconsistency
  assumptions made earlier are forgotten
– Availability
  some data are easier to recall than others
– Underestimation of uncertainty
  tendency to underestimate by a factor of 2 or 3.
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Stakeholders

• **Stakeholder analysis:**
  – Identify all the people who must be consulted during information acquisition

• **Example stakeholders**
  – **Users**
    • concerned with the features and functionality of the new system
  – **Designers**
    • want to build a perfect system, or reuse existing code
  – **Systems analysts**
    • want to “get the requirements right”
  – **Training and user support staff**
    • want to make sure the new system is usable and manageable
  – **Business analysts**
    • want to make sure “we are doing better than the competition”
  – **Technical authors**
    • will prepare user manuals and other documentation for the new system
  – **The project manager**
    • wants to complete the project on time, within budget, with all objectives met.
  – **“The customer”**
    • Wants to get best value for money invested!
Requirements Elicitation

THE PROJECT REQUIREMENTS ARE FORMING IN MY MIND.

NOW THEY'RE CHANGING... CHANGING... CHANGING... OKAY. NO, WAIT... CHANGING... CHANGING... DONE.

NATURALLY, I WON'T BE SHARING ANY OF THESE THOUGHTS WITH ENGINEERING.

I BUDGETED FOR SOME GOONS TO BEAT IT OUT OF YOU.
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• Where do we start?
• Stakeholders

• Requirements elicitation techniques
  – Background reading
  – Hard data analysis
  – Interviews
  – Questionnaire
  – Meetings
  – Group elicitation techniques
  – Participant observation

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Elicitation Techniques

- **Traditional techniques**
  - Reading existing documents
  - Analyzing hard data
  - Interviews
    - Open-ended
    - Structured
  - Surveys / Questionnaires
  - Meetings

- **Collaborative techniques**
  - Focus Groups
    - Brainstorming
    - JAD/RAD workshops
  - Prototyping
  - Participatory Design

- **Contextual (social) approaches**
  - Ethnographic techniques
    - Participant Observation
    - Enthnmethodology
  - Discourse Analysis
    - Conversation Analysis
    - Speech Act Analysis
  - Sociotechnical Methods
    - Soft Systems Analysis

- **Cognitive techniques**
  - Task analysis
  - Protocol analysis
  - Knowledge Acquisition Techniques
    - Card Sorting
    - Laddering
    - Repertory Grids
    - Proximity Scaling Techniques
Background Reading

• **Sources of information:**
  – company reports, organization charts, policy manuals, job descriptions, reports, documentation of existing systems, etc.

• **Advantages:**
  – Helps the analyst to get an understanding of the organization before meeting the people who work there
  – Helps to prepare for other types of fact finding
    • e.g. by being aware of the business objectives of the organization.
  – may provide detailed requirements for the current system

• **Disadvantages:**
  – written documents often do not match up to reality
  – Can be long-winded with much irrelevant detail

• **Appropriate for**
  – Whenever you not familiar with the organization being investigated
“Hard Data” and Sampling

• **Hard data includes facts and figures...**
  – Forms, Invoices, financial information,…
  – Reports used for decision making,…
  – Survey results, marketing data,…

• **Sampling**
  – Sampling used to select representative set from a population
    • Purposive Sampling - choose the parts you think are relevant without worrying about statistical issues
    • Simple Random Sampling - choose every $k$th element
    • Stratified Random Sampling - identify strata and sample each
    • Clustered Random Sampling - choose a representative subpopulation and sample it
  – Sample Size is important
    • balance between cost of data collection/analysis and required significance

• **Process:**
  – Decide what data should be collected - e.g. *banking transactions*
  – Determine the population - e.g. *all transactions at 5 branches over one week*
  – Choose type of sample - e.g. *simple random sampling*
  – Choose sample size - e.g. *every 20th transaction*
Example of hard data

• Questions:
  – What does this data tell you?
  – What would you do with this data?
Interviews

• **Types:**
  – Structured - agenda of fairly open questions
  – Open-ended - no pre-set agenda

• **Advantages**
  – Rich collection of information
  – Good for uncovering opinions, feelings, goals, as well as hard facts
  – Can probe in depth, & adapt follow-up questions to what the person tells you

• **Disadvantages**
  – Large amount of qualitative data can be hard to analyze
  – Hard to compare different respondents
  – Interviewing is a difficult skill to master

*Source: Adapted from Goguen and Linde, 1993, p154.*
Interviewing Tips

• **Starting off…**
  – Begin the interview with an innocuous topic to set people at ease
    • e.g. the weather, the score in last night’s hockey game
    • e.g. comment on an object on the person’s desk: “My,… what a beautiful photograph! Did you take that?”

• **Ask if you can record the interview**
  – Make sure the tape recorder is visible
  – Say that they can turn it off at any time.

• **Ask easy questions first**
  – perhaps personal information
    • e.g. “How long have you worked in your present position?”

• **Follow up interesting leads**
  – e.g. if you hear something that indicates your plan of action may be wrong,
    • e.g., “Could we pursue what you just said a little further?”

• **Ask open-ended questions towards the end**
  • e.g. “Is there anything else you would like to add?”
Questionnaires

• **Advantages**
  – Can quickly collect info from large numbers of people
  – Can be administered remotely
  – Can collect attitudes, beliefs, characteristics

• **Disadvantages**
  – Simplistic (presupposed) categories provide very little context
    • No room for users to convey their real needs

• **Watch for:**
  – Bias in sample selection
  – Bias in self-selecting respondents
  – Small sample size (lack of statistical significance)
  – Open ended questions (very hard to analyze!)
  – Leading questions ("have you stopped beating your wife?")
  – Appropriation ("What is this a picture of?")
  – Ambiguous questions (i.e. not everyone is answering the same question)

*Source: Adapted from Goguen and Linde, 1993, p154.*
Meetings

• **Used for summarization and feedback**
  - E.g. meet with stakeholders towards the end of each stage:
    - to discuss the results of the information gathering stage
    - to conclude on a set of requirements
    - to agree on a design etc.
  - Use the meeting to confirm what has been learned, talk about findings

• **Meetings are an important managerial tool**
  - Used to move a project forward.
  - Every meeting should have a clear objective:
    - E.g. presentation, problem solving, conflict resolution, progress analysis, gathering and merging of facts, training, planning,...
  - Plan the meeting carefully:
    - Schedule the meeting and arrange for facilities
    - Prepare an agenda and distribute it well in advance
    - Keep track of time and agenda during the meeting
    - Follow up with a written summary to be distributed to meeting participants
    - Special rules apply for formal presentations, walkthroughs, brainstorming, etc.
Group Elicitation Techniques

• **Types:**
  – Focus Groups
  – Brainstorming

• **Advantages**
  – More natural interaction between people than formal interview
  – Can gauge reaction to stimulus materials (e.g. mock-ups, storyboards, etc.)

• **Disadvantages**
  – May create unnatural groups (uncomfortable for participants)
  – Danger of Groupthink
  – May only provide superficial responses to technical questions
  – Requires a highly trained facilitator

• **Watch for**
  – sample bias
  – dominance and submission
Joint/Rapid Application Development

- **JAD & RAD Principles:**
  - Group Dynamics - use workshops instead of interviews
  - Visual Aids
    - Lots of visualization media, e.g. wall charts, large monitors, graphical interfaces
  - Organized, Rational Process
    - Techniques such as brainstorming and top-down analysis
  - WYSIWYG Documentation Approach
    - each JAD session results in a document which is easy to understand and is created and agreed upon during the session

- **Notes:**
  - Choose workshop participants carefully
    - they should be the best people possible representing various stakeholder groups
  - Workshop should last 3-5 days.
    - Must turn a group of participants into a team - this takes 1-2 days.
    - Session leader makes sure each step has been completed thoroughly.
    - Session leader steps in when there are differences of opinion - “open issues”.
    - Meeting room should be well-equipped for presentations, recording etc.
Participant Observation

• **Approach**
  – Observer spends time with the subjects
    • Joining in long enough to become a member of the group
    • Hence appropriate for longitudinal studies

• **Advantages**
  – Contextualized;
  – Reveals details that other methods cannot

• **Disadvantages**
  – Extremely time consuming!
  – Resulting ‘rich picture’ is hard to analyze
  – Cannot say much about the results of proposed changes

• **Watch for**
  – going native!
Suitability of the Techniques for Sub-activities

<table>
<thead>
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<th>Identifying requirements sources</th>
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<td>x</td>
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<tr>
<td>Perspective-based reading</td>
<td>Medium to high</td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>
Combine Different Techniques

Background reading (e.g., Internet?)

(Initial) Meeting

Hard Data analysis

Brainstorming

Interviews

Meeting

Meeting

Joint/Rapid Development

...
Elicitation technique Selection: How do experts do it

- Collaborative Sessions
  - Such as joint application development, brainstorming, group sessions
- Interviewing
- Team-building
- Ethnography
- Issue list
- Models
- Questionnaire

- Data gathering from existing systems
- Requirements categorization
- Conflict awareness and resolution
- Prototyping
- Role playing
- Formal methods
- Extreme programming
Document elicited knowledge!
Documenting requirements artefacts

Diagram:

- **Identifier** (1)
- **Description** (1)
- **Requirements artefact**
  - **Goal** (1..*), **Solution-oriented requirement** (1..*), **Scenario** (1..*)
  - **Example of satisfaction**
  - **Complete, disjoint**
  - **Derived from**
  - **Contributes to realisation of**
  - **Is realised by**
- **Criticality** (1)
- **Priority**
- **Risk**
Take Home!

• Where do we start?
• Stakeholders
• Requirements elicitation techniques
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