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
Table of Contents

- Where do we start?
- Stakeholders
- Requirements elicitation technique

- Prof. Steve Easterbrook, Requirements engineering course, University of Toronto
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 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
British Planes
https://en.wikipedia.org/wiki/Abraham_Wald

Abraham Wald
1902-1950

- 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.
Table of Contents

• Where do we start?

**Stakeholders**

• Requirements elicitation techniques

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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
Table of Contents

• 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
    • Ethnomethodology
  – 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 kth 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?”

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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>
<tr>
<th>Technique</th>
<th>Effort</th>
<th>Identifying requirements sources</th>
<th>Eliciting existing requirements</th>
<th>Developing new and innovating requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interview</td>
<td>Medium to high</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Workshop</td>
<td>High to very high</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Focus groups</td>
<td>Medium to high</td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Observation</td>
<td>High to very high</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Questionnaire</td>
<td>Low to medium</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Perspective-based reading</td>
<td>Medium to high</td>
<td></td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

Combine Different Techniques

1. Background reading (e.g., Internet?)
2. (Initial) Meeting
3. Hard Data analysis
4. Interviews
5. Brainstorming
6. Meeting
7. Joint/Rapid Development
8. Meeting
9. ...

...
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

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Document elicited knowledge!
Documenting requirements artefacts

**Take Home!**

- Where do we start?
- Stakeholders
- Requirements elicitation techniques
  - Background reading
  - Hard data analysis
  - Interviews
  - Questionnaire
  - Meetings
  - Group elicitation techniques
  - Participant observation