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

Source:
- Prof. Steve Easterbrook, Requirements engineering course, University of Toronto
## Table of Contents

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

- 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

Credit: CameronMoll
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

Abraham Wald
1902-1950

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

- Prof. Steve Easterbrook, Requirements engineering course, University of Toronto
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... done.

Naturally, I won't be sharing any of these thoughts with engineering.

I budgeted for some goons to beat it out of you.
Table of Contents

• Where do we start?
• Stakeholders

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

• Prof. Steve Easterbrook, Requirements engineering course, University of Toronto

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
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 Gregoire and Linda, 1993, p.154

Note: Questionnaires MUST be prototyped and tested!
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></td>
<td>X</td>
</tr>
<tr>
<td>Questionnaire</td>
<td>Low to medium</td>
<td></td>
<td>X</td>
<td>X</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**

- Background reading (e.g., Internet?)
- (Initial) Meeting
- Hard Data analysis
- Interviews
- Brainstorming
- Meeting
- Joint/Rapid Development
- Meeting
- …
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!
Take Home!

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