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
Table of Contents

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

• Prof. Steve Easterbrook, Requirements engineering course, University of Toronto
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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
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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What the user asked for

How the analyst saw it

How the system was designed

As the programmer wrote it

What the user really wanted

How it actually works
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!
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.
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 $k$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

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<tr>
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<th>Effort</th>
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<tr>
<td>Perspective-based reading</td>
<td>Medium to high</td>
<td></td>
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</tr>
</tbody>
</table>
Combine Different Techniques

Background reading (e.g., Internet?)

(Initial) Meeting

Hard Data analysis

Brainstorming

Interviews

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!
Documenting requirements artefacts

- **Identifier**
  - has
  - 1

- **Description**
  - has
  - 1

- **Requirements artefact**
  - has
  - 0..* to 1
  - has
  - 0..* to 1

- **Criticality**
  - has
  - 1

- **Priority**
  - has
  - 1

- **Risk**
  - has
  - 0..* to 1

- **Goal**
  - 1..* to 1..*
  - example of satisfaction

- **Scenario**
  - 1..* to 1..*

- **Solution-oriented requirement**
  - derived from
  - 1..* to 0..*

- contributes to realisation of

is realised by ▶
Take Home!

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