About Requirements

The big picture.

Requirements Analysis

Design Phase or activity in which the needs of clients with respect to a proposed project or technology are analyzed.

• Understanding the work in order to offer useful functionality
• Understanding the people in order to offer it in a way suitable for them
## Kinds of Requirements

**Functional:** what the human-computer system must do

**Data:** information needed to do it

**Environmental:** context it must fit into  
- Physical  
- Technical  
- Social  
- Organizational

**Users:** who will be part of the system, and their roles

**Usability:** acceptable levels on measures of effectiveness, efficiency, safety, utility, learnability and memorability

## Doing Requirements

**Iterative Process**

1. Data gathering
2. Data analysis
3. Expression as "requirements"

## Requirements: Role in Design

- **Paradox**
  - Essential to have stable requirements (most projects that fail do so because of inadequate requirements)
  - Impossible to know in advance (may need to revise)

- **In practice requirements specification overlaps with design**
Strategies to consider

• Work from ambiguous, incomplete and infeasible specifications to precise requirements
• Use representations as resources for conversation and as formal documentation
• Capture whole system; allocate to computer and humans later

Gathering the Data
A collection of methods .. from which you will chose several

But first ... get a Root Concept
A shared understanding of the project's high level goals and parameters is important to guide data gathering and analysis ...

• Vision: what are we trying to achieve?
• Rationale: why will technology help?
• Stakeholder Groups: those with vested interest (not just "users")
• Assumptions and Constraints: What decisions have we already made? What requirements have been imposed?
Interviews

• Structured, unstructured or semi-structured
• Props, e.g. sample scenarios of use, prototypes, can be used
• Good for exploring issues
• Time consuming

Conducting Interviews

• Identify objectives in advance
• Structured or unstructured? Mixed is recommended …
  - Open ended questions about their work or activity, to get participants started
  - Specific questions, asking for information specifically needed
• How will results be recorded? Notes, audio, video
• Obtain permission!

Focus Groups

• Good for brainstorming, identifying consensus or conflict
• Also helps stakeholders become aware of each other
• Plan like interviews, but also
  - Include moderator
  - Choose participants carefully (watch for dominators and power relationships)
Questionnaires and Surveys

- A series of questions designed to elicit specific information
- Response formats may be yes/no, multiple choice, Likert scale, comment
- Easiest to tabulate if responses are constrained
- *Not easy to design! Must pilot!*
- Useful when stakeholder group is large or dispersed
- Often used in conjunction with other techniques

Naturalistic Observation

- Spend time with stakeholders in their work/life space, observing the activity of interest as it happens
- Good for understanding the nature and context of the tasks, and information artifacts used (distributed cognition perspective)
- Requires time and commitment
- Can result in a huge amount of data

Planning Naturalistic Observations

- From whom do you need permission?
- Is it sufficient to observe whatever happens to be going on?
  - Do you need to show up at a particular time to see important activities?
  - Do you need to ask participants to simulate important but rare activities?
- How will you record your observations?
  - Videotape, Audiotape, Camera, Written notes
- Observer Roles?
Document Analysis

- Procedures and rules written down in manuals
- Source of data about the steps involved in an activity, and regulations governing it
- May not reflect actual practice: not to be used in isolation
- No stakeholder time, which is a limiting factor on the other techniques

Artifact Analysis

- How will you gather the artifacts?
  - Videotaping, photographs
  - Taking them with you
- What does the artifact tell you about the task it supports?
  - Task attributes and information
  - Action sequences
- Best to observe in use (not always used as intended!)
Guidelines for Data Gathering

• Focus on identifying the stakeholders' needs, but not just stated needs
• Involve all of the stakeholder groups
• Involve more than one representative from each stakeholder group
• Use a combination of data gathering techniques
• "First Rule of Usability: Don't listen to users, watch what they do" (do you agree with Nielsen?)

Analyzing the Data

Methods drawn from Scenario Based Design and Usage Centered Design that help us summarize and understand the data on users' tasks and needs.

Data Requirements

• Focus on structure rather than processing
• Include data in whole human-paper-computer system
• Candidate notation: ER diagrams
Functional Requirements

- Focus on what the whole system should do
  - Task allocation comes later
  - What it does, not how it does it
- Iteratively developed
  - Multiple levels of abstraction
  - Avoid premature commitments
- Need notations accessible to users
- Many candidates ...

Dataflow Analysis

- Processes change data
- Not a “flow chart”: flow of data, not control

Dataflow: Airport ATM Example

1. Validate user
2. Check Credit
3. Deliver Currency

User Info
Exchange Rates
Account Info
**Comments on Dataflow**

- Encourages abstraction away from physical processes and assumptions about task allocation
- Helps us focus on usefulness
- Explanations and scenarios may need to "bring to life" for users

**Scenario-based Design (reminder)**

**SBD Requirements Analysis**

But where's the requirements?
Problem Scenarios

- Stories of current practice
  - describe activities in problem domain
  - illustrate implications for design
- Begin with hypothetical stakeholders
- Tell a story for each stakeholder,
carrying out actions to achieve a goal
- Consider interactions with other stakeholders

Claims Analysis

- As you write scenarios, identify
  - important features of situation
  - positive and negative impacts these
    features have on actors
- Typically these will be instances of
  tradeoffs

Usage Centered Design (reminder)
Roles

User Role Model

<table>
<thead>
<tr>
<th>Role Name</th>
<th>Frequency</th>
<th>Intensity</th>
<th>Volume</th>
<th>Interaction Profile</th>
<th>Dominant flow</th>
<th>Origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional Viewer</td>
<td>low</td>
<td>low</td>
<td>low</td>
<td>required</td>
<td>from user</td>
<td>aural</td>
</tr>
<tr>
<td>Professional Editor</td>
<td>medium</td>
<td>medium</td>
<td>medium</td>
<td>irregular</td>
<td>balanced</td>
<td>visual</td>
</tr>
<tr>
<td>Professional Developer</td>
<td>high</td>
<td>high</td>
<td>high</td>
<td>continuous</td>
<td>balanced</td>
<td>mental process</td>
</tr>
</tbody>
</table>

NetLearn Example

Use Cases: Various definitions

- The specification of a sequence of actions ... that a system, subsystem or class can perform by interacting with outside actors [Rumbaugh]
- A typical interaction between a user and a computer system that captures some user-visible function and achieves a discrete goal for the user [Fowler]
Issues in Use Cases

• Typically a description of the interaction between user and system through a particular interface …
• Inappropriate for design of interface! Assumes the design they are supposed to help you reach
• Hence Essential (abstract) use cases were born …

C&L’s Definition

• A single, discrete, complete, meaningful and well defined task of interest to an external user in some specific role or roles in relationship to a system,
• comprising the user intentions and system responsibilities in the course of accomplishing that task,
• described in abstract, technology-free implementation-independent terms using the language of the application domain and of external users in role.

Essential Use Case (see paper)

<table>
<thead>
<tr>
<th>Identification</th>
<th>Contextual Purpose</th>
<th>Supported Roles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process</td>
<td>Preconditions</td>
<td>User Intentions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>System Responsibilities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Asynchronous Extensions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(steps)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Post-conditions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Business Rules</td>
</tr>
</tbody>
</table>
NetLearn Examples

Hierarchical Task Analysis

Given a goal, how can the user achieve the goal?
1) Identify major goals and the activities by which users might achieve them
2) Decompose complex tasks into subtasks and ultimately actions
3) Check out your analysis by discussing with users or comparing to their behavior
Again, this requires an accessible yet precise notation ...

Rosson's example of HTA
Evaluation of HTA

- HTA helps identify organization of highly structured tasks
- HTA might help us identify use cases
  - Don’t decompose all the way to primitive actions
  - Instead, stop before the decomposition requires implementation decisions
- ... but there are limitations
  - Representation is hierarchical/sequential; can’t handle parallel or asynchronous activity well
  - Does not scale up well

Specifying the Requirements

How we write them down

A Requirements Template

Type: functional, data, environmental, users, usability
Origin: event, scenario, use case
Source: person raising this requirement
Description: the intention of the requirement
Rationale: why is the requirement considered important or necessary?
Fit Criterion: how do we know whether a solution meets the requirement?
Customer Satisfaction/Dissatisfaction if implemented/not implemented
Dependencies and Conflicts with other requirements
Comments

- Capture whole human-computer system, not just part you expect to program; assign responsibility later
- Initial representations are a resource for conversations with users rather than "getting it right"
- Subsequently, representations are formal documentation

On Notation

"Notation is, in truth, the user-interface of models."
"... the visual form of notation can significantly increase or decrease the effectiveness of those who create and interpret the models" [C&L]

My research has shown similar influences of notations used during learning.
How do SBD and UCD notations compare?

Let's try it ...

The ICS Web Site as a Community Center
- Define Root Concept
  - High-level vision, Basic rationale, Starting assumptions, Stakeholders
- Plan Data Gathering
  - Interviews, Focus groups, Questionnaires, Observation, Artifact analysis?
- Identify Requirements
  - Functional, Data, Environmental, Users, Usability
• Perform a requirements analysis for your project
• Apply at least 2 of these data gathering methods:
  - Interview
  - Focus Group
  - Questionnaire
  - Naturalistic Observation
  - Document or artifact analysis
• Provide at least 4 of these requirements models:
  - User Role Models (forms and maps)
  - Artifact Analysis
  - Problem Scenario
  - Claims Analysis
  - Hierarchical Task Analysis
  - Essential Use Cases