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Lecture 4: Requirements Elicitation II

Last Week:
Elicitation (I)
Traditional approaches
Interviews & Questionnaires
Scenarios, Goals and Use-Cases

This Week:
Elicitation (II)
Cognitive approaches
Contextual approaches
Ethnography as an RE technique

Next Week:
Modeling and Analysis (I)
Modeling Goals
Modeling Organisations
Modeling Non-Functional Reqs

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Knowledge Elicitation Techniques in RE

→ **Background**

- ⊗ Knowledge elicitation is concerned with discovering 'expert' knowledge
- ⊗ Grew out of Expert Systems work in the 80's
- ⊗ Originally focussed on deriving expert's "rules" for Rule-based Systems
- ⊗ More recently, focussed on "problem solving methods"

Example Techniques

- ⊗ Eliciting domain knowledge
 - > Card Sorting
 - > Laddering
 - > Proximity Scaling Techniques
- ⊗ Eliciting performance knowledge
 - > Protocol Analysis
- ⊗ Using Multiple Experts
 - > Delphi Technique
 - > Focus Groups
 - > Repertory Grids
- ⊗ Automated Techniques
 - > Machine Learning

→ **But KE is hard**

- ⊗ Separation of domain knowledge from performance knowledge
- ⊗ Modeling problems
 - > Brittleness
 - > Assumption of rationality
- ⊗ Representational Problem
 - > epistemological inadequacy
 - > expressiveness vs. acquirability
- ⊗ Expert Bias

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Why is KE so hard?

→ **Experts are not used to describing what they do.**

- ⊗ **Three stage model of learning:**
 - 1) cognitive - verbal rehearsal of tasks;
 - 2) associative - reinforcement through repetition, verbal mediation disappears
 - 3) autonomous - compiled, no conscious awareness of performance.
- ⊗ **Procedural and declarative are different mechanisms**
 - > Declarative knowledge becomes procedural with repeated application - experts lose awareness of what they know and cannot introspect reliably
 - > Experts have little or no introspective access to higher order cognitive processes

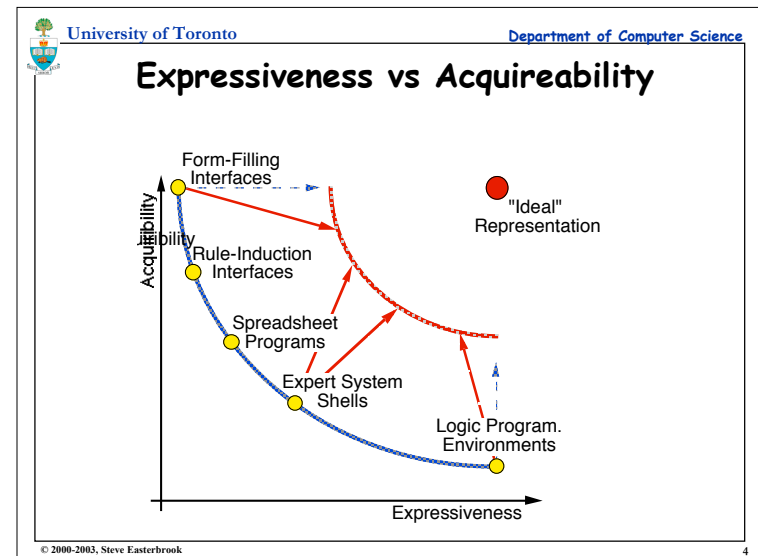
→ **Representational Problems**

- ⊗ **Experts don't have the language to describe their knowledge**
 - > No spoken language offers the necessary precision
 - > Knowledge Engineer and Expert must work together to create a suitable language
- ⊗ **Different knowledge representations are good for different things**
 - > **Epistemological adequacy:** does the formalism express expert's knowledge well?

→ **Brittleness**

- ⊗ **Knowledge is created, not extracted.**
 - > Knowledge models are abstractions of reality and hence are unavoidably selective
 - > Brittleness caused by the simplifying assumptions - instead of adding more knowledge, a better (more comprehensive) model is needed.

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The Knowledge Level

→ View knowledge modelling as:

- Observe behaviour of an agent as black box
 - It acts as if it has some knowledge about its environment which it uses rationally
 - It takes actions to achieve ascribed goals
- Construct two models:
 - Symbol Level** - descriptions for mechanising behaviour
 - Knowledge Level** - descriptions of the agent's knowledge of the world

→ Two-step rationality:

- Agent applies its knowledge in two stages:
 - First creates a task specific model from the KL model based on features of the task.
- Hence, we actually need 3 models:
 - Domain model** - a systematic way of talking about a domain, with a coherent ontology.
 - Task model** - models goals, what it means to achieve a goal, and how goals are related.
 - Problem-solving method** - a way of relating task and domain models to accomplish goals.

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Knowledge Elicitation Techniques

→ Protocol Analysis

- based on vocalising behaviour
 - Think aloud vs. retrospective protocols
- Advantages**
 - Direct verbalisation of cognitive activities
 - Embedded in the work context
 - Good at revealing interaction problems with existing systems
- Disadvantages**
 - Essentially based on introspection, hence unreliable
 - No social dimension

→ Proximity Scaling Techniques

- Given some domain objects, derive a set of dimensions for classifying them:
 - step 1: pairwise proximity assessment among domain elements
 - step 2: automated analysis to build multi-dimensional space to classify the objects
- Advantages**
 - help to elicit mental models, where complex multivariate data is concerned
 - good for eliciting tacit knowledge
- Disadvantages**
 - Requires an agreed on set of objects
 - Only models classification knowledge (no performance knowledge)

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more KE techniques

→ Card Sorting

- For a given set of domain objects, written on cards:
 - Expert sorts the cards into groups...
 - ...then says what the criterion was for sorting, and what the groups were.
- Advantages**
 - simple, amenable to automation
 - elicits classification knowledge
- Problems**
 - suitable entities need to be identified with suitable semantic spread across domain.
 - No performance knowledge

→ Laddering

- Uses a set of probes (types of question) to acquire structure and content of stakeholders' knowledge.
 - Interview the expert.
 - Use questions to move up and down a conceptual hierarchy
- Advantages**
 - deals with hierarchical knowledge, including poly-hierarchies (e.g., goal trees, "is-a" taxonomies).
 - knowledge is represented in standardised format
 - can elicit structural knowledge
 - suitable for automation.
- Disadvantages**
 - assumes hierarchically arranged knowledge.

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KA from Multiple Experts

→ Delphi technique

- Used where contact between experts is difficult:
 - Each expert submits their judgement
 - All judgements are circulated anonymously to all experts
 - Each expert then submits a revised judgement
 - Iterate until judgements converge

→ Focus Groups

- A technique derived from marketing:
 - Assemble experts together and discuss the problem
 - Discussion may be structured (e.g. debate) or unstructured

→ Repertory Grids (based on Kelly's Personal Construct Theory)

- Used to detect terminological differences
 - Get the experts to agree a set of entities
 - Each expert provides attributes and values
 - For each attribute in expert A's grid, find the closest match in expert B's grid. (i.e. are there attributes which have the same discriminatory function?)
 - Experts then rate the entities using each other's attributes

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Abstractionism vs. Contextualism

→ **Abstractionism**

- ↳ Builds models abstracted from a domain; the model is used to answer questions
 - (1) Decide on the ontology of the phenomena we wish to describe
 - (2) Use this ontology to represent the domain of discourse
- ↳ Assumes knowledge and understanding are independent from context
- ↳ Used by natural scientists and engineers.
 - > ...although many scientists don't realize that step 1 involves choice
 - > logical positivism vs. theory-driven observation

→ **Contextualism**

- ↳ Emphasizes the details and idiosyncrasies of the domain
 - (1) Collect naturalistic data from the domain of study (Rich descriptions)
 - (2) Use the data to support explanations (but don't build abstract models)
- ↳ Assumes it is impossible to build models that have meaning when removed from their context
- ↳ Used by many social scientists
 - > but generally limits them to the descriptive rather than predictive/prescriptive

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Participant Observation

→ **Approach**

- ↳ longitudinal studies:
 - > Observer spends time with the subjects, joining in, long enough to become a member of the group

→ **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!

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Ethnomethodology

→ **Basis**

- ↳ Social world is ordered
 - > The social order may not be obvious, nor describable from common sense
- ↳ The social order cannot be assumed to have an a priori structure
 - > Social order is accomplished on a moment-to-moment basis through participants' collective actions (rather than through any pre-existing structures)
 - > i.e. social order only observable when an observer immerses herself in it.
- ↳ Observation should be done in a natural setting
- ↳ Need to consider how meanings develop and evolve within context

→ **"Use the members' own Categories"**

- ↳ Most conventional approaches assume preexisting categories
 - > This may mislead the observer (e.g. appropriation)
- ↳ Ethnography attempts to use the subjects' own categories
 - > What categories (concepts) do they use themselves to order the social world?
- ↳ What methods do people use to make sense of the world around them?
 - > Use the same methods members use during observation, for example, by developing a legitimate role within the community under observation.

→ **Measurement**

- ↳ No scientific objectivity, so use the subjects' own measurement theory

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Ethnomethodological approach

→ **Ethnomethodology is a subarea of Anthropology**

- ↳ Looks for behaviours that may be different in a specific culture but which have the same underlying purpose or meaning.
 - > E.g. how do people go about gaining status in different cultures;
 - > Frenchmen brag about sexual conquests to gain status;
 - > Americans brag about money to gain status.
 - > Each of these topics is taboo in the other culture

→ **Uses a very tightly controlled set of methods:**

- ↳ Conversational analysis
- ↳ Measurement of body system functions - e.g. heartbeat
- ↳ Studies of Non-verbal behaviour (e.g. gestures, body language)
- ↳ Detailed video analysis
- ↳ These techniques are useful in capturing information about a social setting.

→ **Other observation techniques can be applied:**

- ↳ Time-motion study
 - > who is where, when?
- ↳ Communication audit
 - > who talks to whom about what?
- ↳ Use of tools - status symbols plus sharing rules

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Postscript: Postmodernism

→ Modernism

- ↳ Rationality is the highest form of mental functioning
- ↳ Modern science produces universal truths
 - > ...independent from the context and status of the scientist who produced them
- ↳ Rationality will always lead to progress and perfection
 - > All human institutions can be scientifically analyzed and improved
- ↳ Reason is the ultimate judge of what is right (true, legal, ethical,...)
- ↳ Language must be rational
 - > it only exists to represent the real world;
 - > there must be a firm, objective connection between the "signifier" and the "signified"
 - > the meaning cannot depend on the audience

→ Postmodernism

- ↳ Questioning the grand narrative
 - > A grand narrative is a story that a culture/society tells itself about it's practices and beliefs
 - > E.g. in the US: "democracy is the most enlightened/rational form of government"
 - > E.g. in science: "scientific truths are universal and eternal"
 - > Postmodernism identifies and critiques such narratives
- ↳ Instead, look for mini-narratives
 - > Stories that explain small practices, local events, situated, contingent behaviour
 - > ...and don't make any claims about universality, truth, or stability
- ↳ E.g. Literary Deconstruction
 - > Examine what a text does not say, what it represses
 - > Reveal internal arbitrary hierarchies and dichotomies
- ↳ E.g. Semiotics
 - > The study of the relationship between signs and the things they signify

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