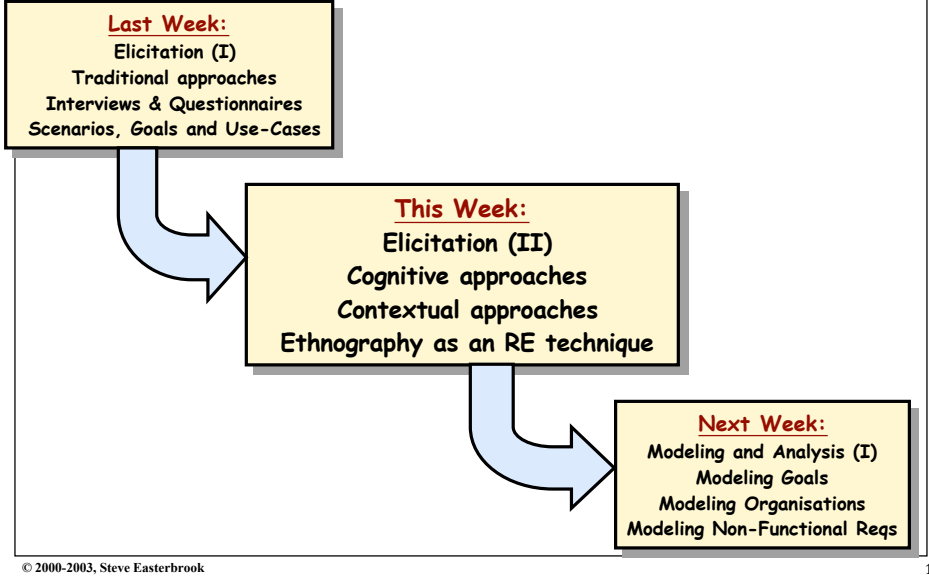




Lecture 4: Requirements Elicitation II



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"

→ 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

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



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?

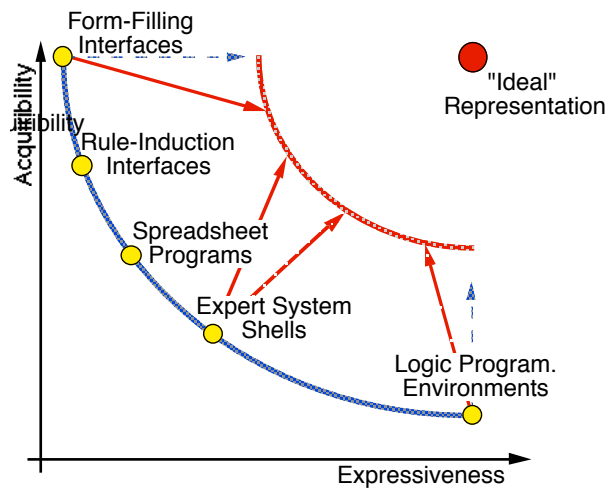
→ Brittleness

↳ 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.



Expressiveness vs Acquireability





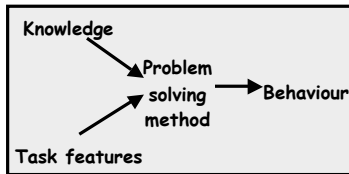
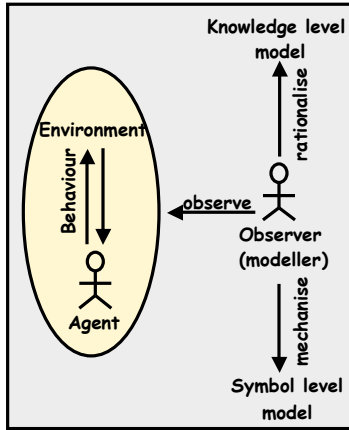
The Knowledge Level

→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.



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)



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.



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



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



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!



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



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



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 its 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



An RE Methods Classification (after Lyotard)

