A Framework for Iterative, Interactive Analysis of Agent-Goal Models in Early Requirements Engineering (Research Proposal)

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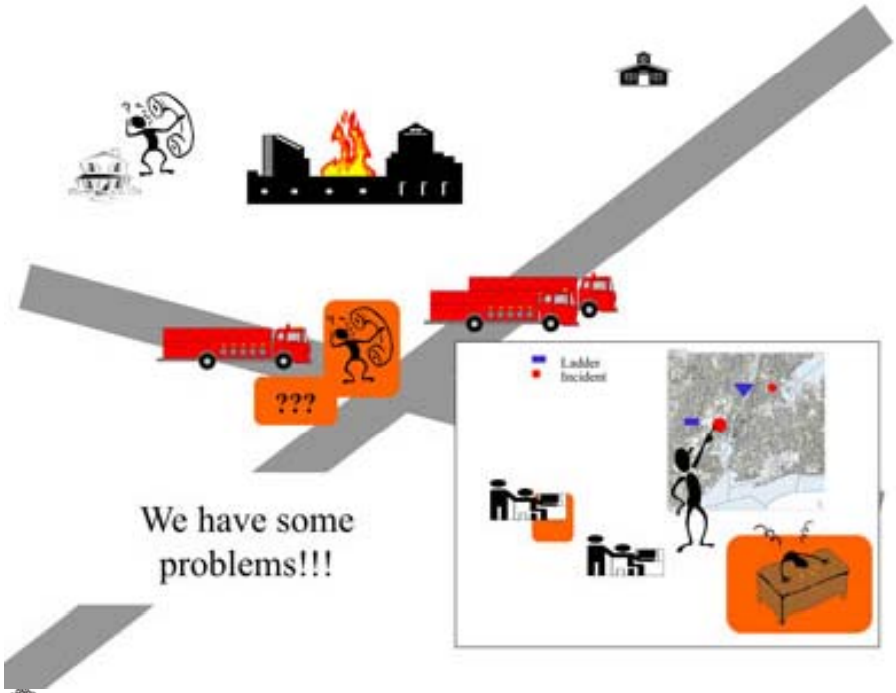
Early Requirements Engineering

- Early stages of requirement analysis focusing on understanding:
  - Stakeholders and systems
  - Stakeholder's needs
  - Domain problems
  - Different views of the problems
- Challenges in Early RE
  - Incomplete and imprecise information
  - Difficult to quantify or formalize critical success criteria such as privacy, security, employee happiness, customer satisfaction
  - Ideally Early RE should involve a high degree of stakeholder interaction
    - Gather and validate information

Existing Approaches for Early RE

- Example: Soft System Methodology (rich pictures) (Checkland, 2000)
- Example: Text (or tables)
  - Flexible, user-friendly, but difficult to systematically analyze or support via tools
- Examples courtesy of RE'09 "Next Top Model" Competition



New NY-FEDS Requirements Documentation

Authors: Team RE-POT: Harnessing the Power of Natural Language – Martin Glinz and Joy Beatty

1. Business Problems

ID	Business problem	Source of problem
B1	Dispatching errors create high operational cost and unhappy customers	1. Incorrect information collected or entered 2. Manual ladder and resource selections are incorrect 3. Redundant dispatches occur
B2	Dispatcher training and turnover rate create high cost	1. Extensive training (time and cost) required to know geography and nature/urgency of incidents 2. High turnover due to stressed and unhappy dispatchers
B3	Inefficiencies create high operational cost (and slow response)	1. Manually selecting ladders and number of resources 2. Updating and viewing velcro situation board 3. Redundant dispatches occur 4. Resource status isn't up-to-date 5. Extra info captured about incidents

2. Business goals

G1	Service fire emergency calls effectively and efficiently	B1, B3
G2	Increase attractiveness of the dispatcher job	B2
G3	Reduce training cost	B2
G4	Minimize administrative overhead	B3
G5	Increase quality of service as perceived by customers	B1

3. System context

System comprises
- Call processing
- Dispatch support
- Resource database
- Car on-board equipment
- Simulator
- Measurement manager

Context comprises
- Dispatch center
- Ladders
- Fire brigades
- Callers reporting fire incidents
- Training center

4. Actors

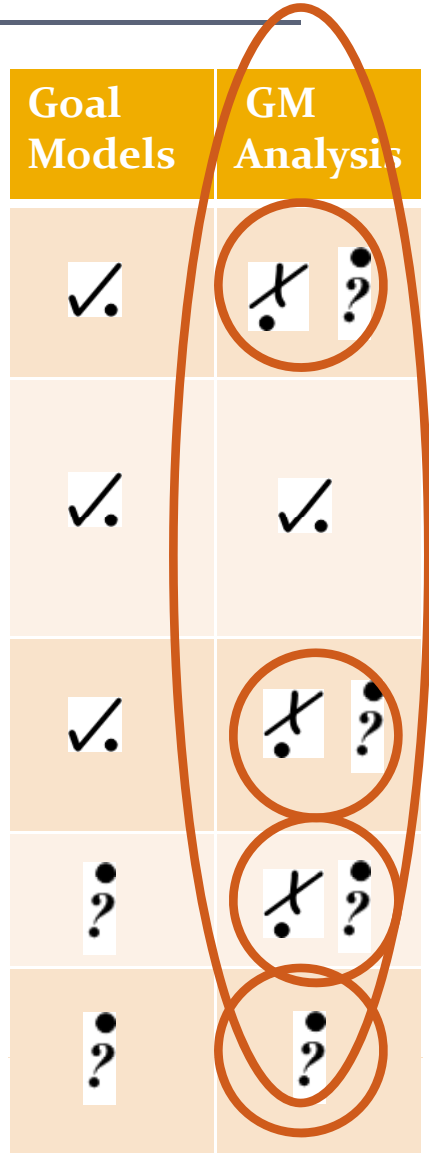
Actor	Roles
Dispatcher	Records calls, confirms/rejects duplicates, consults map, dispatches, does follow-up
Ladder officer	Receives/acknowledges orders, keeps resource information up-to-date
Fire brigade officer	Receives/acknowledges orders
Resource officer	Enters/maintains map and resource data
Any authorized person	Retrieves statistics/measurements
Trainer	Runs the simulator

Existing Approaches for Early RE

- Goal- and Agent-Oriented Models (GORE) (agent-goal models)
  - Can allow modelers to model **fuzzy concepts** (softgoals)
  - Provide **useful views** even over incomplete and imprecise information
  - Allow for **systematic analysis**; however:
    - Existing analysis procedures often require specific information such as probabilities, costs, priorities, or quantitative estimates
      - (Giorgini et al., 2004), (Franch, 2006), (Letier & van Lamsweerde, 2004), (Amyot et al., 2010), (Bryl et al., 2007), (Gans et al., 2004), (Fuxman et al., 2004), etc.
    - Claim: Quantitative results are often based strongly on estimates, which are especially unsure during early stages
    - Most procedures are fully automated "push-button"-type
    - Claim: Difficult for stakeholders to understand or trust results produced automatically over incomplete and imprecise information

Research Objectives

- Need: Methods and tools to support Early RE elicitation and analysis which:
  - Are simple enough (on the surface) to use with stakeholders
  - Are structured enough to:
    - provide user guidance
    - allow for systematic analysis
    - allow for tool support
  - But are flexible enough to allow for:
    - representation of imprecise and incomplete information
  - Allow for incomplete and imprecise information to be supplemented by domain knowledge
  - Prompts iteration over domain knowledge
    - Increasing the likelihood of discovering objects, problems and alternative designs in the domain



Our Approach

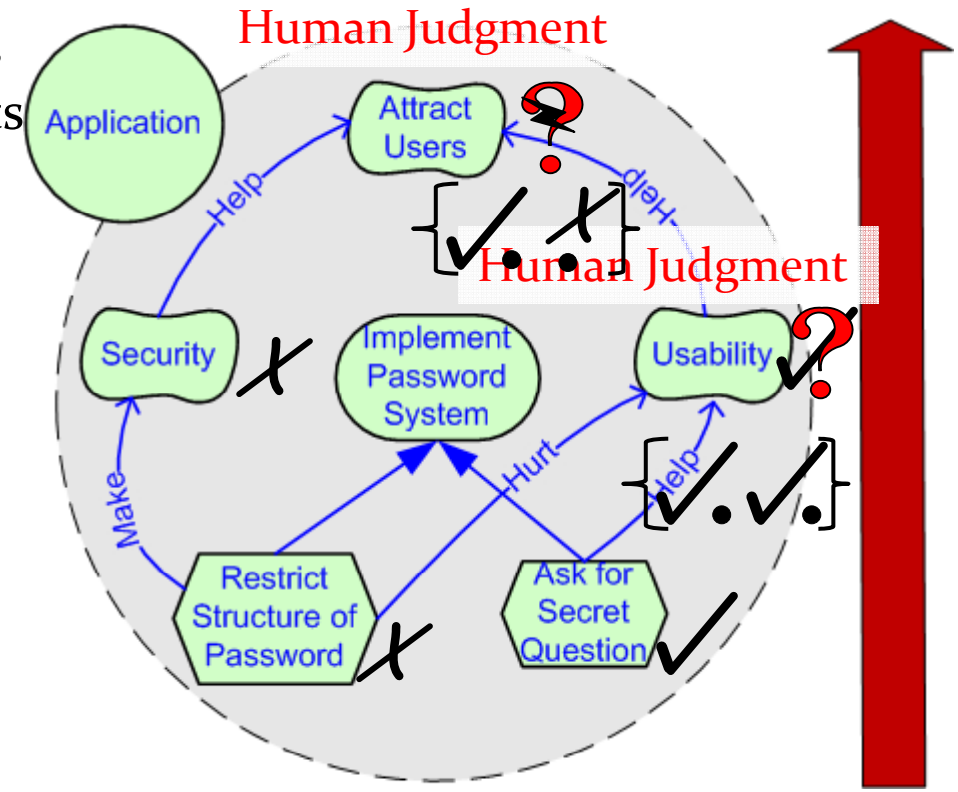
- A Framework for Iterative, Interactive Analysis of Agent-Goal Models in Early Requirements Engineering
- Expand the capabilities of agent-goal models in the following ways:
  - Survey and analysis of existing analysis procedures
  - Interactive forward evaluation
  - Interactive backward evaluation
  - Multiple evaluations over a single model
  - Human judgment management
  - Assumptions and argumentation
  - Supporting model iteration
  - Suggested methodology

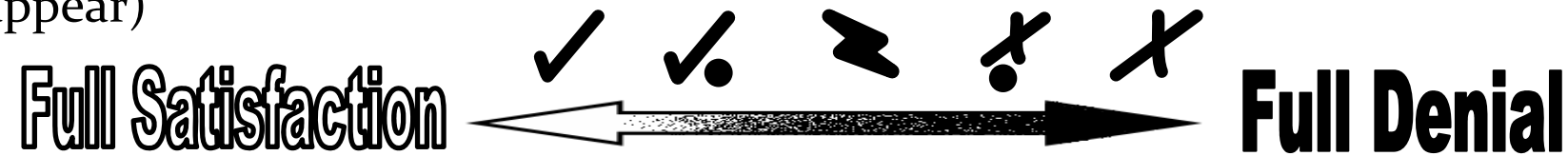
Survey and Analysis

- Many different approaches for agent-goal model analysis
  - Forward and backward satisfaction propagation: (Giorgini et al., 2004), (Amyot et al., 2010), (Letier & van Lamsweerde, 2004)…
  - Metrics: (Franch, 2006)…
  - Planning: (Bryl et al., 2007)…
  - Simulation: (Gans et al., 2004)…
  - Model Checking: (Fuxman et al., 2004)…
- Which procedures support **what GM syntax**?
- Which procedures to **use in what circumstances**? (How do you select among them?)
- More specific comparison: what differences do different conventions in forward satisfaction propagation procedures have on the results?

Interactive Forward Satisfaction Analysis

- Allow "What if?" questions
- A question/scenario/alternative is placed on the model and its affects are propagated "forward" through model links
- Interactive: user input (human judgment) is used to decide on partial or conflicting evidence "What is the resulting value?
- Qualitative: uses a simple qualitative scale
- Publications: CAiSE'09 (short paper), PoEM'09, IJISMD (to appear)





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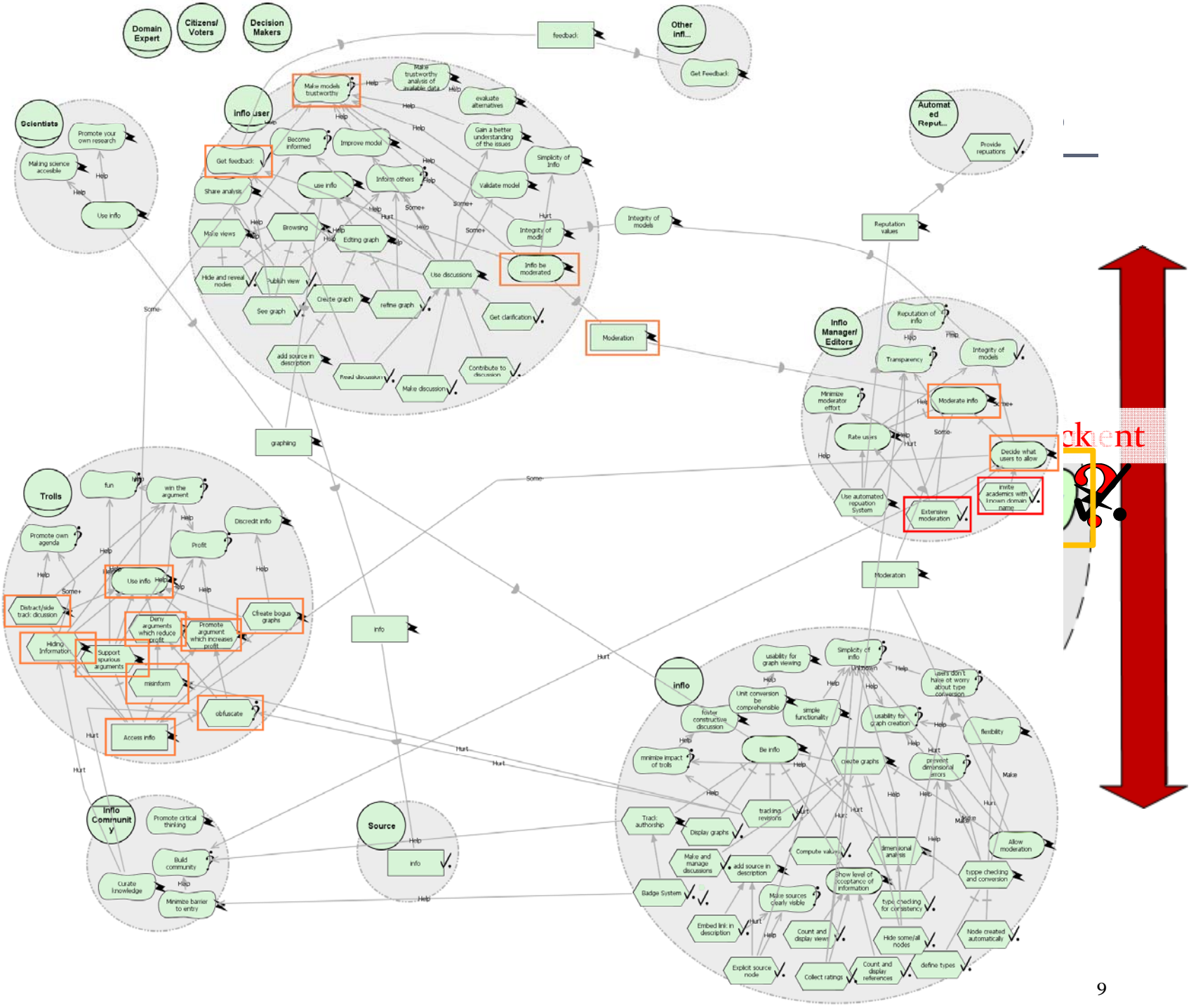


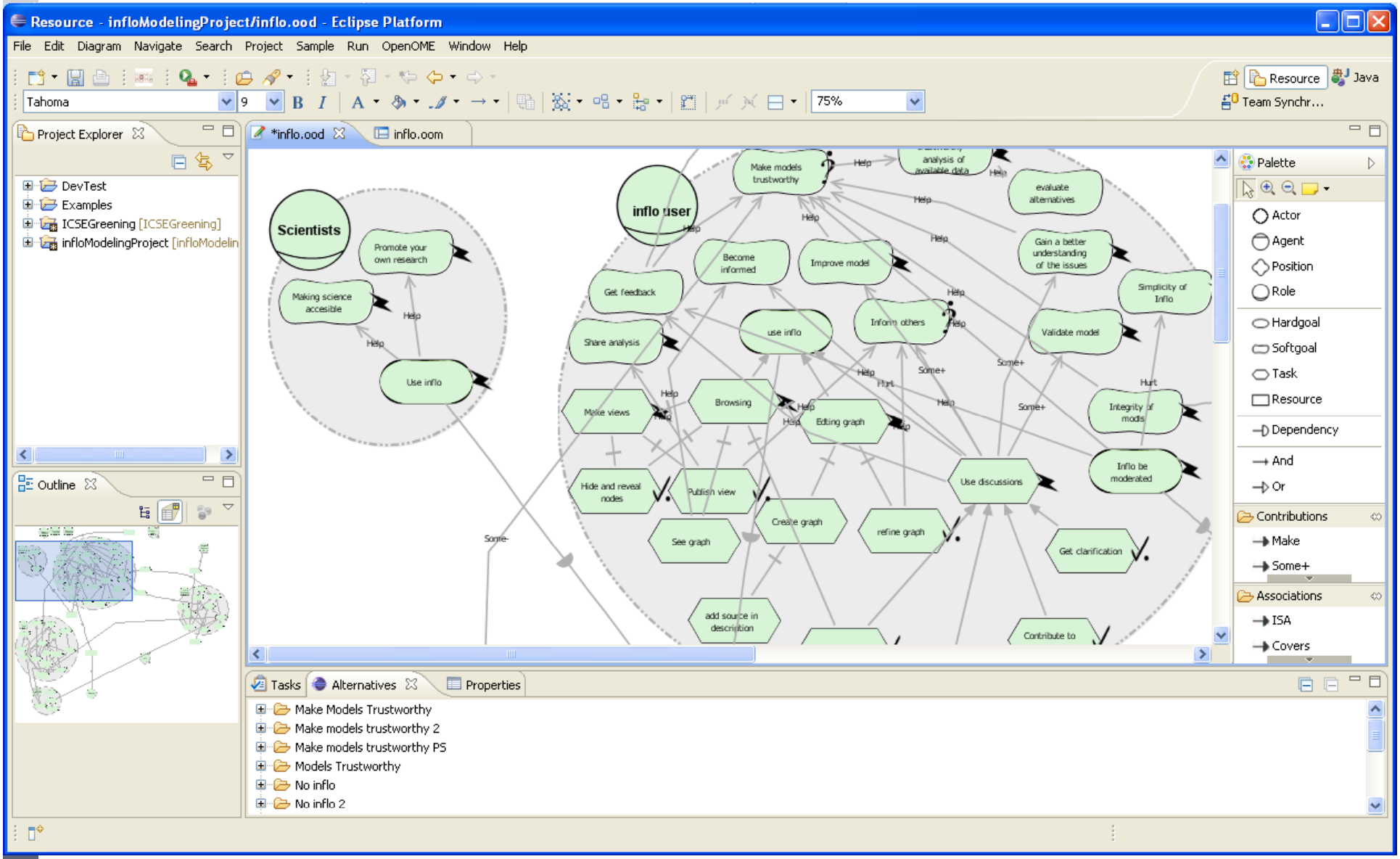
Multiple Evaluations & Human Judgment Management & Model Iteration

- Allow users to manage and compare alternatives over a model
  - Need to allow users to conceptualize, and itemize alternatives, comparing results
  - Works for both forward and backward procedures
- Allow users to manage, reuse and change their judgments over the models
  - (Optionally) reuse human judgments, build a DB of judgments per model
  - Perform checks for consistency, make suggestions?
- Support model iteration
  - When users change the model or their judgments:
    - The effects of the change on evaluation results should be displayed
    - Re-evaluation should be allowed, but only for the results affected by the change

Assumptions, Arguments & Suggested Methodology

- Allow users to record and use important domain information in the modeling analysis process
  - Capture arguments behind model constructs and evaluation judgments
  - Capture domain assumptions
  - Explore ways to use assumptions and arguments beyond the model
    - Lists, views, tables, requirement specs
- Provide a methodology to guide early modeling and analysis
  - Guidelines for participatory modeling and evaluation:
    - Where to start, how to come up with useful evaluation questions?
    - Iterating over models
  - First draft: PoEM'09, IJISMD (to appear)

Tool Support: OpenOME



Case Studies (Validation)

- Application of forward procedure
  - Trusted Computing, Knowledge Management, i* Patterns, Social Service Organization
  - PST'06, HICSS'07, REFSQ'08, CAiSE'09, PoEM'09, IJISMD
- Exploratory experiment tested benefits of forward procedure
  - Model iteration, prompted further elicitation, improved understanding
  - Careful examination of model vs. systematic procedure?
  - CAiSE'09, PoEM'09, IJISMD
- Expansion of experiment to individual case studies over more subjects using both forward and backward implementation (in progress)
  - Comparison of results using and not using the procedure
  - Initial results show issues in i* knowledge, usability issues in the analysis procedures and the affects of model and domain "buy-in"
- Case Studies with groups/organizations: apply implementation of forward and backward procedure
  - Inflo in-house case study (in progress)
  - Later industrial case study (security patterns?)

Summary: Scientific Contributions

- **Early RE Analysis**: Allowing analysis over informal, incomplete agent-goal models
- **Iterative, Interactive Algorithm:** Detailed algorithm which iterates, adapting to user input
- **Model Iteration** - Supporting iteration over the model by showing users effects of model and judgment changes
- **Minimal re-evaluation** - after model changes
- **Multiple Case Studies** - Assessing how agent-goal model evaluation can be used in practice with stakeholders through multiple case studies in a variety of settings

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- OpenOME:
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Future Work

- The suggested framework could be extended to:
  - Support varying levels of qualitative scales
  - Support varying levels of human interaction
  - Tie into "Late" RE analysis using detailed information
    - Mixture of qualitative and quantitative values (use numbers where you have them)

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