Requirement Elicitation: Toward the Unknown Unknowns

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Key Contributions of the Paper

- Requirement elicitation from perspective of **Common Ground** and **requirement specification framework**
- Propose a **roadmap** to tackle elicitation problems involving **tacit knowledge**
- Remarks the possibility of tackling "**Unknown unknown requirements**"
- **Research prospects** for techniques, models and tools in **green field domain** and **brown field domains**

What is Requirement Elicitation?

- Elicitation technique covers identification of stakeholders, fact gathering, collecting requirements in different forms, prioritizing and finally recording them.

- Issues with RE:
  - Missing or mistaken requirements delay projects time
  - Increased cost over-runs

Approach for discussion

- Elicitation Review Framework : elaboration of unknown definitions
- Analyzing of different elicitation techniques and tools using ERF
- Road map for future requirement elicitation research using ERF in context of green field and brown field RE

Elicitation Review Framework [1/4]

- Used to elucidate properties of elicitation techniques rather than to score them for effectiveness or appropriateness
- objective is to investigate how different aspects of requirements elicitation contribute to requirement understanding.
- Uses the "**Clark's theory of Common Ground**", to evaluate elicitation techniques and representations in terms of human conversations.

Elicitation Review Framework [2/4]

The requirements can be divided in the following format:

- **Known knowns**: it is known to the stakeholder and analyst
- **Known unknowns**: analyst is aware of type of knowledge but the customer might have forgotten to inform it
- **Unknown knowns**: knowledge held by stakeholder but is not articulated due to issues
- **Unknown unknowns**:
  - most severe threat
  - when domain knowledge is incomplete i.e. both party unaware of missing or relevant knowledge

Elicitation Review Framework [3/4]

Tacit knowledge framework is divided using properties :

Properties	Known knowns	Known unknowns	Unknown knowns	Unknown unknowns
Expressible	YES	NO	YES	NO
Articulated	YES	NO	NO	NO
Relevant	YES	POTENTIALLY	YES	POTENTIALLY

Elicitation Review Framework [4/4]

Tacit knowledge poses the following threats:

- **Identifying tacit knowledge :** even when the analyst suspects they exist.
- **Knowing what is relevant** and what should be articulated, necessary details issue
- **Articulating the knowledge** where it is needed, i.e. in correct context

Solution: recognize there may be missing info and prepare to invest resources in finding out if there is any

Requirement Elicitation Technique[1/3]

Basic elicitation techniques are:

- Interviews
- Observations
- Workshops
- Protocols
- Scenarios
- Prototypes etc

But a combination of these techniques is used to find out the unknown requirement

Requirement Elicitation Technique[2/3]

A. UNKNOWN DISCOVERY:

The ability to detect unknown depends on analyst's plan and sampling strategy

Technique	Unknown unknown methods
Interview	Flexible, follow-up questions etc
Observations	Using ethnography provide memory prompts
Workshops	Number and composition
Protocol	Least effective as more resource intensive
Scenario	Sample size , diversity , economic to collect
Prototype	Least effective , articulation limited

Requirement Elicitation Technique[3/3]

B. ESTABLISHING COMMON GROUND THROUGH ERF

Common ground explains how a meaning is constructed by conversation and action between the stakeholder and analyst.

Technique	Reflection	Scope/Arena
Interviews	Only via notes/recording	Good but depends on participant and time
Workshops	Only via notes	Depends on sample and time of participant
Scenario	Good	Depends on sample data
Prototype	Good but depends on extent	Limited to ecological evaluation

- Interview + workshops are more effective for tacit knowledge.
- Scenarios provide grounding examples

Models[1/3]

- Passive representations designed for inspection-based analysis or formal models which are integrated with model checking and reasoning tools
- Depicts how they address different types of requirement knowledge
- Different types of models are as follows:
  - Use Cases
  - Volere template
  - KAOS
  - GORE
  - i*
  - ISRE

Models(2/3)

Model	Specification	Domain Knowledge
Use Cases	Baseline for representation, Implicit goals	Limited
GORE	Goals in hierarchy form, gives details of the agents, objects ,processes etc	Detailed
KAOS	Refines requirement spec. Formal language is used	Represented in form of obstacles and assumptions
I*	Rich in representation, inter agent relationships are modelled as dependencies	Implicit
ISRE	Focuses on organizing and generating scenarios	Description of spatial env , ecological context of system Bayesian reasoning

Models(3/3)

- In spite of plethora of models , informal methods and volere template are more preferred, use cases are not suited for complicated / complex knowledge
- The power of representations and models for discovering unknown depends on scope of their semantics and how the problem space is covered
- But larger arena and setting in the CG are more comprehensive and thus much more difficult to understand
- In CG perspective the role of models depends on how well the integration is done into the analyst-stakeholder relation

Tools Support[1/4]

Divided into 3 parts:

- Natural Language tools: process requirement text and documents
- Model- checking tools: Checkers and reasoners
- Social Collaboration Support Tools: general support tools

Tools Support[2/4]

NATURAL LANGUAGE TOOLS

- Ontologies:
  - They are used to support inspection based elicitation and refinement which have been developed to support web services.
  - They have simple model checking for consistency, detection of conflicts etc.
  - It is useful for helping in the analyst's understanding of the domain.
- Text-mining tools:
  - They help in categorizing of the requirement sets, and prioritization by grouping them according to the ownership and the similarity basis.
  - More suited for brown field RE
- Have potential for development to address the known unknowns

Tools Support[3/4]

MODEL CHECKING TOOLS

- Model checker have been developed to determine the match between requirements for monitoring and environmental events and suggests how adaptations can be matched to information and its source in the environment
- Rely on semi-formal interface i.e. conversion to more friendly language
- Address to known unknowns
- To capture the unknown unknowns , support tools can be used like i-require

Tools Support[4/4]

SOCIAL COLLABORATION SUPPORT TOOLS

- Harness human collective effort rather than relying on models/existing documents
- Stimulates awareness of knowns from both the RE and user perspective by information sharing
- Extend CG to multi party conversations by social networks
- Capture and integrate the opinions of many over time
- Once the requirements have been gathered, they are prioritized and agreement is made

STATE OF ART AND RESEARCH ROAD MAP[1/3]

- Prospects of improvement
- Clark's Common Ground Theory emphasis on the process of building mutual understanding in the elicitation problems. It can be applied to understand the dependency between software machines and their environment.
- Focusing on people-oriented issues may help to elicit the knowledge category of unknown knowns when people suppress details due to political issues or due to any other clashes

STATE OF ART AND RESEARCH ROAD MAP[2/3]

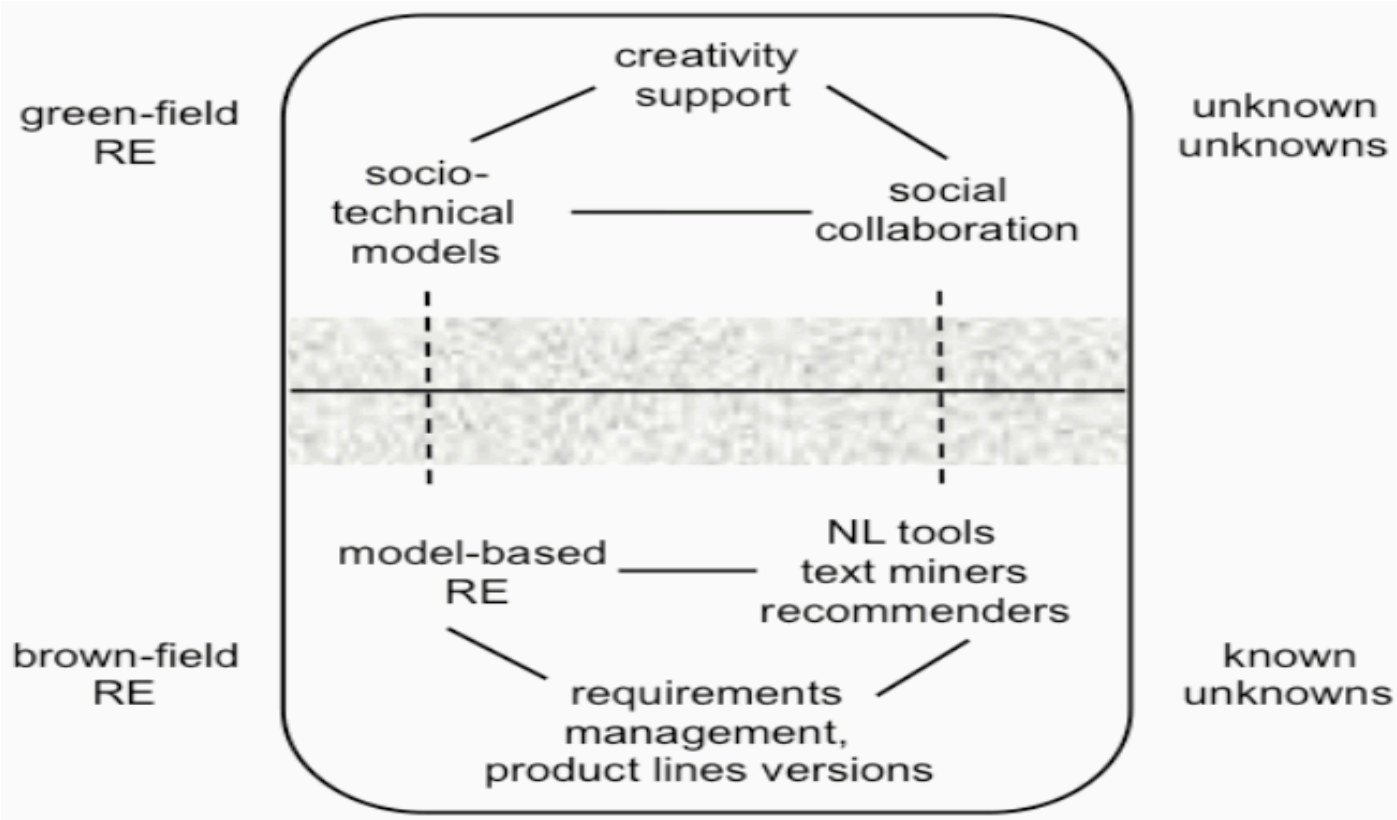

Fig. 1 Road map for future requirements elicitation in the perspective of brown- and green-field domains. The shaded boundary acknowledges that systems are rarely 100% 'green or brown field.

STATE OF ART AND RESEARCH ROAD MAP[3/3]

There are 4 research directions to push the boundaries of the unknowns:

1. **Unknown knowns**: Analyst discovers what the stakeholder knows but is not articulating, emotional intelligence guidance needs to be provided so that tacit knowledge is gathered
2. **Known unknowns**: Analyst has awareness of basic knowledge. Examples and analogies need to be extended so obstacles can be recognized.
3. **Design discovery:** Challenge is to solve " I'll know what I want when I see it" . Prototypes, storyboards and mockups have helped in overcoming this issue
4. **Unknown unknowns**: 2 approaches; Creative RE needs to inculcate the social media so that a collaborative data is formed. Use of analogies and examples can challenge the boundaries to develop new ideas

Conclusions

- The elicitation of unknown unknowns can be considered through sophisticated tools, natural language approaches and social media inculcation

- While there is no ultimate solution to the unknown unknown problem beyond harness of human imagination, the quest for the issue is driven by life critical requirements

Strengths of the Paper

- Various different requirement techniques and tools have been mentioned
- Roadmap as to how to proceed with the data is mentioned

Weaknesses of the Paper

- Main implementation towards the unknown unknowns is missing
- No specific examples are mentioned for better understanding
- No discussion of drawbacks, limitations is imposed for the unknown techniques

Open Questions and Future Research

- Is there a better approach to address the unknown unknowns?

- How to proceed once the unknown data has been captured towards the end of the system building?