Requirements Engineering as Science in the Small

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RE from a Sociotechnical Systems Perspective

Requirements
Value Preferences

Stakeholders

Norms
Assumptions
Mechanisms
Metrics

Principal

... Principal

Social Tier
Technical Tier

Agent

Data and Devices

represent
interact
regulate
realized in
specify
identify

Agent

communicate
represent

Data and Devices
Natural Science

The scientist controls the model but the universe, as instrumented and observed, is fixed.

The assumptions scope out the observations and the model.
Software Development
The developer controls the solution artifact but not the requirements

The assumptions carry contractual force between developers and stakeholders
Refine Requirements into Specifications and Assumptions
Requirements can be informal and lack clear criteria for evaluating specifications

- Specify
- Tacit Assumptions
- Specification
- Assumptions
- Evaluate
- Requirements

Inform
Uncover
Apply
Solutions Implement Specifications
The assumptions delineate the limitations of the solution artifact

The assumptions should be more general for a solution than for the specification
Pairing Assumptions and Specifications

Shifting the assumptions to the specification is crucial, else the contract with the stakeholders is meaningless because different solutions are incomparable.
Adopting Ideas from the Philosophy of Science

Quality Criteria
- Verifiability
- Falsifiability
- Generality
- Parsimony
- Strong inference

Process Elements
- Elicitation
- Development
- Design
RE Challenges

Entrenchment

- Harms generality
- Harms parsimony
- Incrementality wins
- Conflicting requirements
- When universes collide
- Coherence
- Paradigm shifts

Tacit assumptions

- Verify
- Remove

Harms generality
Harms parsimony
Incrementality wins
Conflicting requirements
When universes collide
Coherence
Paradigm shifts
Ideas for RE

- Verifiability (specs)
- Verifiability (reqs)
- Falsifiability
- Strong inference
- Refinement
- Reify
- View as an assumption
- Runtime monitoring
- Testing
- Evaluate validity and parsimony
- Not always clear
- Largely ignored
- Testing methodologies
- Work prioritization
- Adaptive requirements?
# RE as Science in the Small

<table>
<thead>
<tr>
<th>Focus</th>
<th>Natural Science</th>
<th>RE</th>
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<tbody>
<tr>
<td>Representation</td>
<td>Existing universe</td>
<td>Artificial universe, to be realized</td>
</tr>
<tr>
<td>Correctness</td>
<td>Theories about observations</td>
<td>Specifications as bases for contracts</td>
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<tr>
<td>Human acceptance</td>
<td>Descriptive seeks objectivity</td>
<td>Prescriptive Negotiated</td>
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<tr>
<td>Entrenchment</td>
<td>Not essential</td>
<td>Essential</td>
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<tr>
<td>Social</td>
<td>Theories build on prior theories</td>
<td>Requirements based on current practice</td>
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<td></td>
<td>Global community</td>
<td>Problem-specific community</td>
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Thanks!

- Singh: Science of Security Lablet
- Chopra: EPSRC grant EP/N027965/1 (Turtles)

http://www.csc.ncsu.edu/faculty/mpsingh/
https://research.csc.ncsu.edu/mas/