A Semiotic Approach to Quality in Requirements Engineering

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Agenda

- Background on requirements specification
- Overview of model quality framework
- Specialization of the framework for requirements specification models
- Summary

Background on requirements specification

- Specify what a system is to do, not how (which is design)
- Look at the externally observable behavior of the system
- Typically documented as a combination of graphical models and structured text including both functional and non-functional requirements
  - Security
  - Dependability
  - Usability
  - Performance
  - Maintainability
  - Portability

Properties of a requirements specification (Davis)

- Unambiguous
- Complete
- Correct
- Understandable
- Verifiable
- Internally consistent
- Externally consistent
- Achievable
- Concise
- Precise
- Design-independent
- Traceable
- Modifiable
- Electronically stored
- Annotated by relative importance
- Annotated by relative stability
- Annotated by version
- Not redundant
- At right level of detail
- Cross-referenced
- Reusable
- Traced
- Organized

Model quality framework

- For (information systems) models in general
- Differentiate quality levels of a model in a way that coincide with the semiotic levels
- Quality levels related
- Differentiate between quality goals and means to support these goals
- Set-oriented definitions of the quality levels

Model of the quality framework
Model of the quality framework

Language quality
- Domain appropriateness
- Participant language knowledge appropriateness
- Knowledge externalizeability appropriateness
- Comprehensibility appropriateness
- Technical actor interpretation appropriateness
- Conceptual basis: Meta-model
- External representation: Notation

The domain of a requirements specification
- Primary domain: e.g., requirements to a system in the banking domain
- Pre-existing context: Constraints on the model because of earlier baselined models - e.g., Business requirements: We are to provide self-service to our customers for managing changes to their own accounts
- Purpose context: Constraint due to the fact that the model is to be the basis of a technical implementation - e.g., the service must be available over internet using standard web browsers in 3 months

Physical quality
- Davis: Electronically stored
  - Externalization: \( K_{MD}(M, D) = 0 \)
  - Language quality aspects
    - Domain appropriateness
    - Participant language knowledge appropriateness
    - Knowledge externalizeability appropriateness
  - Language extensions
- Internalizeability
  - Persistence
  - Availability
  - repository functionality

Empirical quality
- Davis: Understandable
  - Empirical quality of a model is about
    - Ergonomics
    - Graph and document layout
    - Readability
  - Language quality
    - Comprehensibility appropriateness
    - Expressive economy
  - Modeling activities
    - (Automatic) graph-layout, readability index for textual models, evaluating the use of color etc.
**Syntactic quality**

- Not mentioned by Davis
  - Syntactic correctness: $ML = \emptyset$
  - Two types of errors
    - Syntactic invalidity
    - Syntactic incompleteness
- Language quality
  - Formal syntax
- Modeling activities
  - Error prevention
  - Error detection
  - Error correction

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**Semantic quality**

- Goal
  - Validity: $MD = \emptyset$
  - Completeness: $DM = \emptyset$
- Language quality
  - Formal (mathematical) semantics, analyzability
- Modeling activities
  - Model testing (consistency checking)
  - Model reuse
  - Driving questions

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**Semantic quality relative to the primary domain**

- Complete (= complete)
- Correct (= valid)
- Internal consistency (valid + complete)
- Precise
  - Use of numerical quantities (vs. completeness)
  - Granularity vs. completeness and validity

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**Semantic quality relative to pre-existing context**

- Traced (Complete)
-Externally consistent (Complete + valid)

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**Semantic quality relative to purpose context**

- Annotated by priority (completeness)
- Annotated by stability (completeness)
- Annotated by version (completeness)
- Traceable (completeness)
- Verifiable (completeness)
- Achievable (validity)
- Design-independent (validity)
- Unambiguous (completeness and validity)
- Other means
  - Modifiability, non-redundant, use of formal languages, 'proof-of-concept' prototyping, preliminary design and test modeling

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**Pragmatic quality**

- Davis: Executeability, interpretability, basis for prototyping, organized, cross-referenced
- Goal: Comprehension (I=M)
- Language quality
  - Operational semantics, executeability
- Other modeling activities: Inspection, visualization, filtering, explanation generation, simulation, animation, report generation
Social quality

Not mentioned by Davis
- Goal: Agreement
- Language properties: Possible to express inconsistencies
- Modeling activities:
  - Model integration
  - Conflict resolution

Summary

- Davis surprisingly weak on technical aspect
  - Physical, empirical, syntactical
- Davis extends our coverage of semantic quality
- Davis weak on pragmatic and social quality
- The work is connected to a general process description for modeling, specialized for the development of requirements specifications

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