Quality of models and modeling languages

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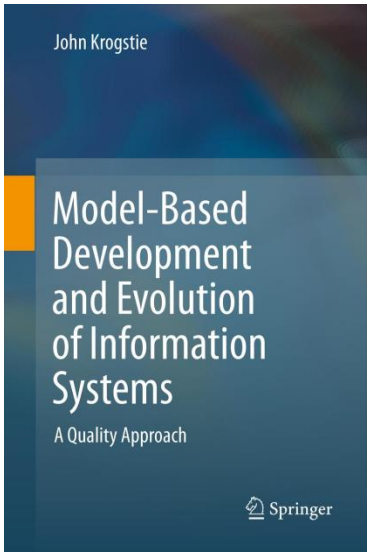
Short background on me

- Master and PhD in Information Systems (1991, 1995), modeling techniques, quality of modeling in particular
- Employed 9 years in Andersen Consulting (Accenture)
- 2000-2005 SINTEF ICT (Oslo)
- Professor at IDI, NTNU, Trondheim, Norway 1.August 2005.
- Leader of Strategic Area ICT at NTNU, coordinate cross-disciplinary ICT research at the university (health informatics, eGovernment etc)
- Leader of IFIP WG 8.1 on Design and Evaluation of Information Systems (EMMSAD, POEM, BPMDS, ME…)

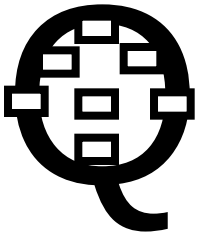
Overview of presentation

- **What is quality ?**
- **Overview presentation of semiotic model quality framework (SEQUAL)**
  - Quality of models
  - Quality of modelling languages (briefly)
- **Based on Krogstie, J: Model-based Development and Evolution of Information Systems: A Quality Approach. Springer 2012**



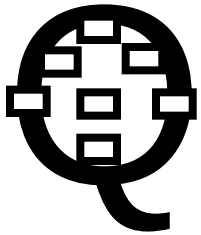
Different views on quality

- According to requirements (ISO 9000 – support stated or implied needs)
- The user is satisfied (Denning)
- Properties of the product (-ilities) (ISO/IEC 9126)
- Properties of a requirements specification or model (Davis/Pohl)
- Quality related to different semiotic levels (Lindland, Stamper, Price/Shanks, Nelson/Poels..)
- Product vs. Process quality (e.g. CMM)

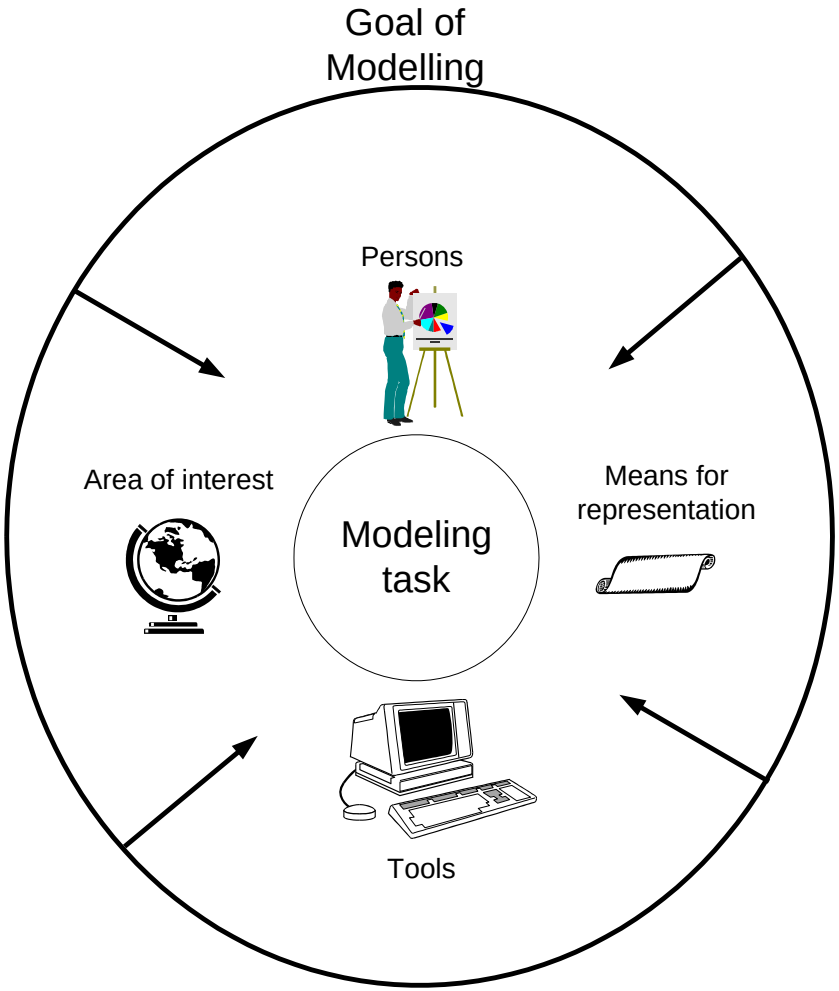


SEQUAL – A framework for understanding and assessing quality of models based on semiotics

- For models as a knowledge representation in general
- Can be extended and specialised towards specific types of model and modelling languages
- Differentiate between quality of different levels based on semiotic theory
- Differentiate between goals of modelling (quality characteristics) and means to achieve these goals
- Set-oriented definition to enable a formal discussion of the different quality levels
- Takes into account that models are socially constructed



Main elements of a modelling activity



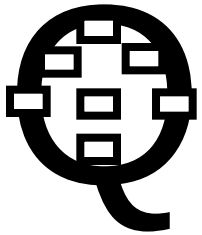
- **Example of goal:**

Create a requirements specification for a travel agency on the net

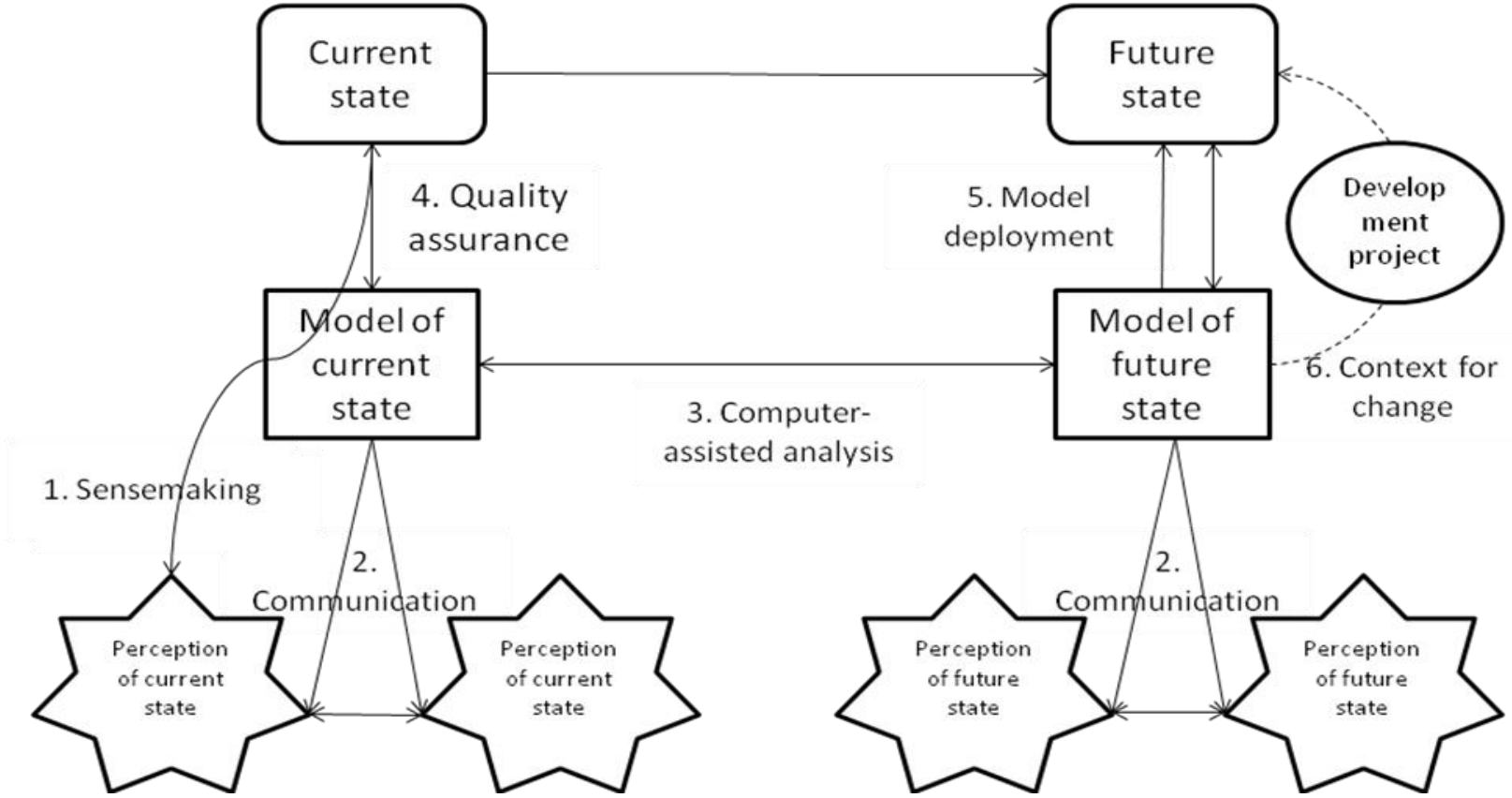
Sets in the quality framework

- A: Actors that develops or has to relate to (parts of) the model. Can be persons or tools (technical actors).
- L: What can be expressed in the modelling language
- M: What is expressed in the model
- D: What can be expressed about the domain (area of interest)
- K: The explicit knowledge of the participating persons
- I: What the persons in the audience interpret the model to express
- T: What relevant tools interpret the model to say
- G: The goals of the modelling

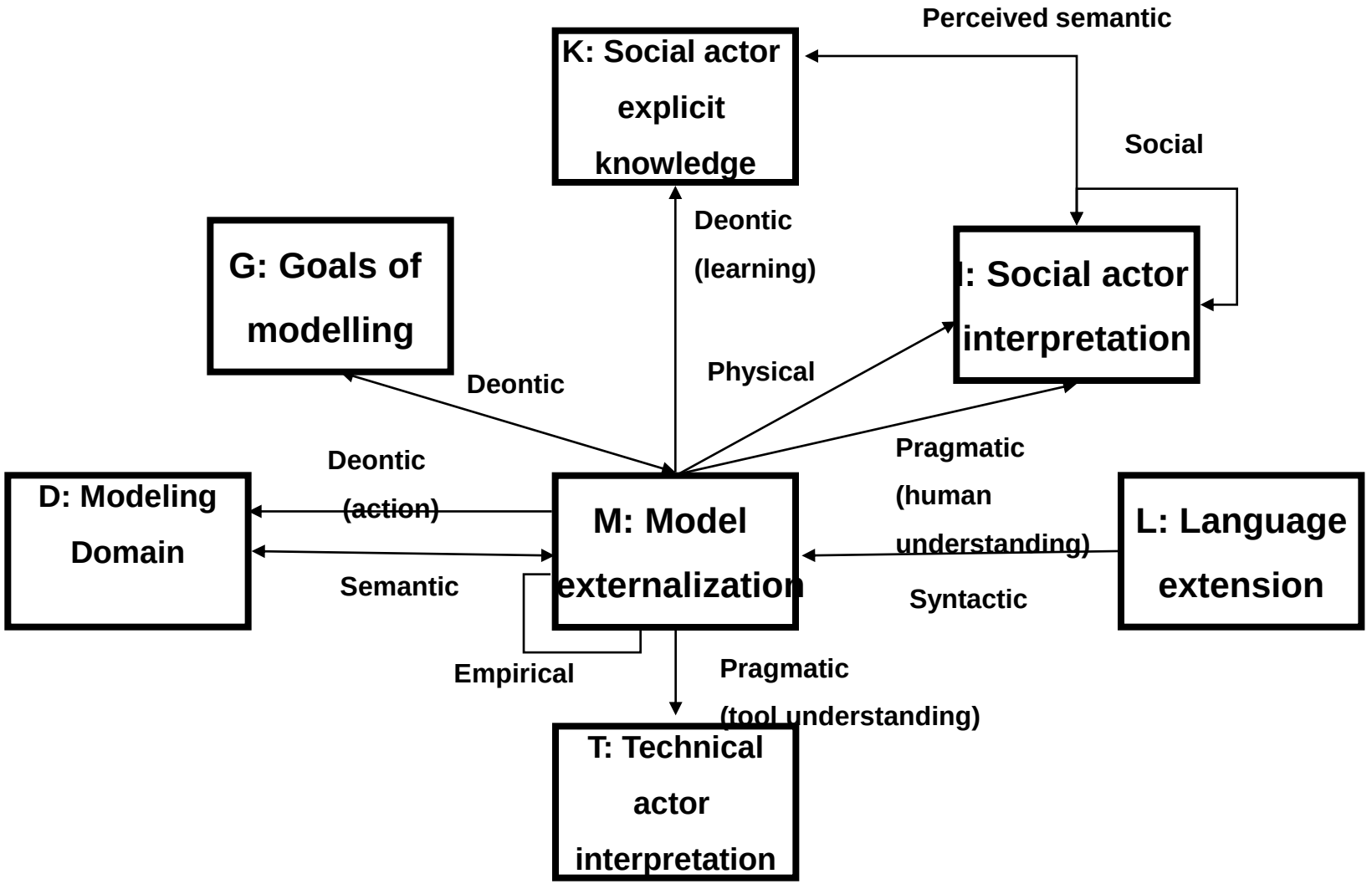
All of these sets evolves as part of modelling



Usage of modeling and models

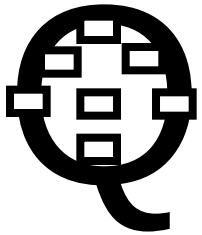


SEQUAL

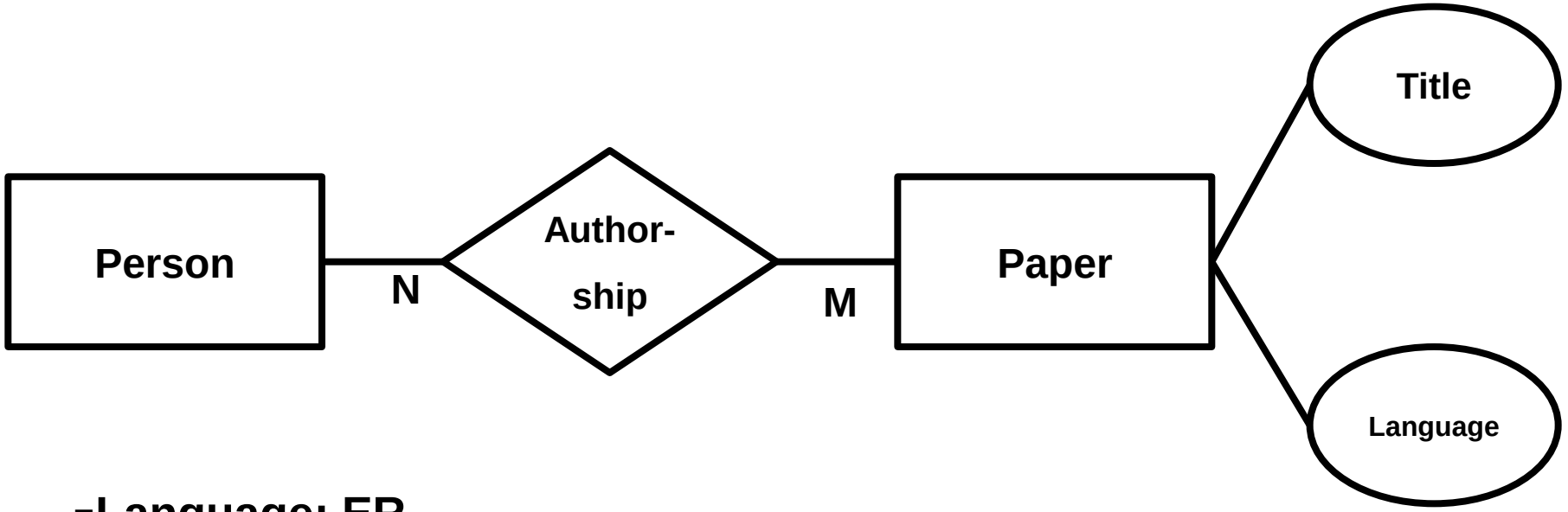

K: Social actor explicit knowledge
Perceived semantic
Social
G: Goals of modelling
Deontic (learning)
I: Social actor interpretation
Deontic
Physical
Pragmatic (human understanding)
Deontic (action)
D: Modeling Domain
M: Model externalization
L: Language extension
Semantic
Syntactic
Empirical
Pragmatic (tool understanding)
T: Technical actor interpretation

Overall structure of framework

- **Quality type (physical, empirical…)**
  - One or more quality characteristics per quality type
    - Means to achieve the quality characteristics
      - Beneficial existing quality
      - Model properties
      - Language properties
      - Modeling activities
      - Tool-support



Model example to illustrate the different quality levels

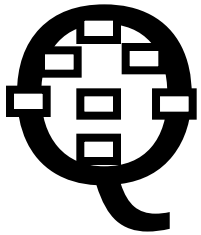


- Language: ER
- Domain: Conference organizing
- Goal: Design of database solution to support conference organizing

Physical Quality

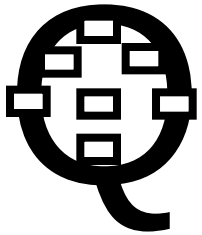
- **Internalizability**
  - Model persistence
  - Model availability
  - Currency

  -> Database functionality (model repository)

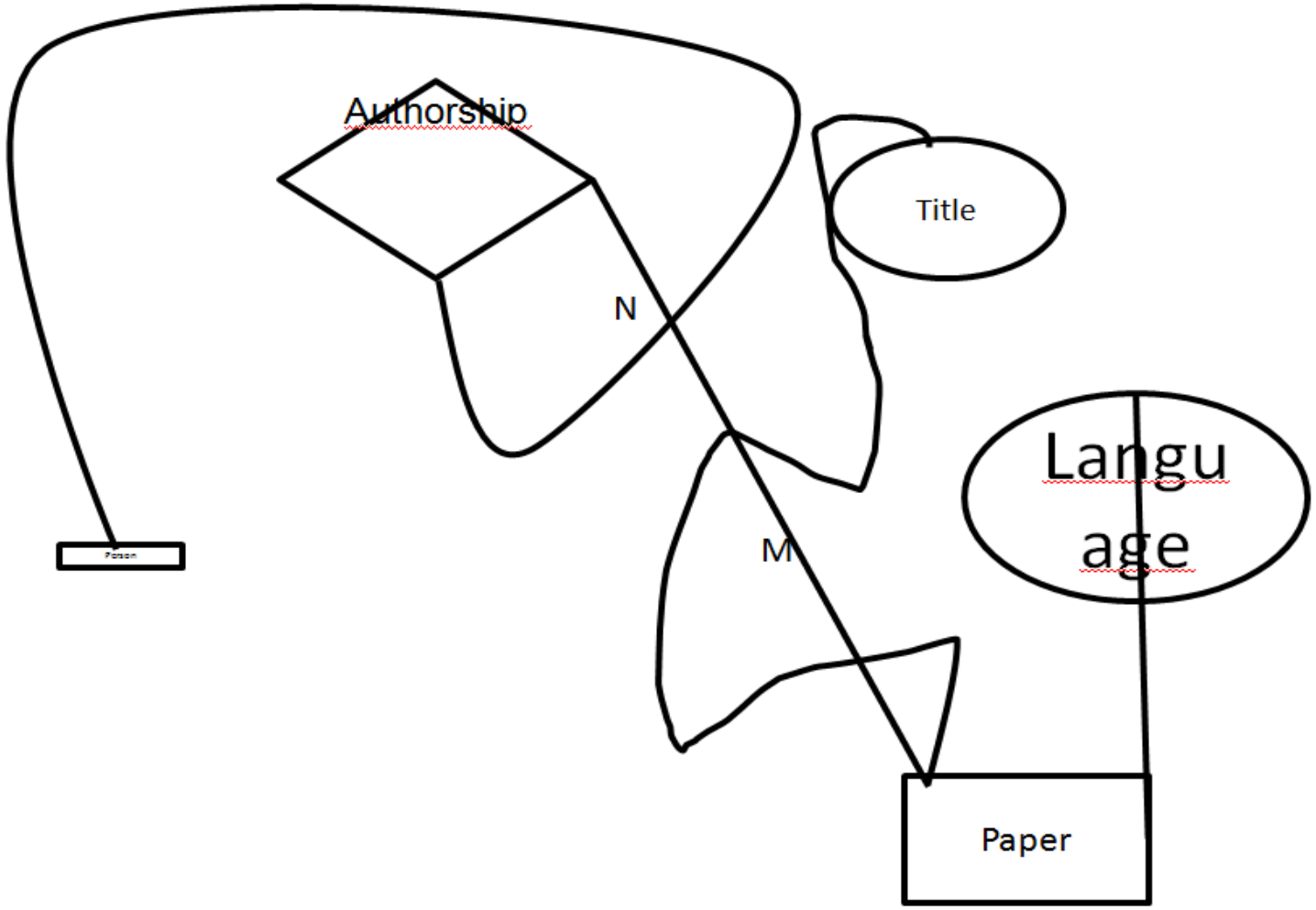


Empirical quality

- **Look on aspects related to**
  - Ergonomics
  - Graph and document layout
  - Readability
- **The model must be externalised**
- **Language properties**
  - Comprehensibility appropriateness
- **Modelling and tool activities**
  - (Automatic) graph-layout, readability index calculation, grammar checking, evaluation of use of colour.

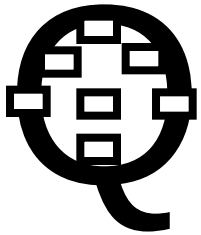


Example of poor graph-layout

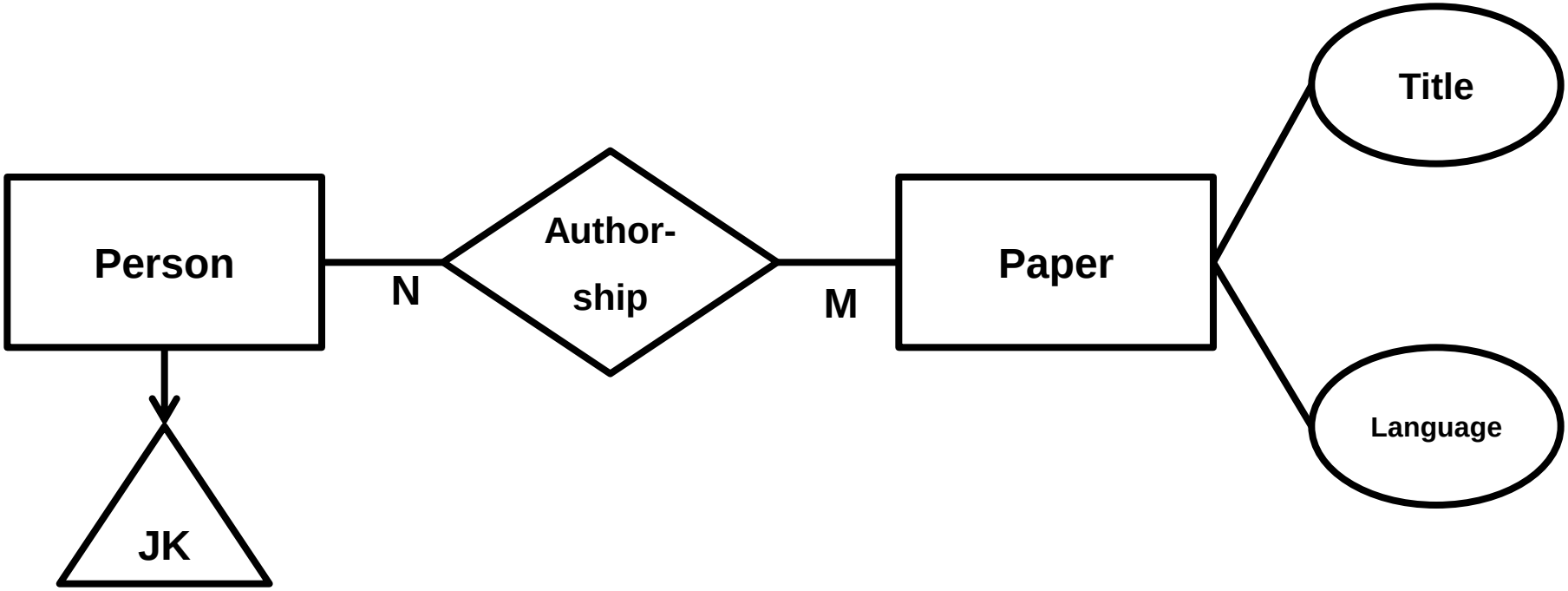


Syntactic quality

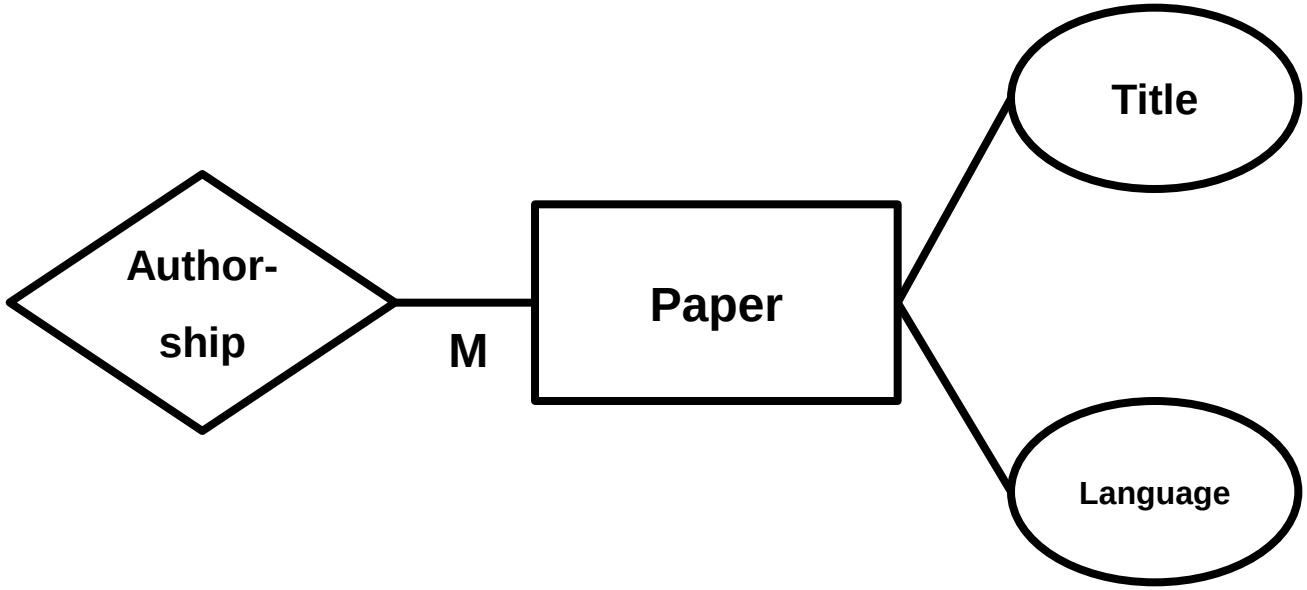
- **Syntactic correctness : M\L = Ø**
- **Two types of errors**
  - Syntactic invalidity
  - Syntactic incompleteness
- **The model must be externalised**
- **Language properties**
  - Formal syntax
- **Activities**
  - Error prevention
  - Error detection
  - Error correction (automatically or by suggestion (”spellcheck”))



Example of syntactic invalidity

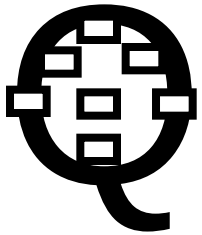


Example of syntactic incompleteness

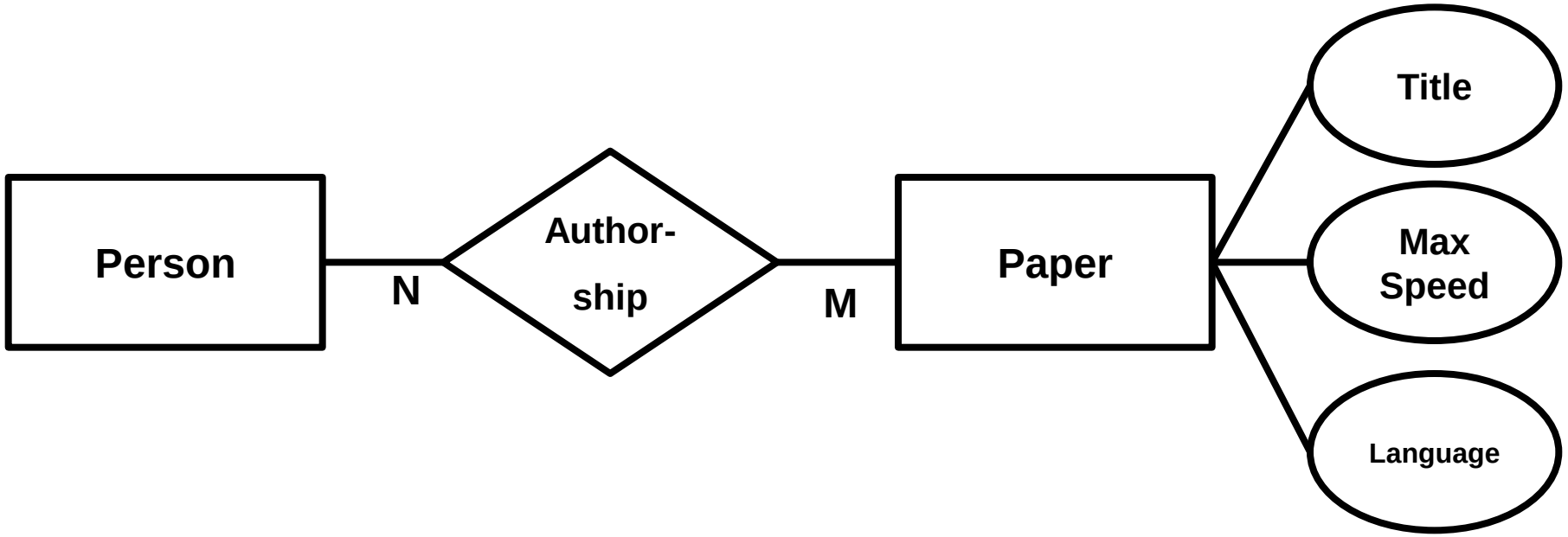


Semantic quality

- **Quality characteristics**
  - Validity: M\D =Ø
  - Completeness: D\M = Ø
- **Necessary/useful that the model is externalised and is syntactically correct**
- **Language properties: Formal semantics, domain appropriateness, modeller appropriateness**
- **Activities: Model testing (consistency checking), reuse of models, ’driving questions’, meta-model adaptation**

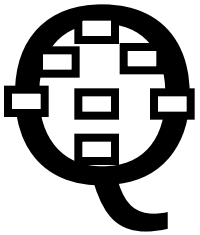


Example of semantic invalidity (and incompleteness)



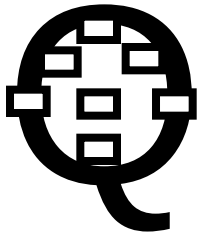
Pragmatic quality

- **Quality characteristics**
  - Comprehension, do the audience understand what the model express ? (I=M)
- **Useful that the model have high physical, empirical, and syntactic quality before evaluating pragmatic quality.**
- **Language properties:**
  - Operational semantics
  - Executability
  - Explicit modelling of intention
  - Participant appropriateness
- **Activities: Inspection, visualization, filtering/views, explanation generation, simulation, animation, reporting, execution/prototyping, model-generated solutions**



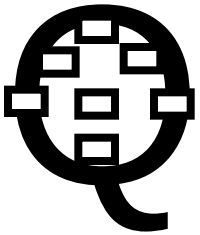
Perceived semantic quality

- **Quality characteristics**
  - Perceived validity I\K = Ø
  - Perceived completeness: K\I = Ø
- **Useful that the model has high physical, empirical, syntactic, and pragmatic quality before investigating perceived semantic quality**
- **Same means and activities as for semantic quality.**



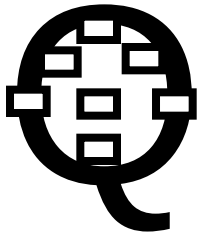
Social quality

- **Quality characteristics: Agreement**
  - Agreement in knowledge/interpretation/model
  - Relative vs. absolute agreement
- **Important first to address physical, pragmatic and perceived semantic quality**
- **Language properties: Possibility to explicitly express inconsistencies based on disagreement.**
- **Activities: Model integration and conflict resolution**

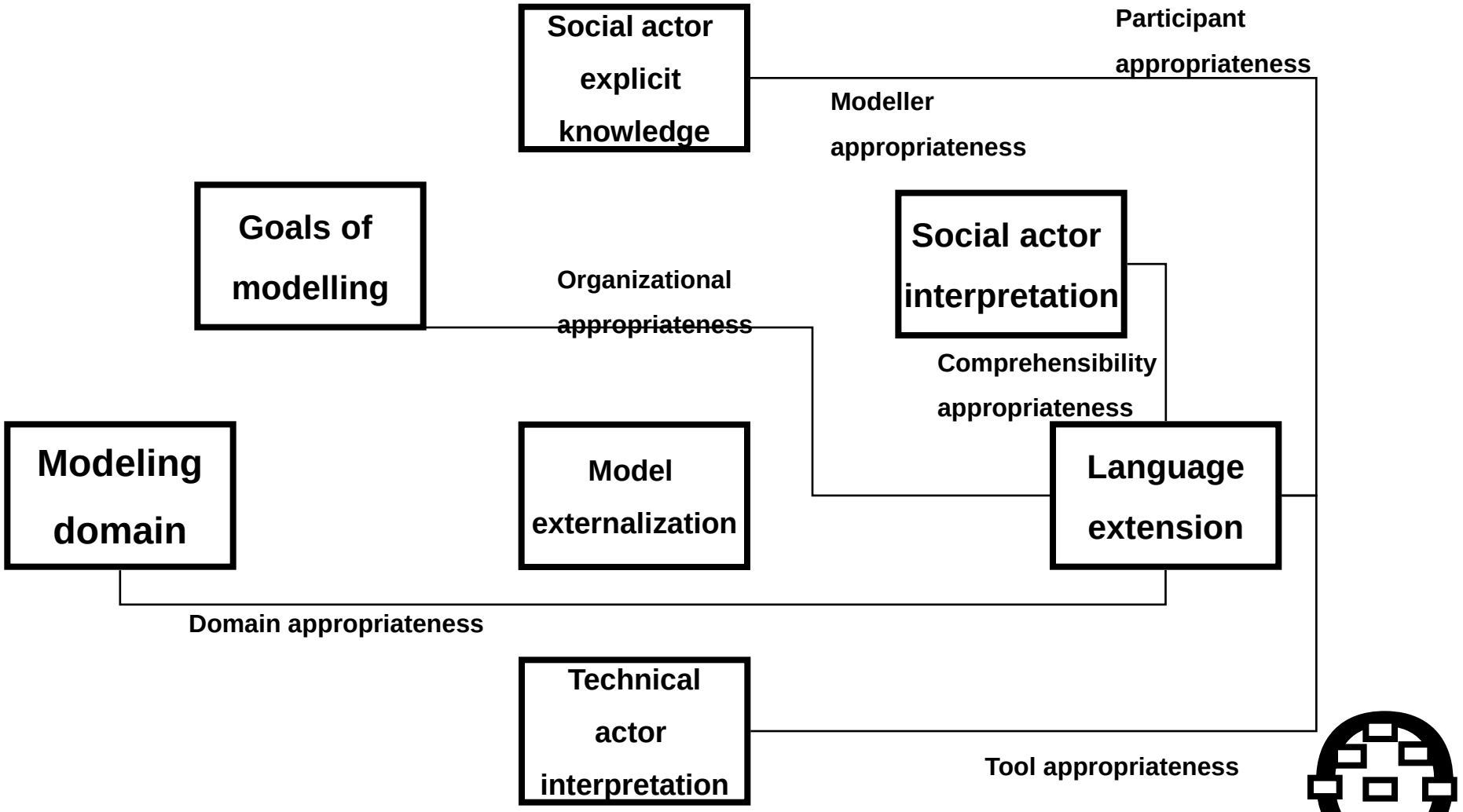


Deontic quality

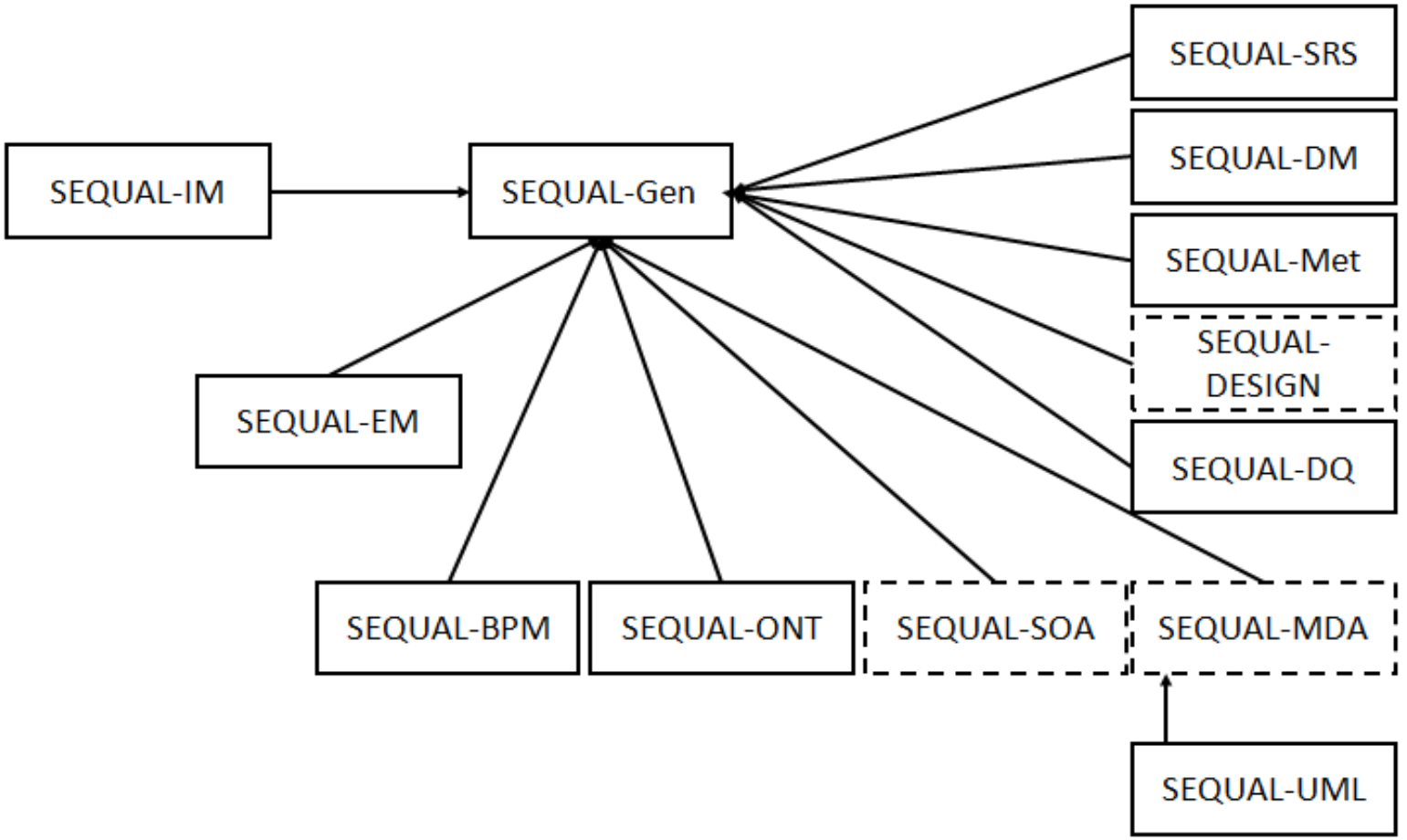
- **The deontic quality of the model relates to**
  - that all statements in the model contribute to fulfilling the goals of modelling (goal validity)
  - that all the goals of modelling are addressed through the model (goal completeness)
- **Language properties: Organizational appropriateness**
- **Deontic quality introduce a context that relax wanted quality for a model on the other levels (e.g. trade-of between completeness of the model relative to cost).**
- **Expressed with the notion of feasible quality (particularly on the levels of semantic, pragmatic, perceived semantic and social quality)**
- **Goals include also aspects relative to participant learning and domain improvement**



SEQUAL – language quality

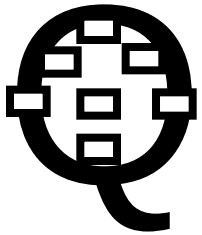


SEQUAL specializations



Usage of the SEQUAL

- **E.g. in ATHENA (EU project)**
  - Evaluation of a modeling language under development
  - Evaluation of the model of the modeling language (meta-model)
  - Evaluation of a modeling tool/environment
  - Evaluation of a modeling methodology
    - The methodology as a model
    - The way the methodology support development of models of high quality
- **Evaluation and choice of modeling languages (UML, BPMN, EEML, others)**
- **Evaluation of models**
- **Methodology guidelines for developing good models**
- **Guidelines for developing new modeling languages (Domain specific models)**
- **Variants for other types of visual representations (MAPQUAL)**



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