

On Developing an Artifact-based Approach to Regulatory Requirements Engineering

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Short bio

Current position:

- Researcher at fortiss (2020 - now).
- Industrial PhD student at Blekinge Institute of Technology (BTH) (2021 - now).

Education:

- Master of Engineering (2019)
- Master of Laws (2012)

Work experience:

- process management and requirements engineering in large international enterprise;
- pre-sales engineer for information security solutions.

Research goal
Methodology

Context

There is an increasing number of regulations applicable to software systems.

Regulations present a challenging source of requirements, necessitating the involvement of legal experts for their processing and implementation (in one way or another).

Some of the recent examples are:

- *GDPR / CCPA*
- *Data Act*
- *AI Act*
- *Digital Markets Act (DMA)*
- *Digital Services Act (DSA)*
- *Cyberresilience Act*
- *Medical Device Regulation (MDR)*

Problem

Some studies highlight a gap between existing requirements engineering (RE) methods and the expectations of legal experts as stakeholders.

This gap is evident in several aspects:

- studies frequently concentrate on a single process area of the SDLC (e.g., architecture, testing);
- research often addresses only specific compliance-related activities (e.g., compliance checking);
- unrealistic scenarios are used (such as addressing only one regulation in isolation);
- there is a lack of a unified understanding and approach to the semantic concepts derived from legal texts.

Research goal

We conducted an empirical study with the following objectives:

- identify the main challenges in regulatory RE from the perspective of legal researchers.

RQ1: What are the challenges in regulatory RE from the perspective of legal researchers?

- develop the initial version of our regulatory RE approach.

RQ2: How can the challenges in regulatory RE be effectively addressed through an integrative regulatory RE approach?

- perform an initial conceptual validation of the approach.

RQ3: How do RE and legal researchers assess the applicability of an integrative regulatory RE approach?

Methodology

Exploratory focus groups

- Two exploratory focus groups each involving two legal researchers (following guidelines by Kontio et al.).

Approach synthesis

- Literature review to identify the relevant legal theories and identify potential RE approaches.

Conceptual validation

- Model walkthrough with five participants: two RE researchers, one legal informatics researcher, two legal researchers.
- Focus on the ability of the model to capture legal knowledge and support engineering-legal interaction.

Results: Focus groups

Results of focus groups

- Challenge 1: Detachment from legal interpretation practice
- Challenge 2: Non-linear and iterative nature of legal interpretation
- Challenge 3: Ignorance of the software context
- Challenge 4: Limited application of legal concepts in regulatory RE approaches

Ch4: Limited application of legal concepts in regulatory RE

Our Approach	LegalRuleML [30, 31]	LKIF [27]	Cerno [20]	Nomos [8, 13, 21]	GaiusT [3]	NomosT[11]	Breaux's Upper Ontology [1, 7]	Massey's Classification [2]	Maxwell's Classification [10]	Legal GRL [22, 23]
Agent	Agent	Agent	Actor	Role (Holder)	Agent	Role (Holder) / Actor	Subject	Actor	Actor	Subject (Actor)
Artifact		Artifact	Information		Resource / Information / Asset			Data Object		
		Natural Object			Resource / Information / Asset			Data Object		
		Document / evidence	Information		Resource / Information / Asset					
Authority	Authority	Public Body / Legislative Body								
Auxiliary Party	Auxiliary Party	Organisation / Co-operative ...			Actor	Actor	Target	Actor	Actor	
	Auxiliary Party	Person	Actor	Role	Actor	Role	Target	Actor	Actor	
Compliance	Compliance			Satisfies Norm/situation		Satisfies Norm/situation				
Constraint / Condition	Context	Cause	Constraint		Constraint	Condition			Precondition	Precondition
Definition	Constitutive Statement						Definition	Definition	Definition	
Delegation		Assignment / Delegation / Mandate / Trade					Transaction			
Exception		Exception	Exception	Block norm	Exception	Block norm / Derogation /	Exception	Exception		Exception
Fact	Factual Statement	Fact					Fact			
Location / Jurisdiction	Jurisdiction	Place					Location			
Modality							Modality			Modality
Obligation	Obligation	Obligation	Obligation	Norm (Duty)	Obligation	Norm (Duty)	Obligation	Obligation	Obligation	Duty/Claim -- Immunity/Disability*
Exclusion		Immunity	Anti-obligation		Anti Obligation		Exclusion			Immunity/Disability
Penalty	Penalty Statement									
Permission	Permission	Permission / allowed					Permission		Permission	Privilege/NoClaim -- Power/Liability*
Prescriptive provision	Prescriptive Statement									Hohfeldian Statement
Prohibition	Prohibition	Prohibition	Anti-right	Norm (Duty)	Anti Right	Norm (Duty)	Refrainment	Refrainment		
Reason		Reason			Goal		Purpose			
Reference	Legal Source / Reference	Legal Source	Policy / Cross-Reference					Cross-Reference	Cross-Reference	Cross-Reference
Result				Activate norm / Consequent		Activate norm / Consequent				
Sanction	Reparation									
Right	Right	Right	Right	Norm (Right)	Right	Norm (Right)		Right	Right	Power/Liability
Role	Role	Role		Role	Actor	Role / Actor		Actor	Actor	
Action / Situation		Action / Process	Event	Situation / Antecedent	Action	Situation / Antecedent Role (Beneficiary) /	Act / Instrument	Action		Clause (verb) / Clause (action) Subject (Exception Actor)
Target	Bearer			Role (beneficiary)	Actor	(Beneficiary) /	Object / Target	Actor	Actor	
Time	Time / Temporal	Time	Date		Temporal Condition					
Violation	Violation	Disallowed		Break Norm/situation		Break Norm/situation				
--	Override									
--		Application / Efficacy					Quality	Prioritization		

* according to the authors

- Agent
- Artifact
- Authority
- Auxiliary party
- Compliance
- Constraint
- Definition
- Delegation
- Exception
- Fact
- Location/ Jurisdiction
- Modality
- Obligation
- Exclusion
- Penalty
- Permission
- Prescriptive provis.
- Prohibition
- Reason
- Reference
- Result
- Sanction
- Right
- Role
- Action/Situation
- Target
- Time
- Violation

Results: Approach synthesis

Model synthesis: Identification of legal concepts

- We identified the work by Radbruch as one containing a set of basic concepts for “any legal order”:
 - Legal subject
 - is more than 18 years old
 - “belongs” to jurisdiction
 - ..
 - Legal object
 - Is allowed to be traded
 - ..
 - Legal relation
 - Sanction (Illegality)

- Further search yielded more concepts.

Model synthesis: Components of an artifact-based approach

Artifact Model for Regulatory RE (AM4RRE)

C1: Role Model

Roles involved

R1: Requirements Engineer

R2: Legal Expert

R3: Domain Expert

C2: Process Model

Milestones

M1: Project Scope defined

M2: Reg. Context spec. accepted

M3: Reg. Demands Spec. accepted

M4: Requirements Spec. accepted

C3: Artifact Model

Structure and content of artifacts

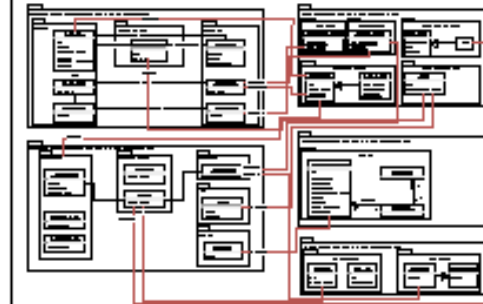
C3.1 Structure Model

Classes of content of artifact (content items)

C3.1.1
Reg. Context Spec.
C3.1.2
Reg. Demands Spec.
C3.1.3
Context Spec.
C3.1.4
Req-s Spec.
C3.1.5
System Spec.

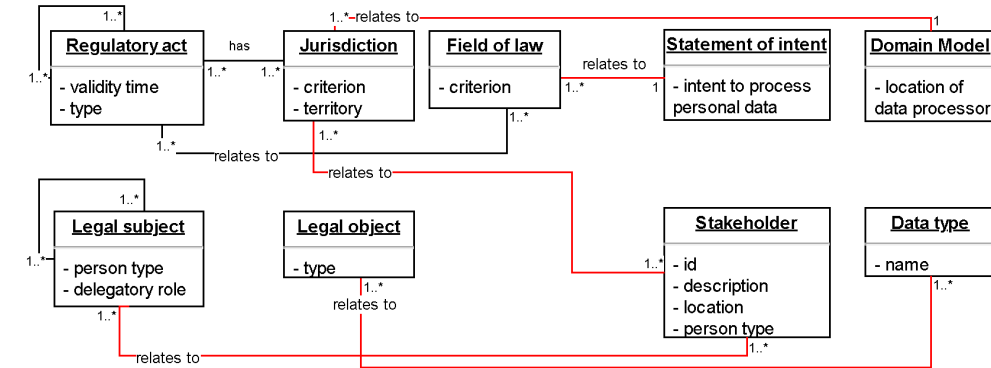
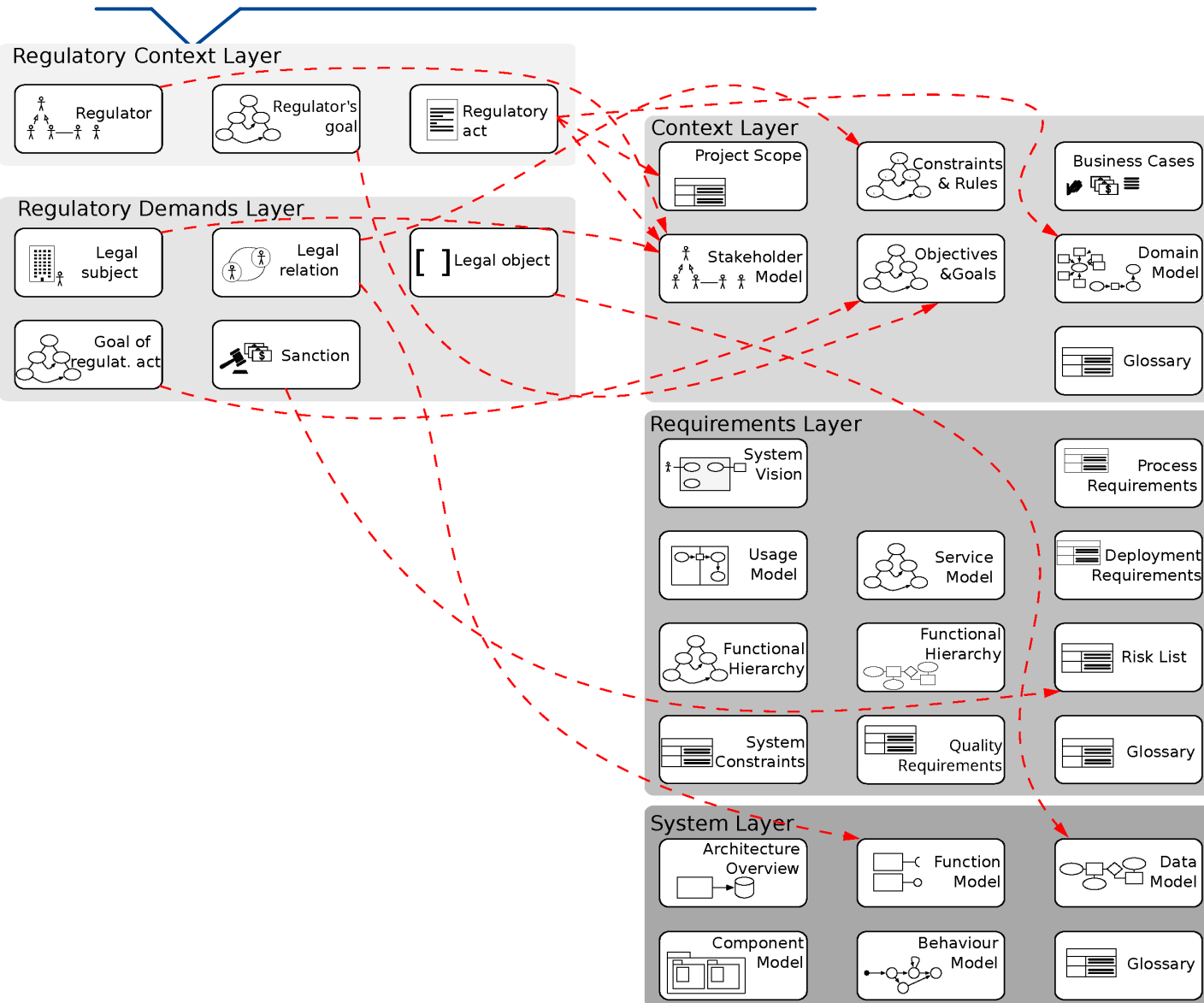
C3.2 Content Model

Content of artefacts (concepts)



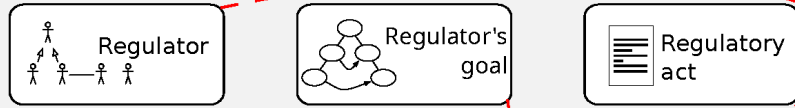
Operationalization: 1. Templates 2. Checklists 3. Tool support 4. Tailoring profiles

Model synthesis: Detailed overview

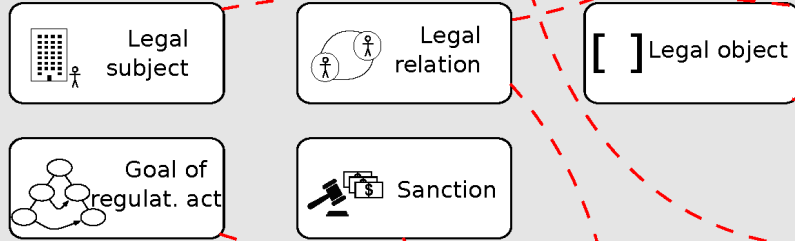


Results: Conceptual validation

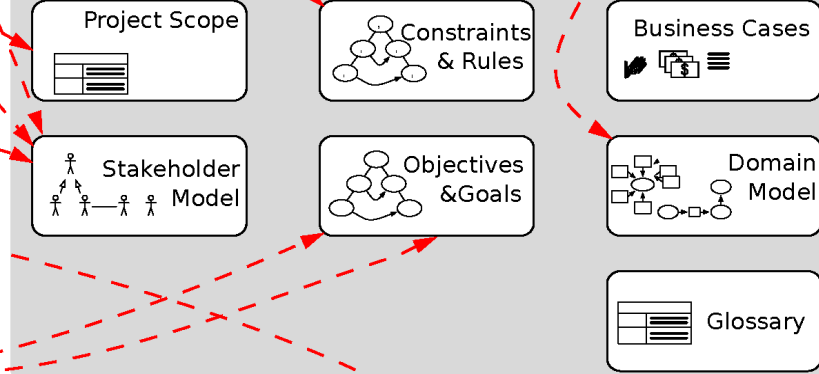
Regulatory Context Layer



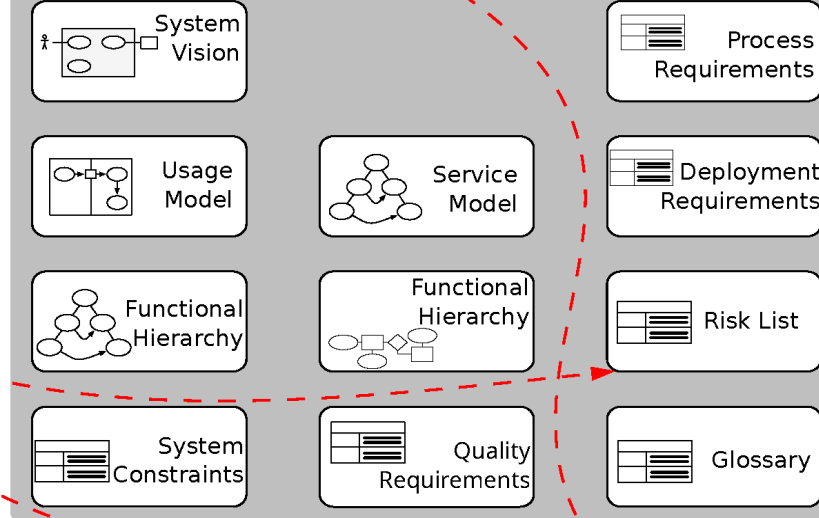
Regulatory Demands Layer



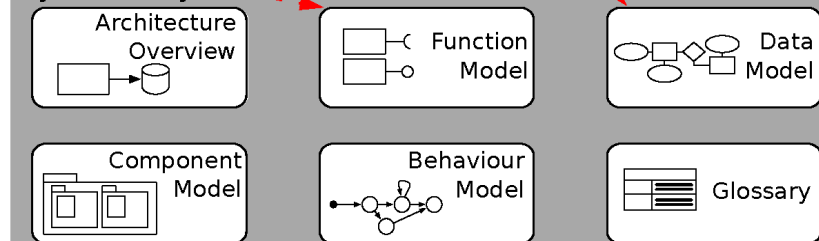
Context Layer



Requirements Layer



System Layer



Conceptual validation

Core questions:

- Are all the required legal and requirements concepts included?
- Are the legal and requirements concepts understandable?
- Is the model applicable for legal interpretation and regulatory requirements engineering?
- Does the approach explicate legal knowledge?
- Does the approach facilitate engineering-legal interaction?
- What are the main potential advantages of using the approach?
- What are the potential drawbacks of using the approach?

Conceptual validation: summary of the main benefits

- inclusion of legal experts as stakeholders (Requirements engineering researcher 1 (RER1))
- representation of both engineering and legal concerns (Legal researcher 1 (LR1), LR3)
- facilitation of engineering - legal communication (RER1, LR1, LR2, LR3);
- explication of legal knowledge to a certain degree (RER1, LR1, LR2, LR3).

"This [walkthrough] is the way I was taught to do legal interpretation at the University. Amazing that you can model it.,,

- one of the focus group participants

Conceptual validation: summary of the main drawbacks

- incapability to fully replace communication and interpretation (RER1, RER2, LR2, LR3);
- model can be complex to use (RER1, RER2, LR1);
- more flexibility can be required for different cases (LR1, LR2, LR3),
- unclear how variability will be addressed (RER2, LR2, LR3).

"This [walkthrough] is the way I was taught to do legal interpretation at the University. Amazing that you can model it.,,

- one of the focus group participants

Conclusions

- legal experts demand the application of original legal concepts to support the execution of legal interpretation;
- artefact-based requirements engineering approaches can assure seamless integration of legal concepts into requirements engineering processes;
- according to the results of conceptual validation our suggested artifact-based RE approach can facilitate the explication of legal knowledge and engineering-legal interaction.

Thank you very much!

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