

An Ontology for Infrastructure Interdependency

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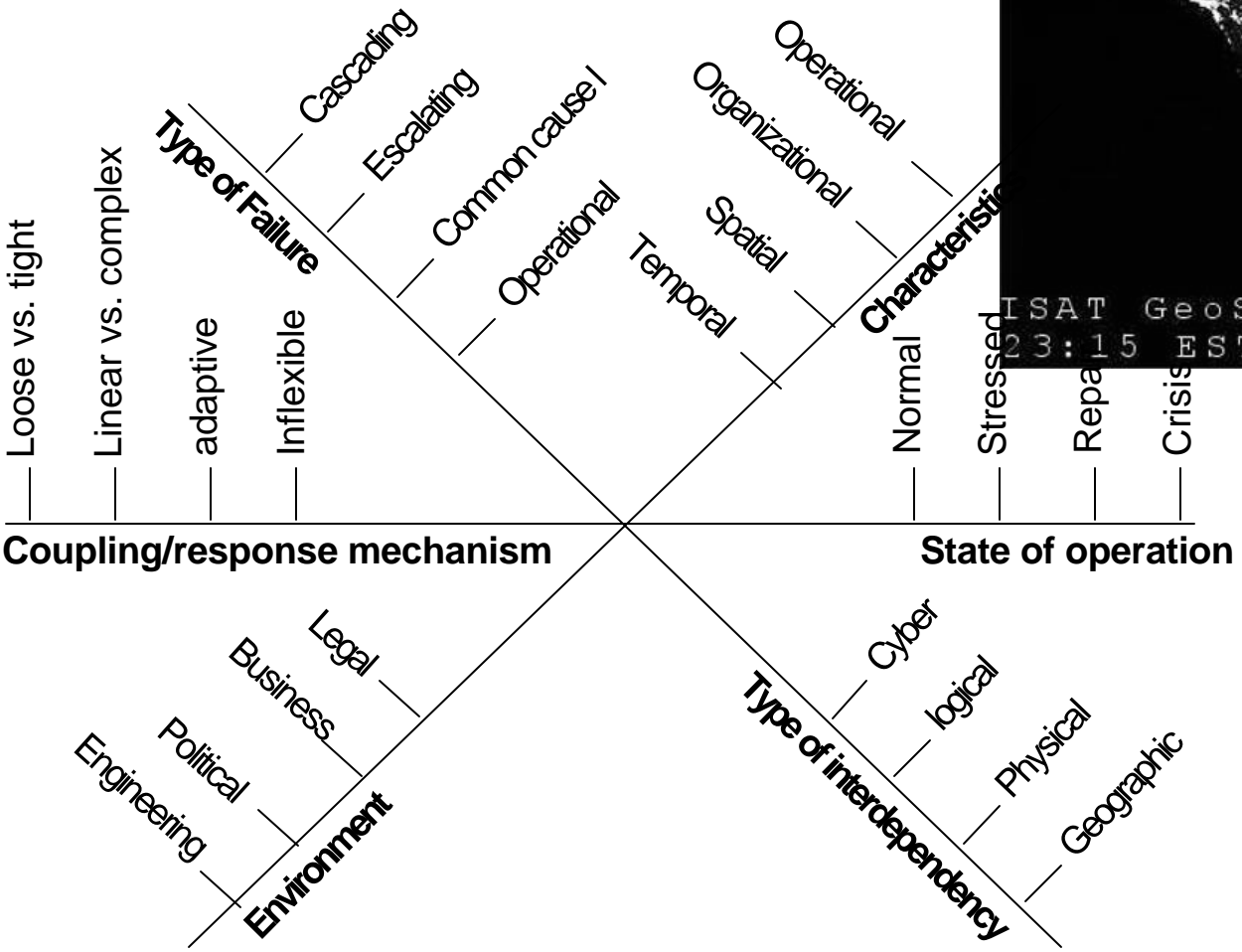
What is Ontology?

- An explicit specification of a conceptualization", while "a conceptualization is an abstract, simplified view of the world that we wish to represent for some purpose" and "explicit" refers to the fact that it is explicitly represented (Gruber 1995) .
- Formal: machine-readable

Why Ontology?

- Interoperability—Data Exchange
- Object Oriented—Web Services
- Knowledge Representation
 - Taxonomies (“is a”)
 - Relationships
 - Axioms

Interdependency



Literature Reviews

		SDSFIE	LandXML	Miltispeak	Q&P	E&K	Hal
Utilities	Water Supply	■	⊗		■		
	Waste Water	■	⊗		■		
	Gas	■	⊗		■		
	Electricity	■		■	■		
	Telecom.	■			■		
Transp.	Highways	⊗	■			■	
	Bridges	■	⊗				■
	Railroads	■					
	Airports	■					
Other	Dams	■					
	Buildings	■	⊗				
	Parcels		■				

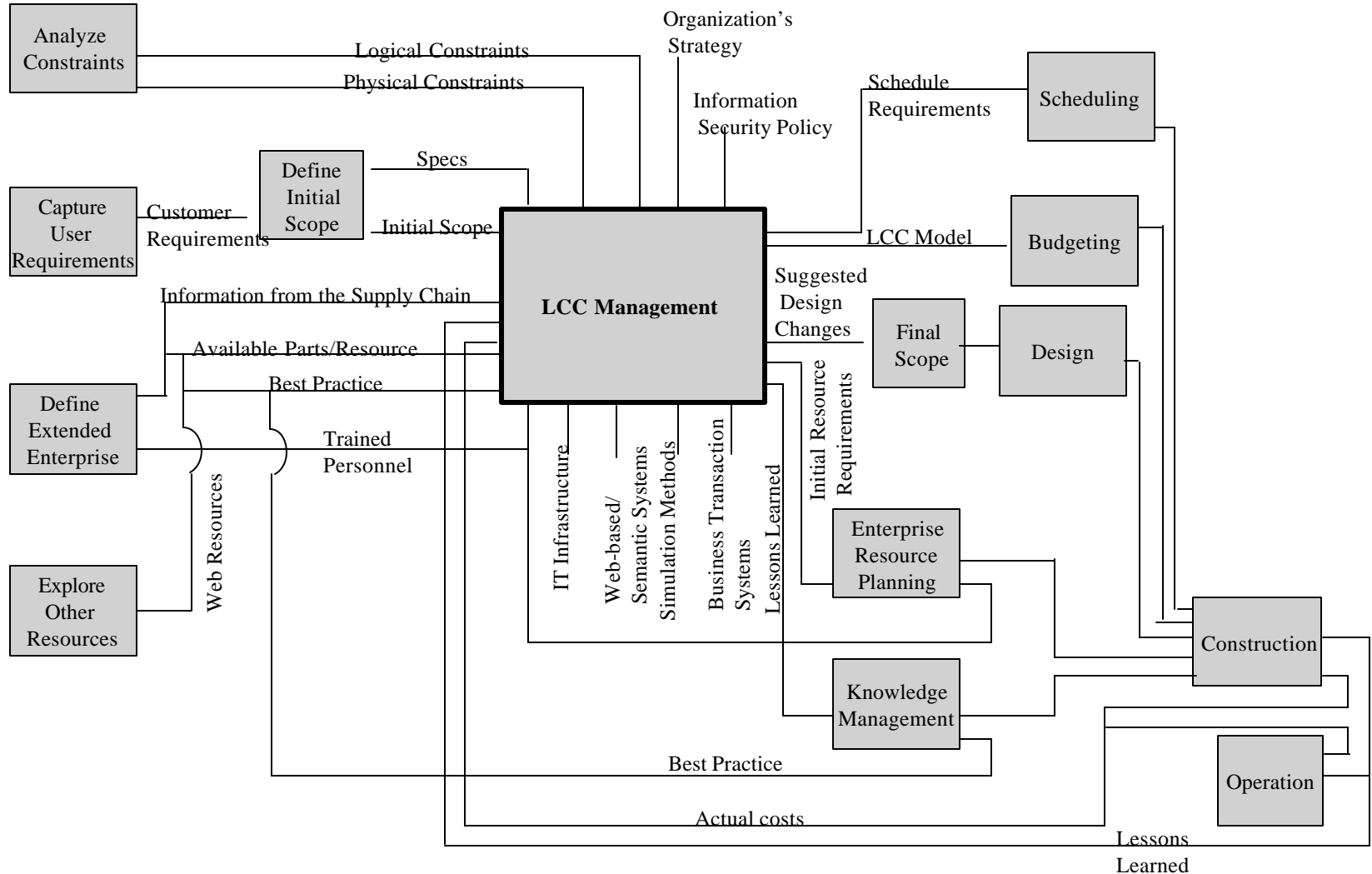


Partial representation

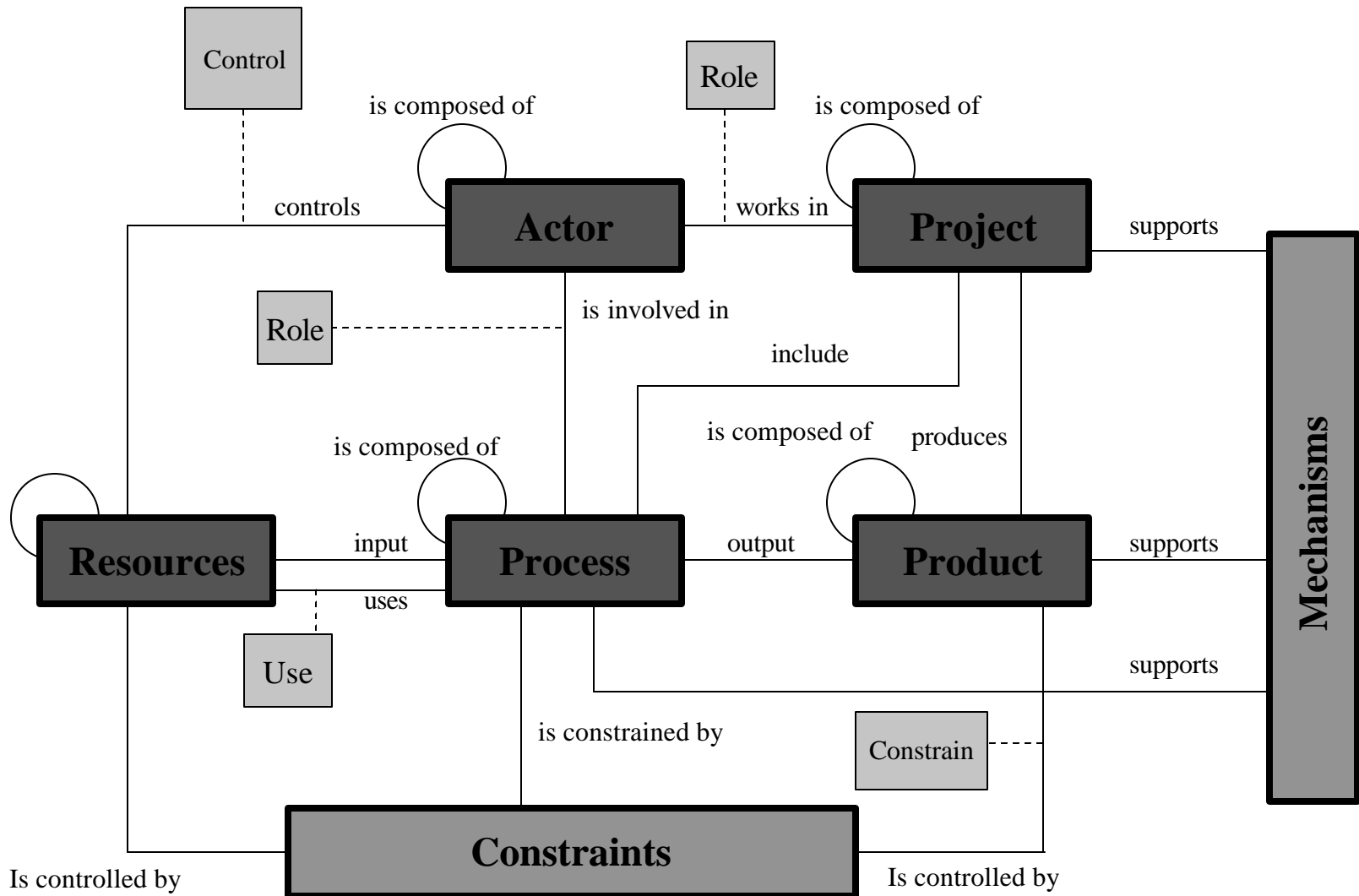


Comprehensive representation

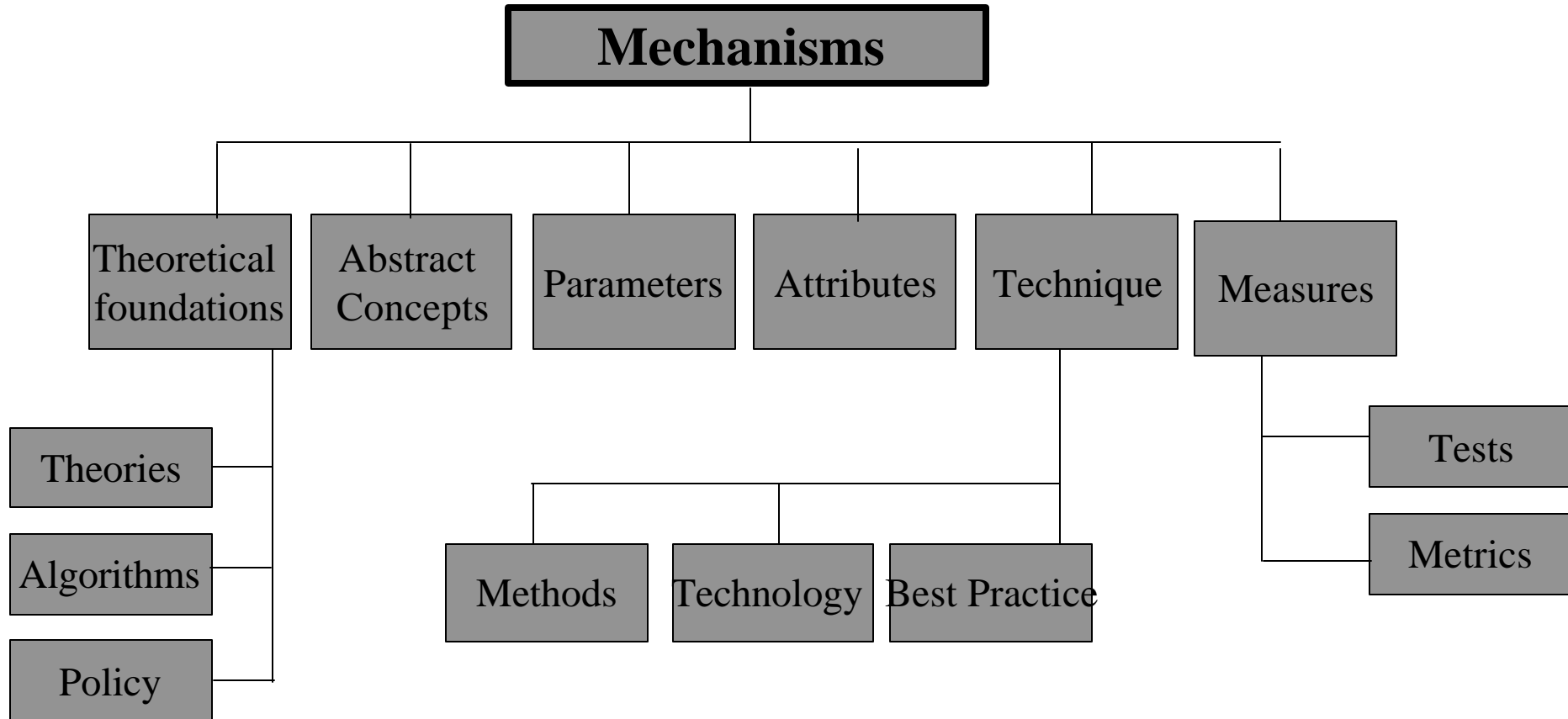
The Basic Ontology 1



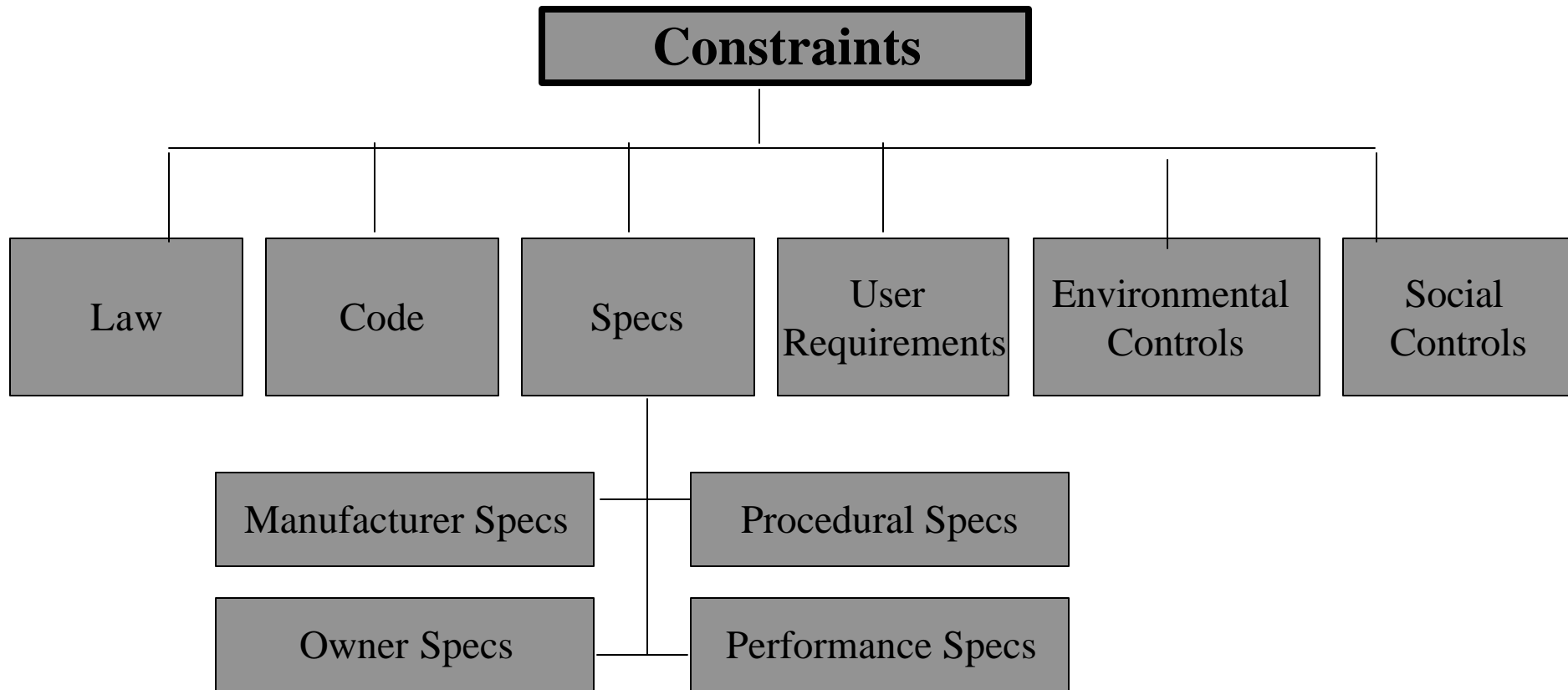
Basic Ontology 2



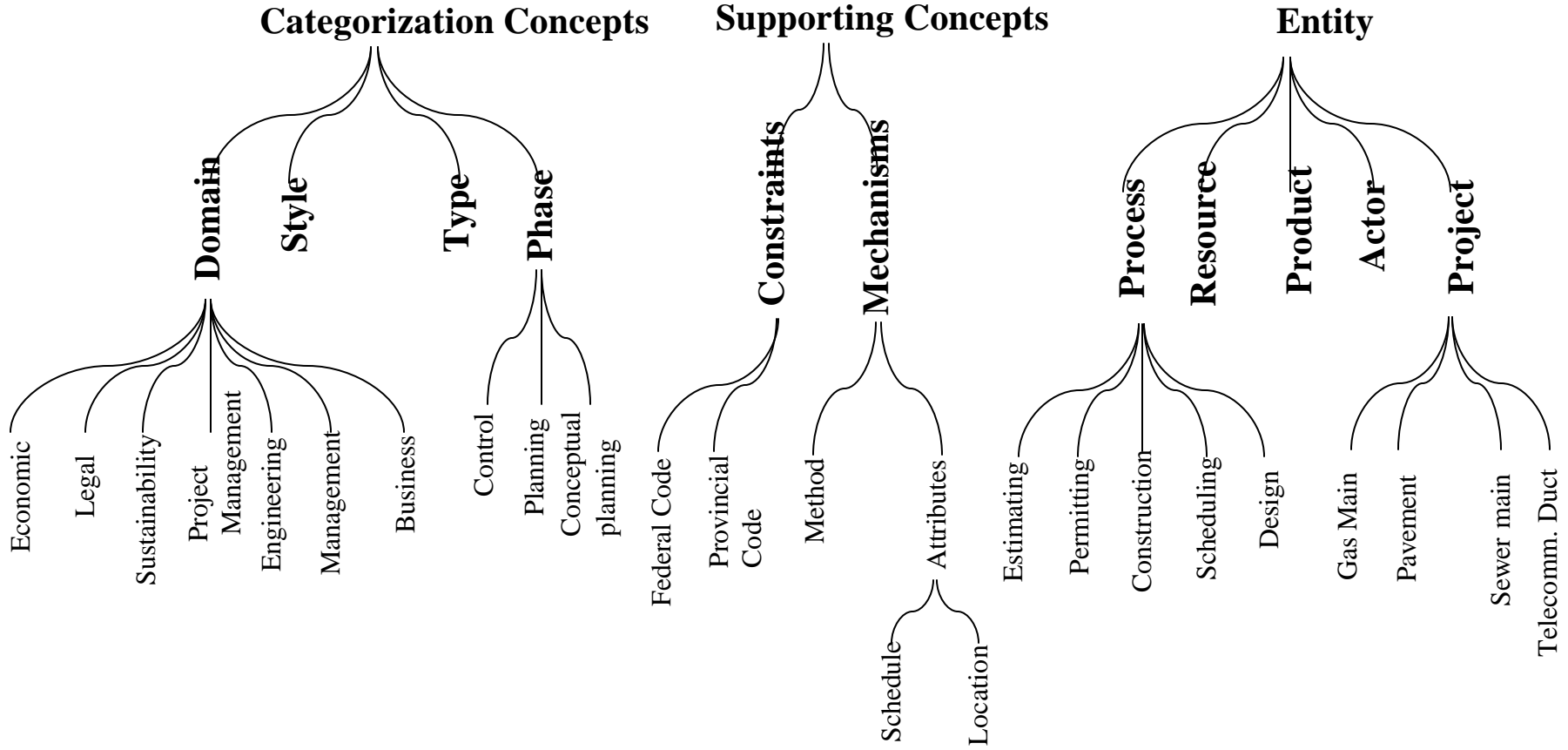
Mechanisms

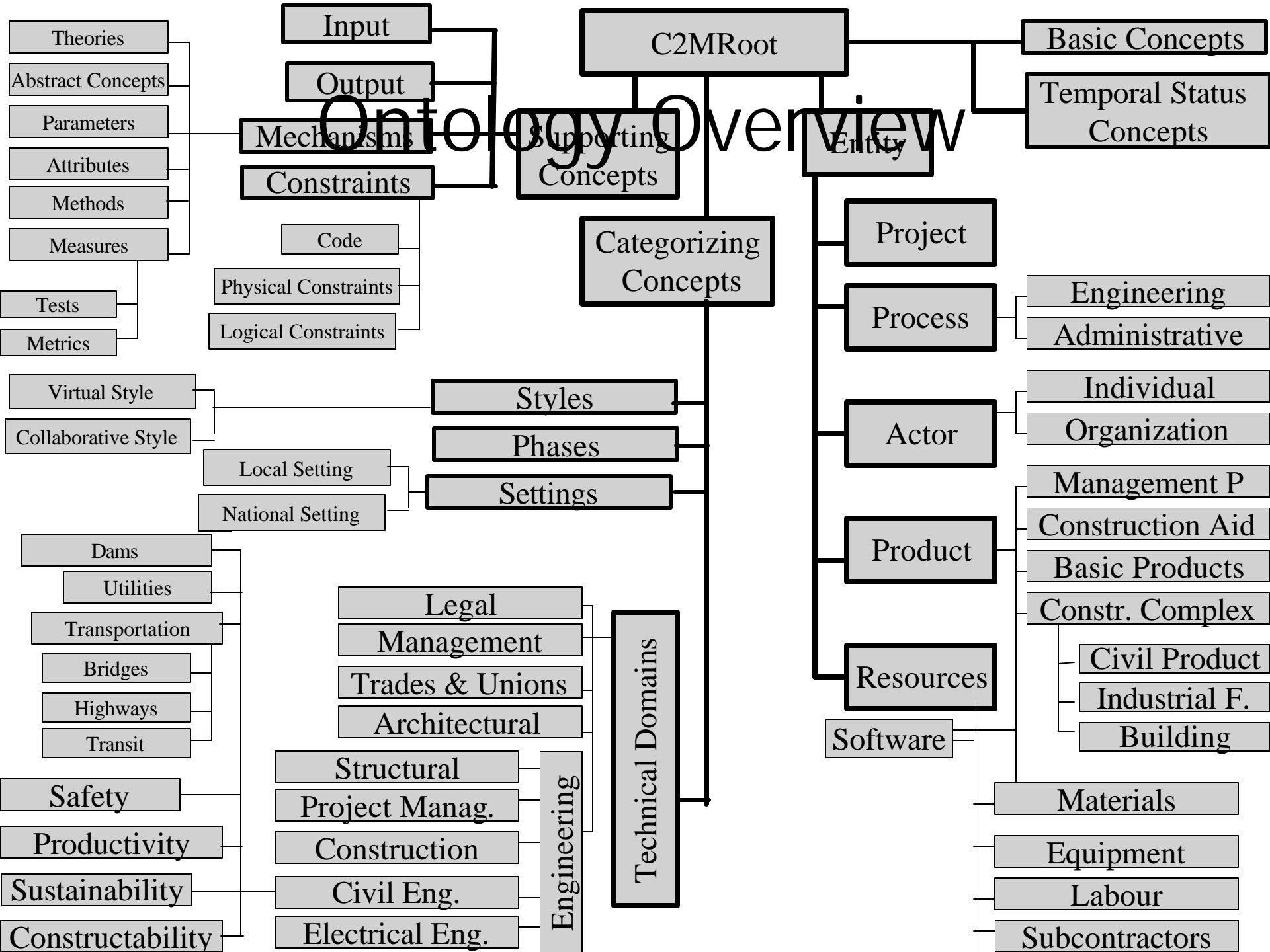


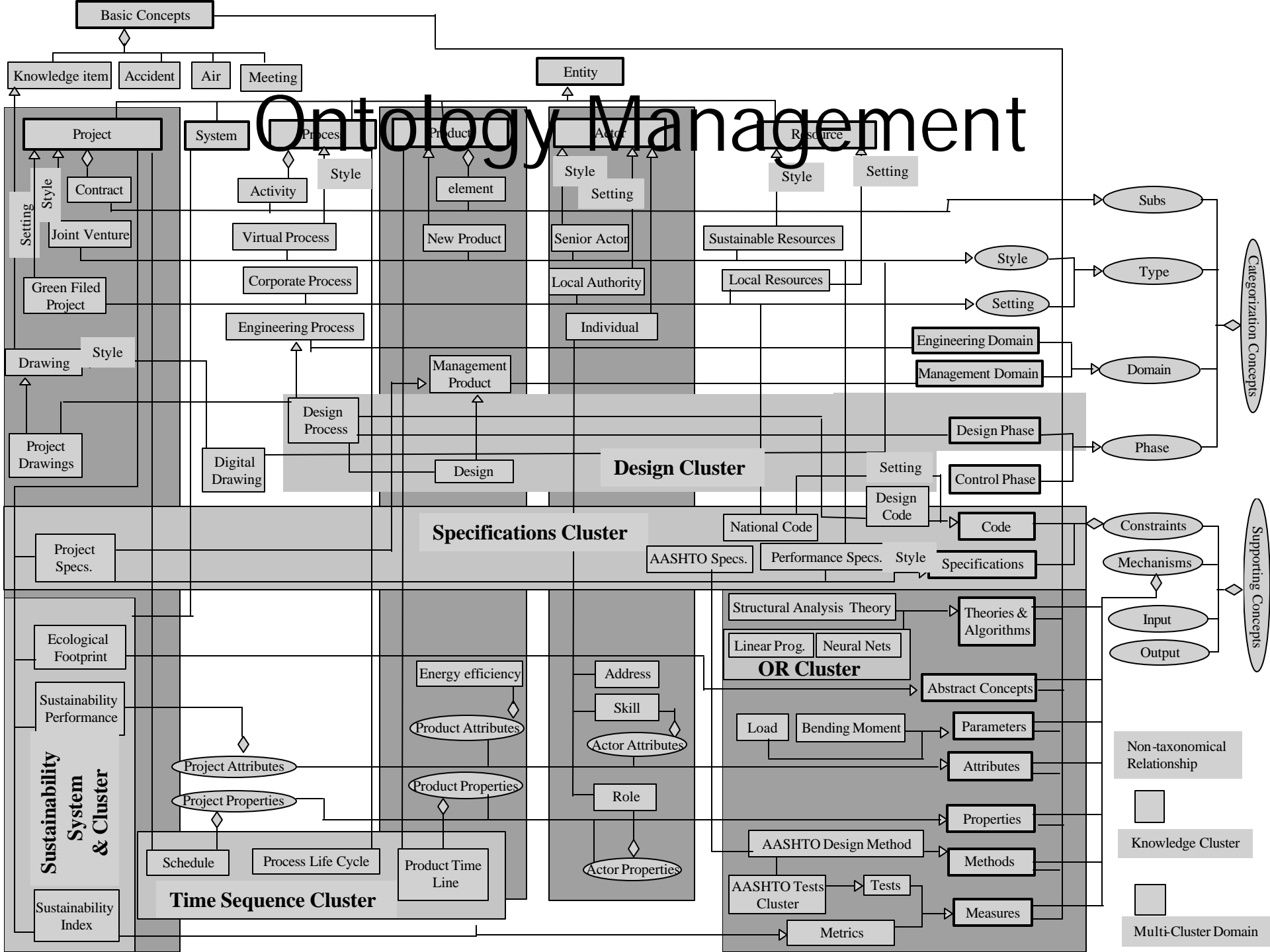
Constraints



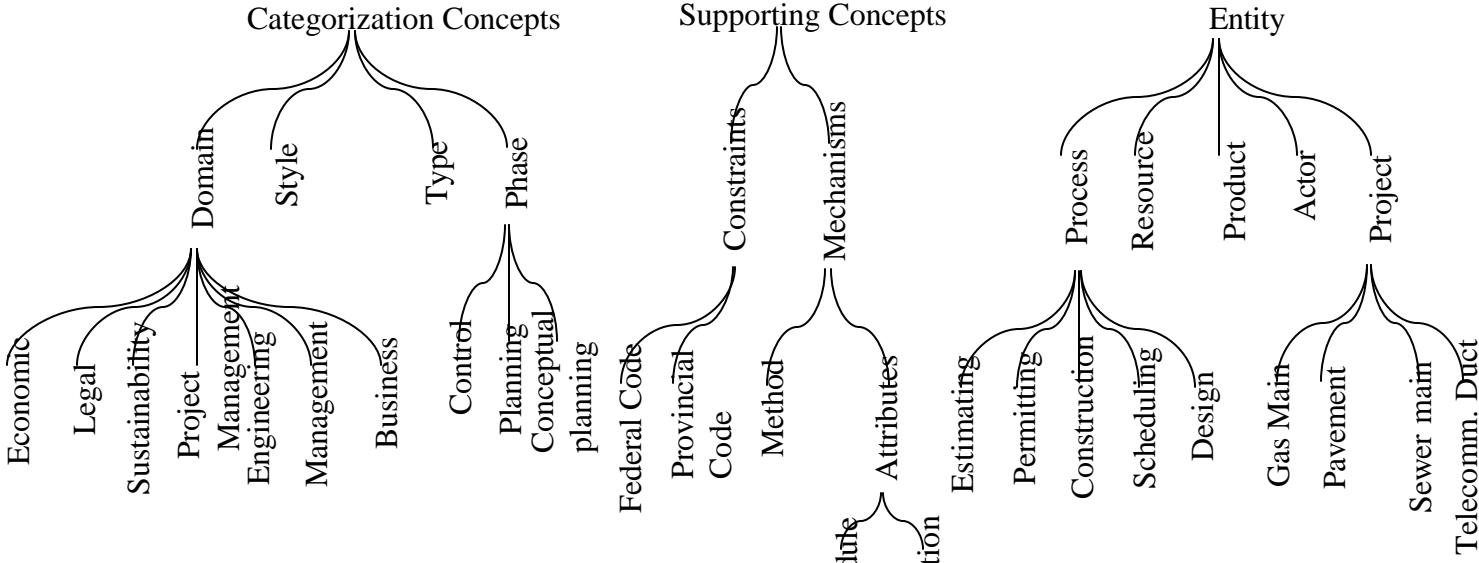
Simplified Taxonomy







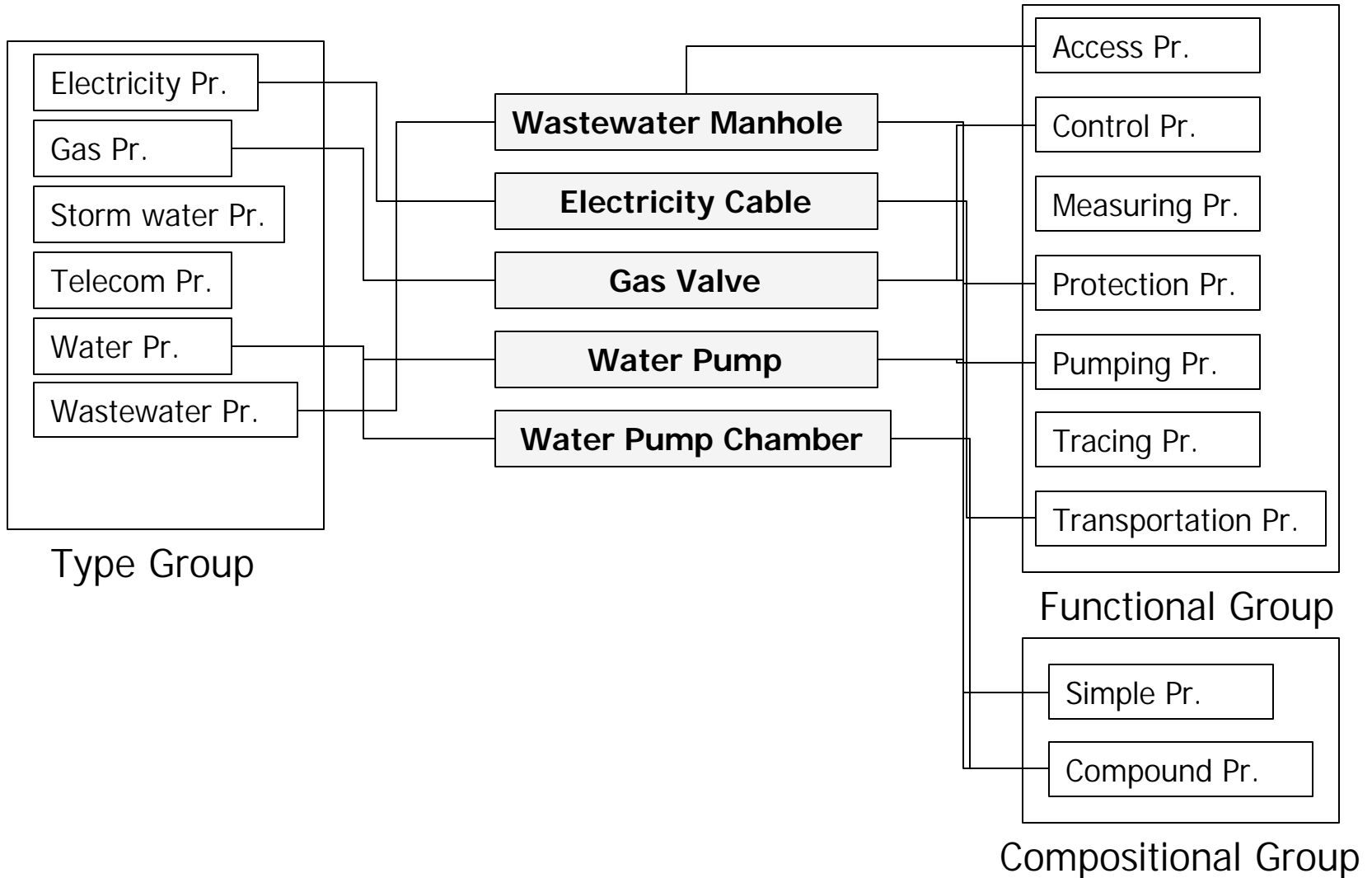
The Self-Describing Concept



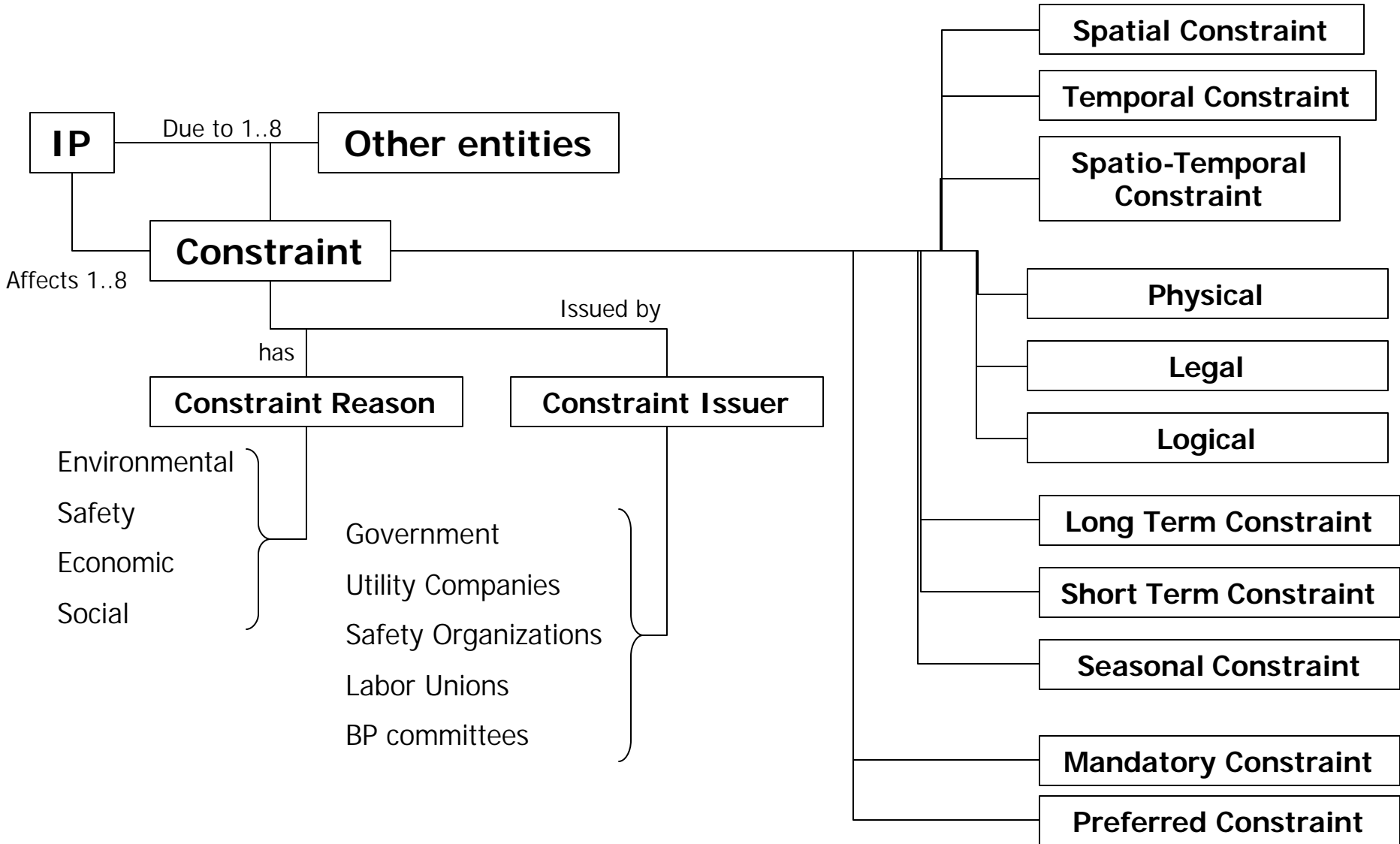
SDC	Domain	Style	Type	Phase	Constraints	Mechanisms	Process	Resource	Product	Actor	Project
SDC1	X	X	X	X	TR	T1 Z1					X
SDC2		X	X	X	DB	T2 Z1		X			50%
SDC3		X	X	X		T3 Z1			X		80%
SDC4	X	X	X	X	TR	T4 Z1	50%			80%	

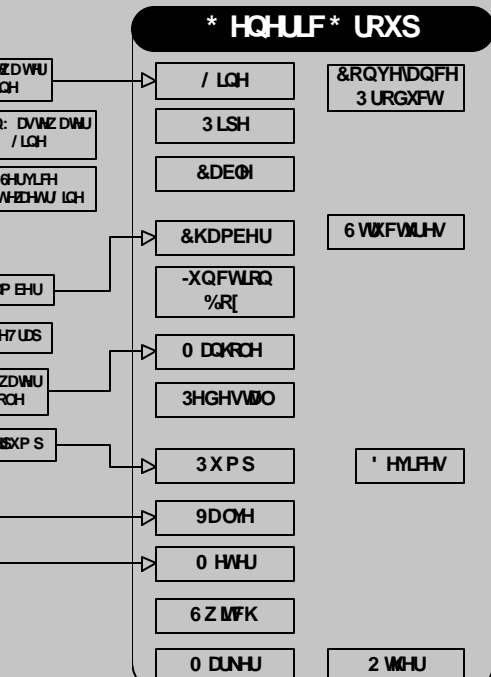
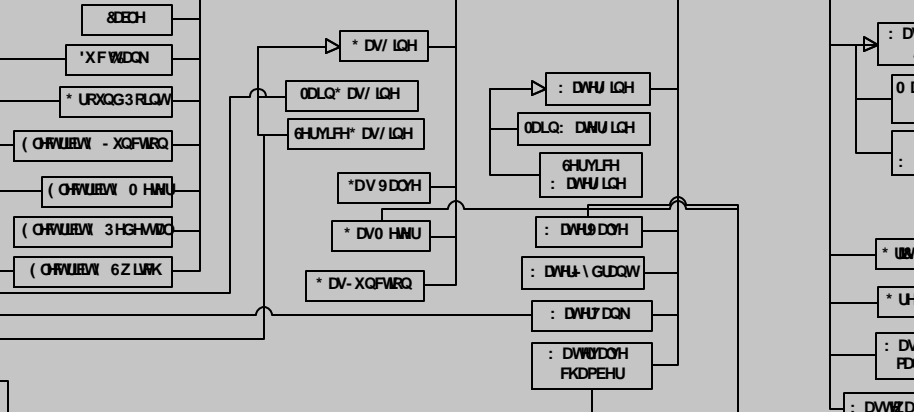
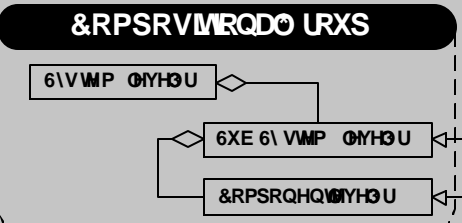
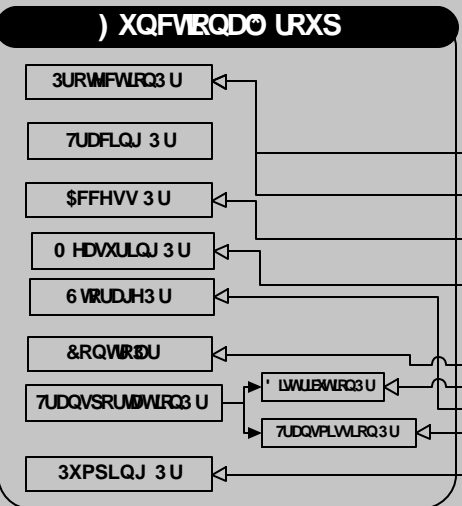
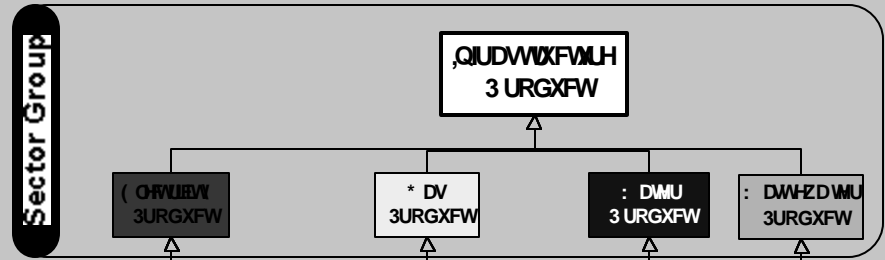
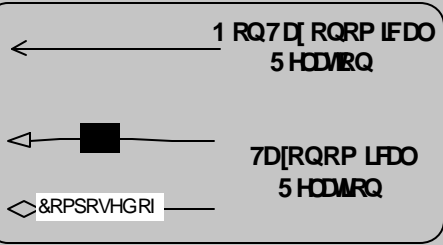
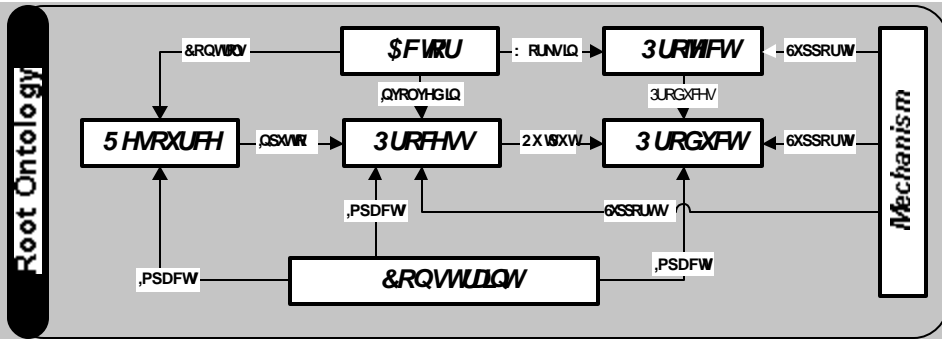
SDC: Self-Describing Concept, T: Time Interval, Z: Zone, TR: Trenching method, DB: Directional Boring

Product Ontology



Product Constraints

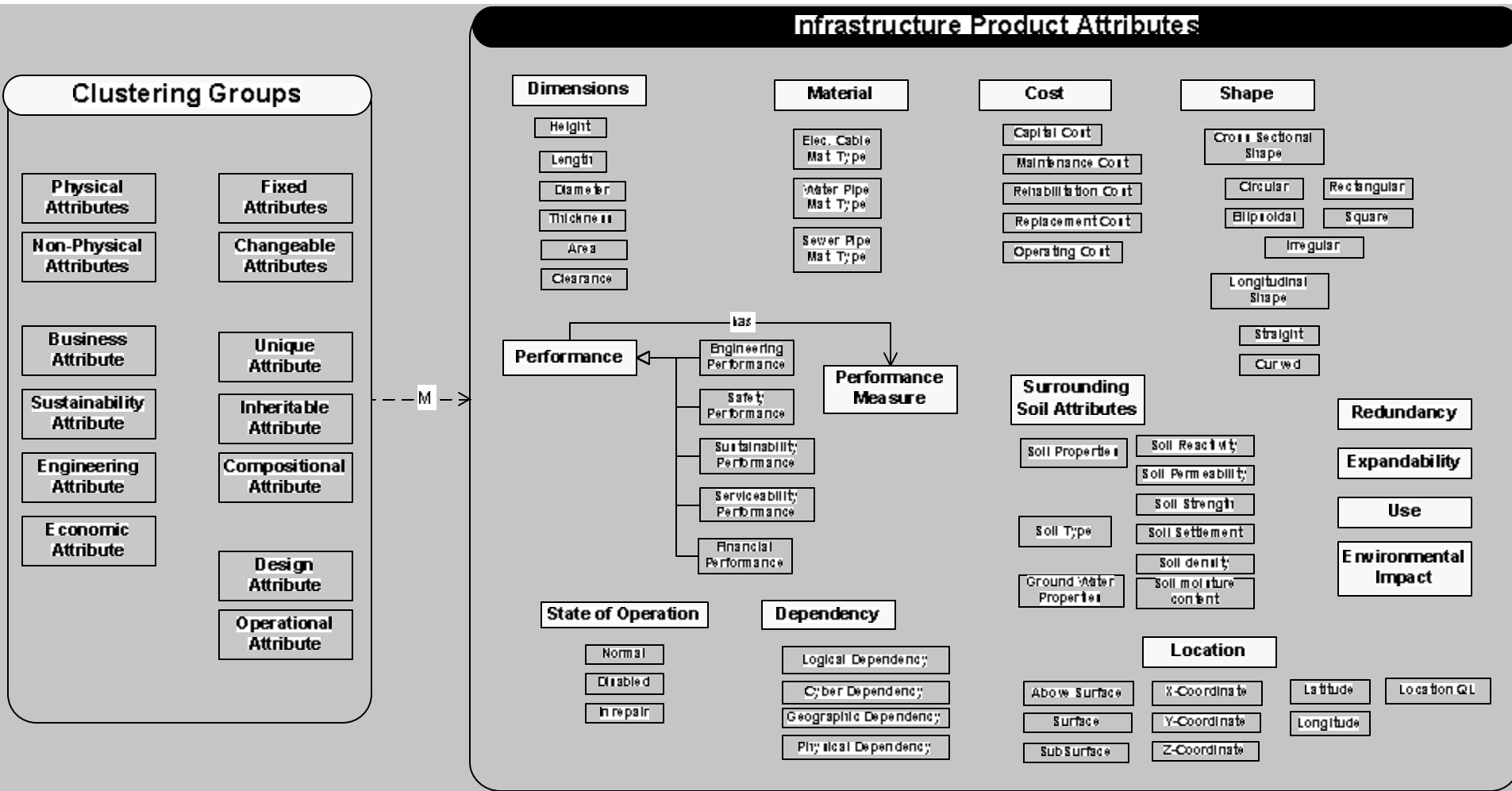


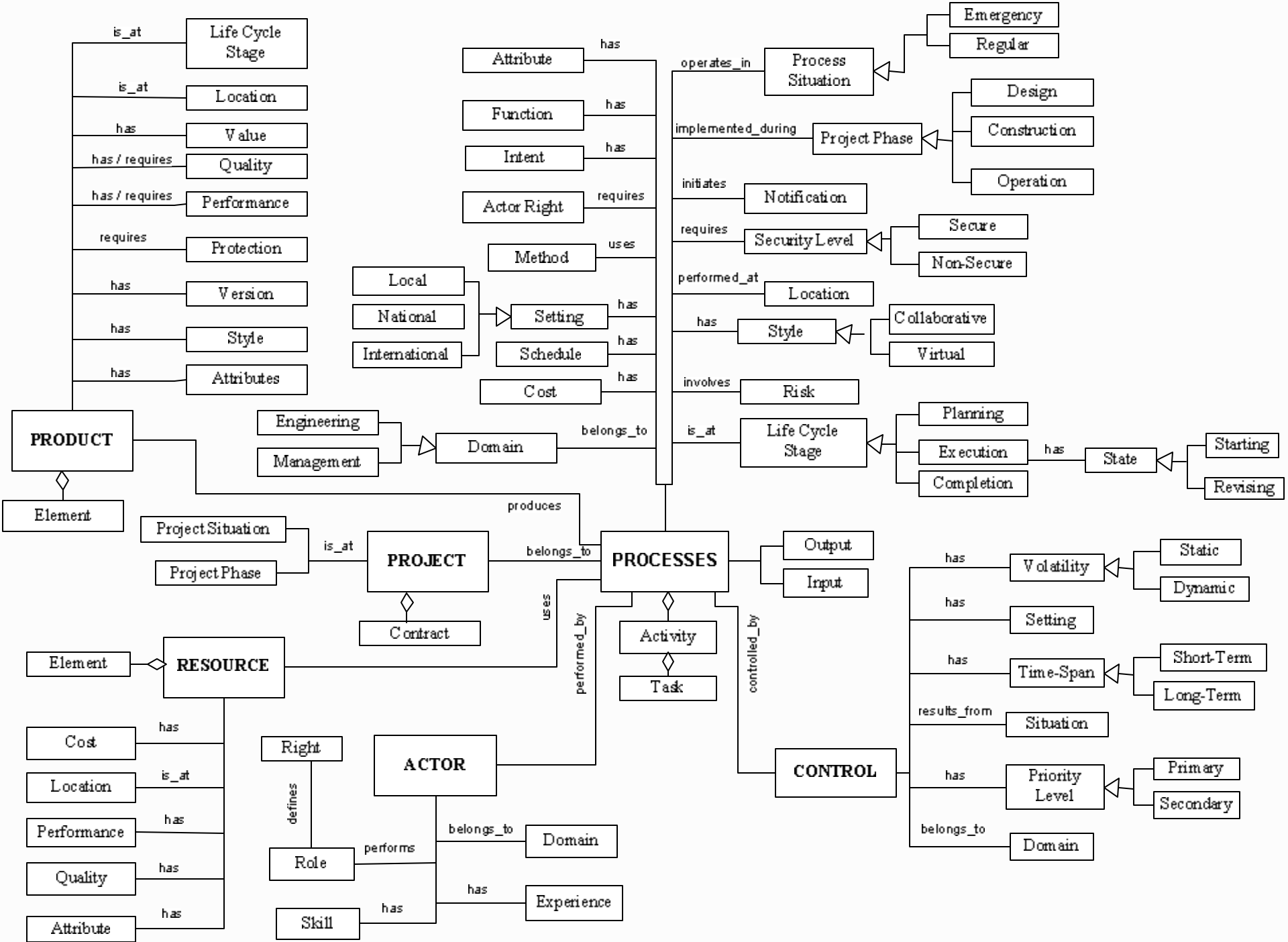


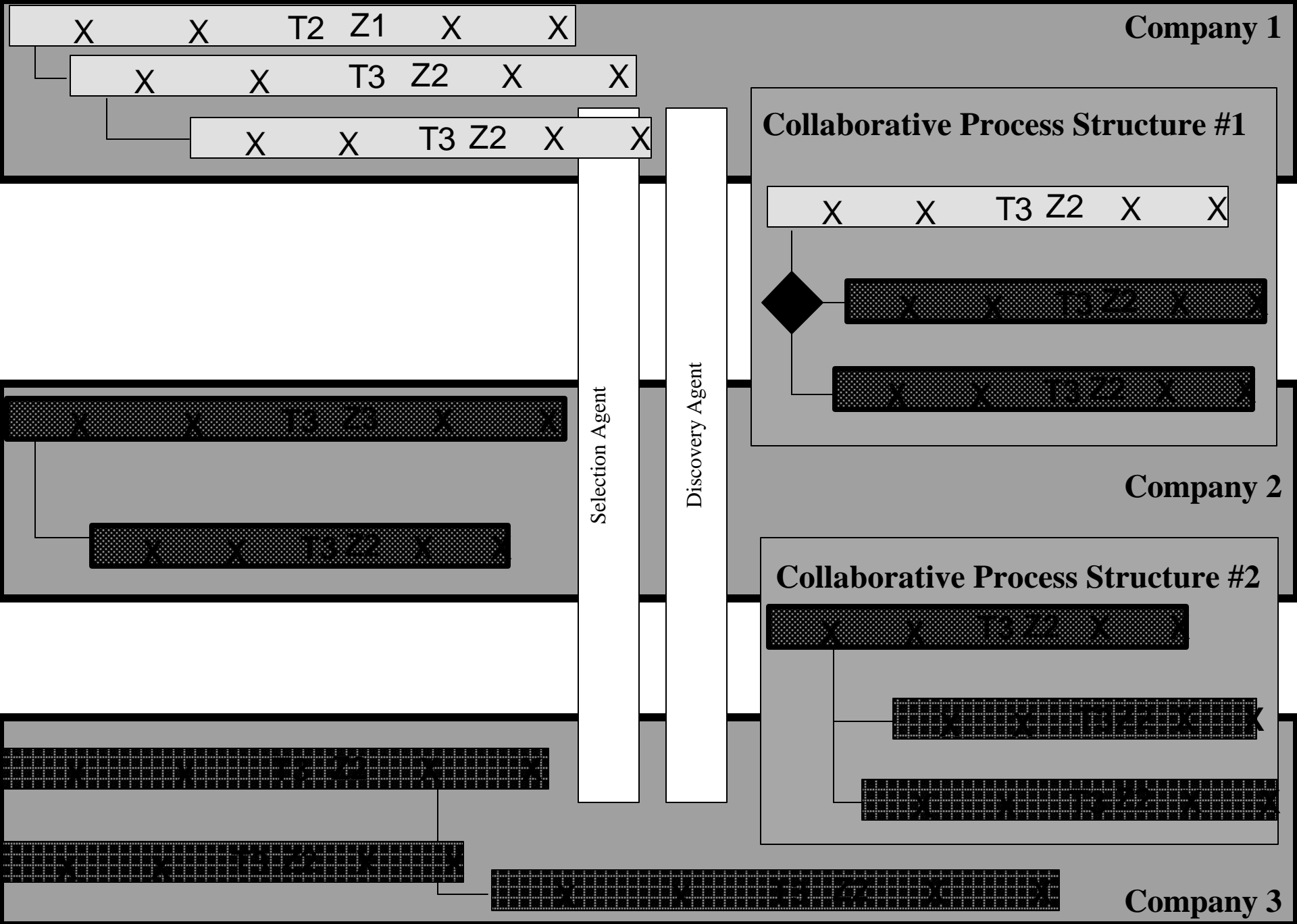
Attribute Modeling

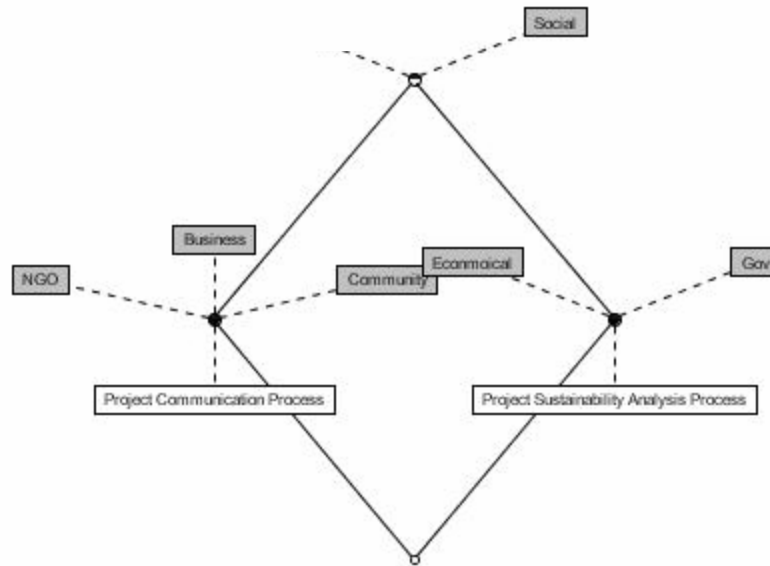
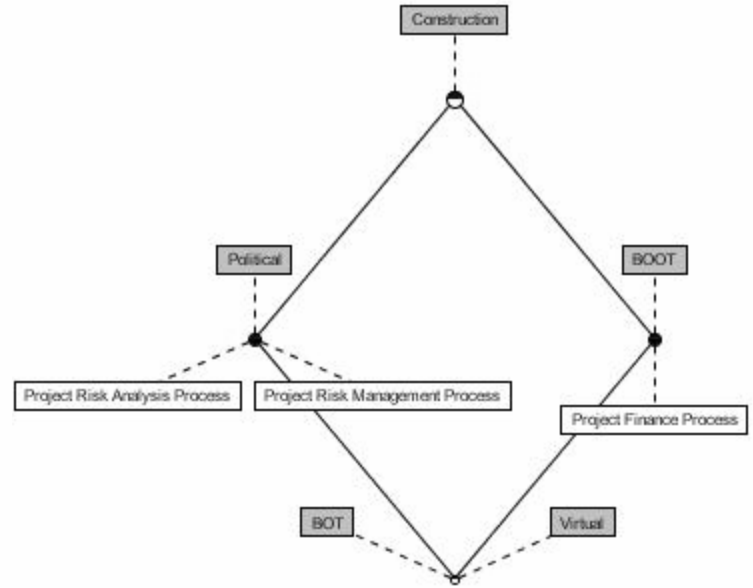
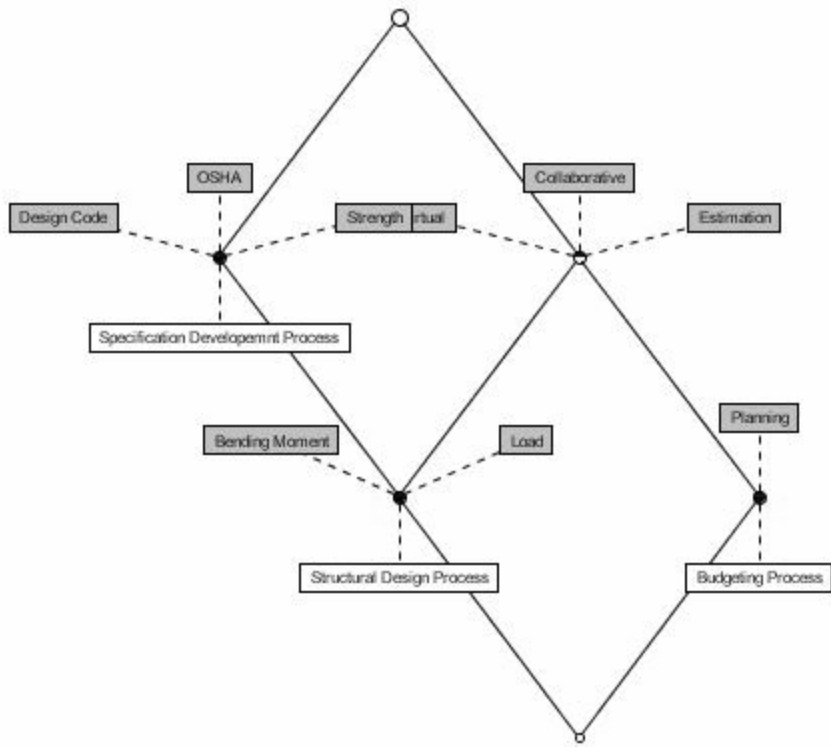
	Physical / Logical	Fixed / Changeable	Design / Operational	Domain <i>(EN/EC/BU/SU/SE)</i>	Composition (U/I/C)
Dimension	Physical	Fixed	Des./Oper.	EN	U
Material	Physical	Fixed	Des./Oper.	EN	U / I
Cost	Logical	Fixed	Des./Oper.	EC / BU	C
Shape	Physical	Fixed	Des./Oper.	EN	U
Performance	Physical	Changeable	Oper.	EN / BU	U
Ownership	Logical	Changeable	Oper.	BU	I
Surrounding Soil	Physical	Fixed	Des./Oper.	EN	I
Location	Physical	Fixed	Des./Oper.	EN	U / I
Dependency	Logical	Changeable	Des./Oper.	EN / SE	U
Redundancy	Logical	Changeable	Des./Oper.	EN / BU	U
Environmental Impact	Logical	Changeable	Des./Oper.	SU	I

Product Attributes

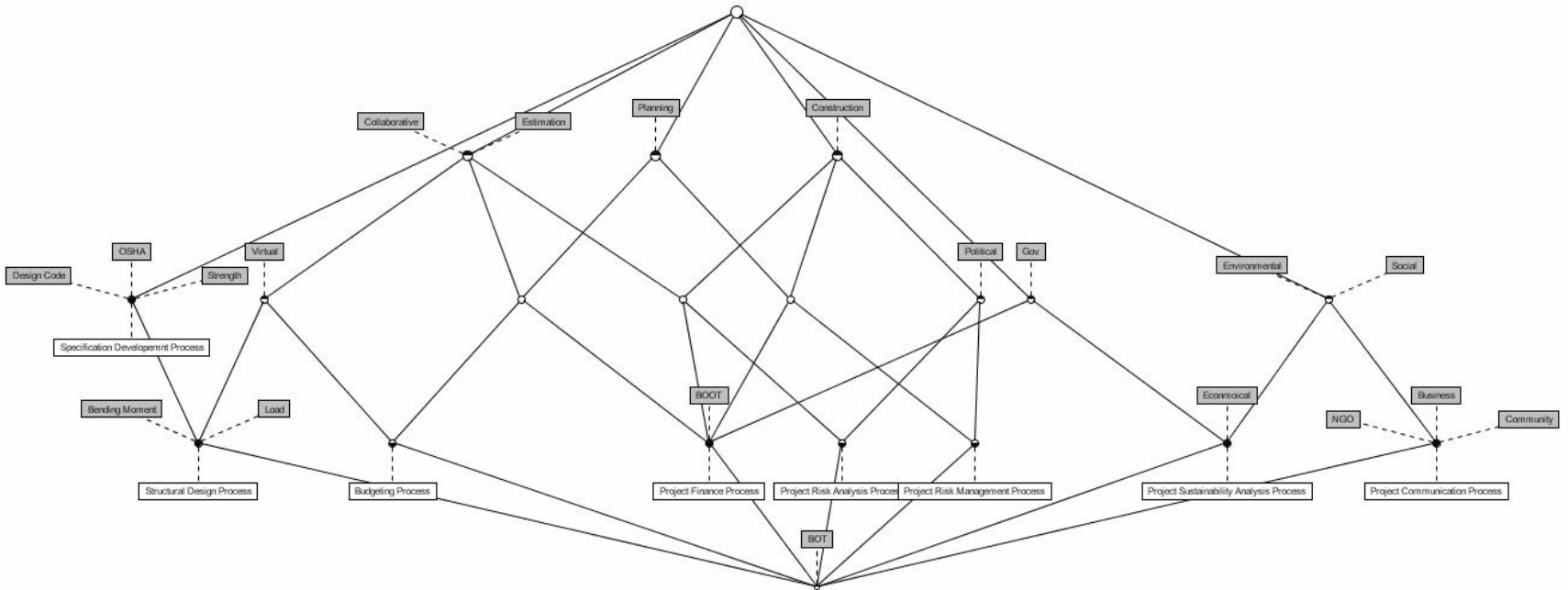








Ontology Merger



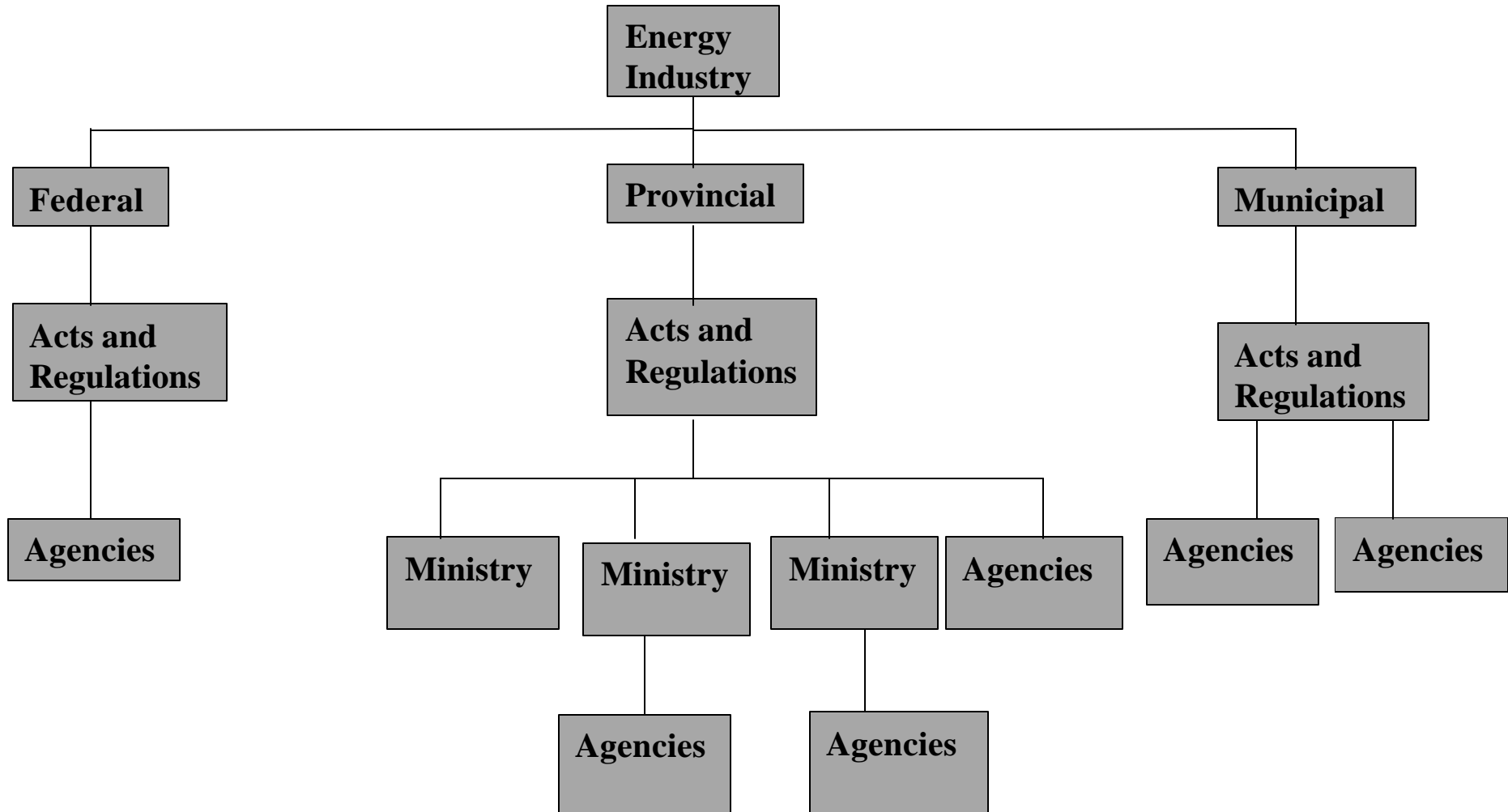
Actor Ontology

- Main features/attributes/roles and skills of actors
- Software agents as actor proxy

An Ontology for Infrastructure Code

- Code sections
- Intent
 - Safety
 - Environmental
 - Technical
- Actors
- Processes

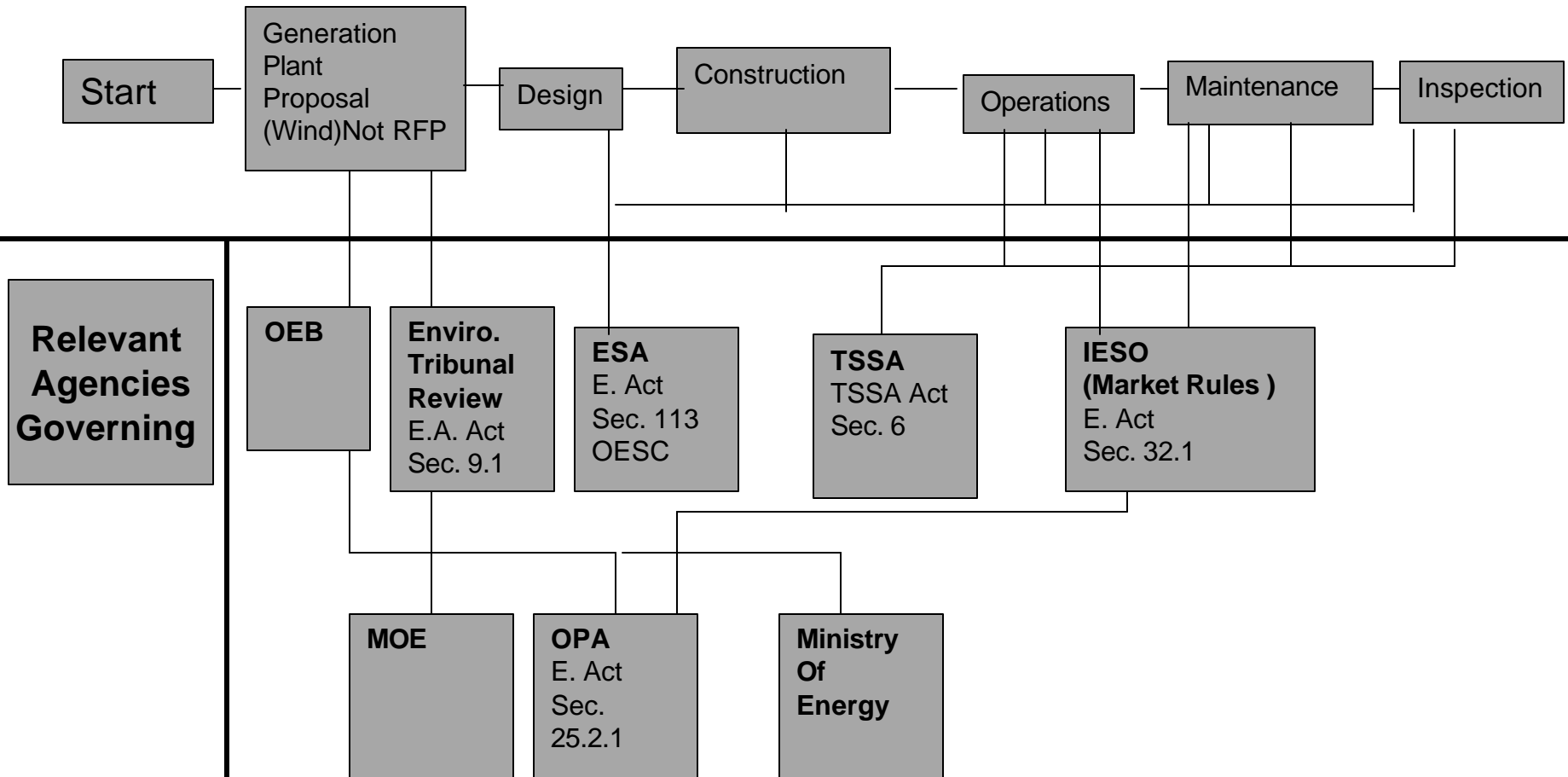
Regulatory Structure: Energy Industry



Modeling the Code

		Constraints			Actors		Process	
Sections of Acts		Public Policies	Enviro./ENG Requirements	Business impacts	Ministry	Agencies.	Design	construction
2.31*				M	M			M
2.50*		M				M		
8.50*								
9.0.2*		M		M		M		
9.03*								
10.1.6*				M	M		M	
10.2.6*			M		M			
* Examples, not actual sections								

The Sequence



Collaborative Design: I have

Fixed that for you!

