Big System Models

Ontology Benefits beyond Data Integration

2-Feb-2012

Many hopes for ontology data modeling

- Data integration
- Data model reengineering
- Neutral formats for data storage
- Single (unified) system model
- Automated verification
- Generative design

Model complexity growth

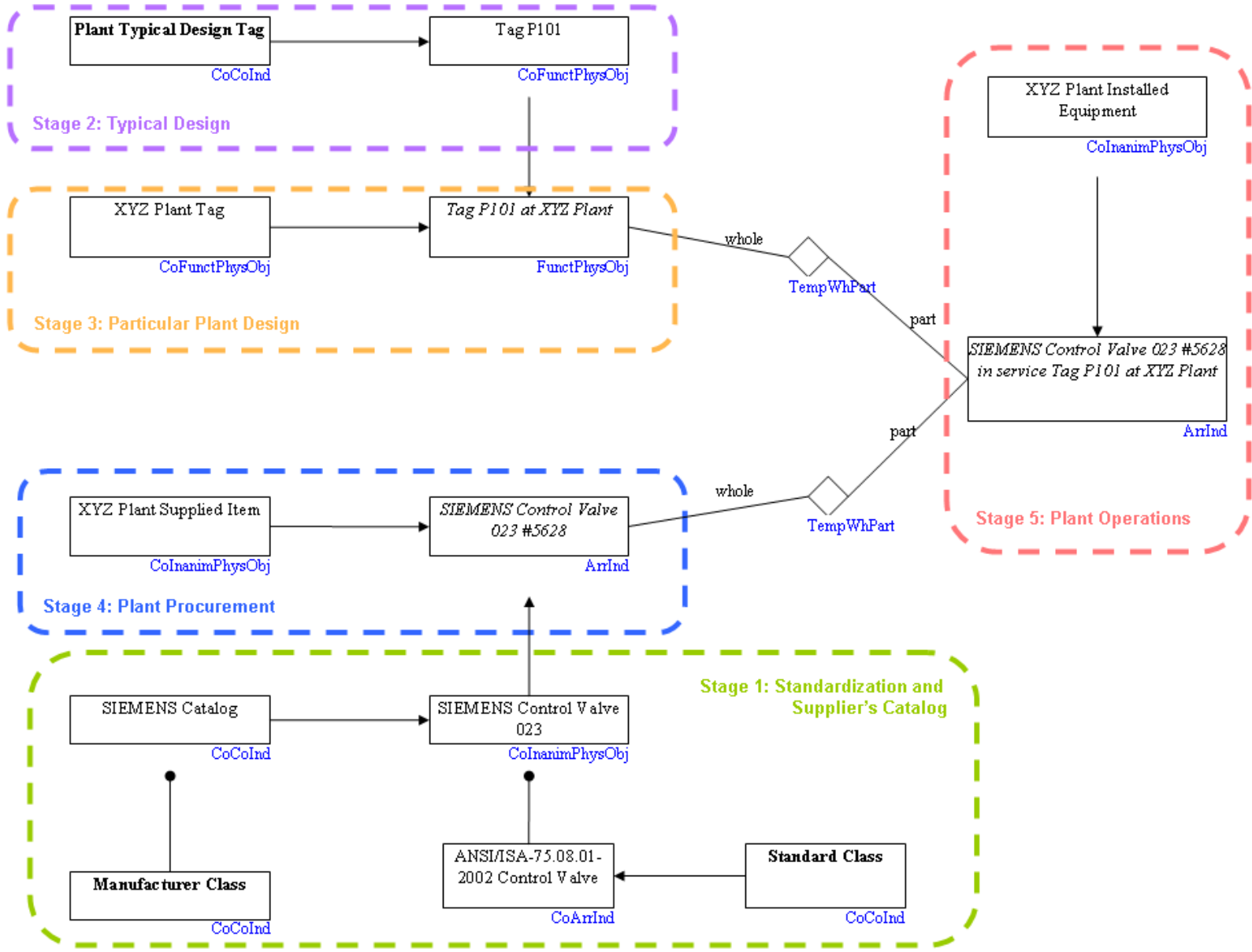**The best material model of a cat is another, or preferably the same, cat.**

N. Wiener "Philosophy of Science (1945)"

- "Paper" epoch in system modeling is coming to an end

- Is Wiener phrase true for information models also?

- New models are better – are they more complex?

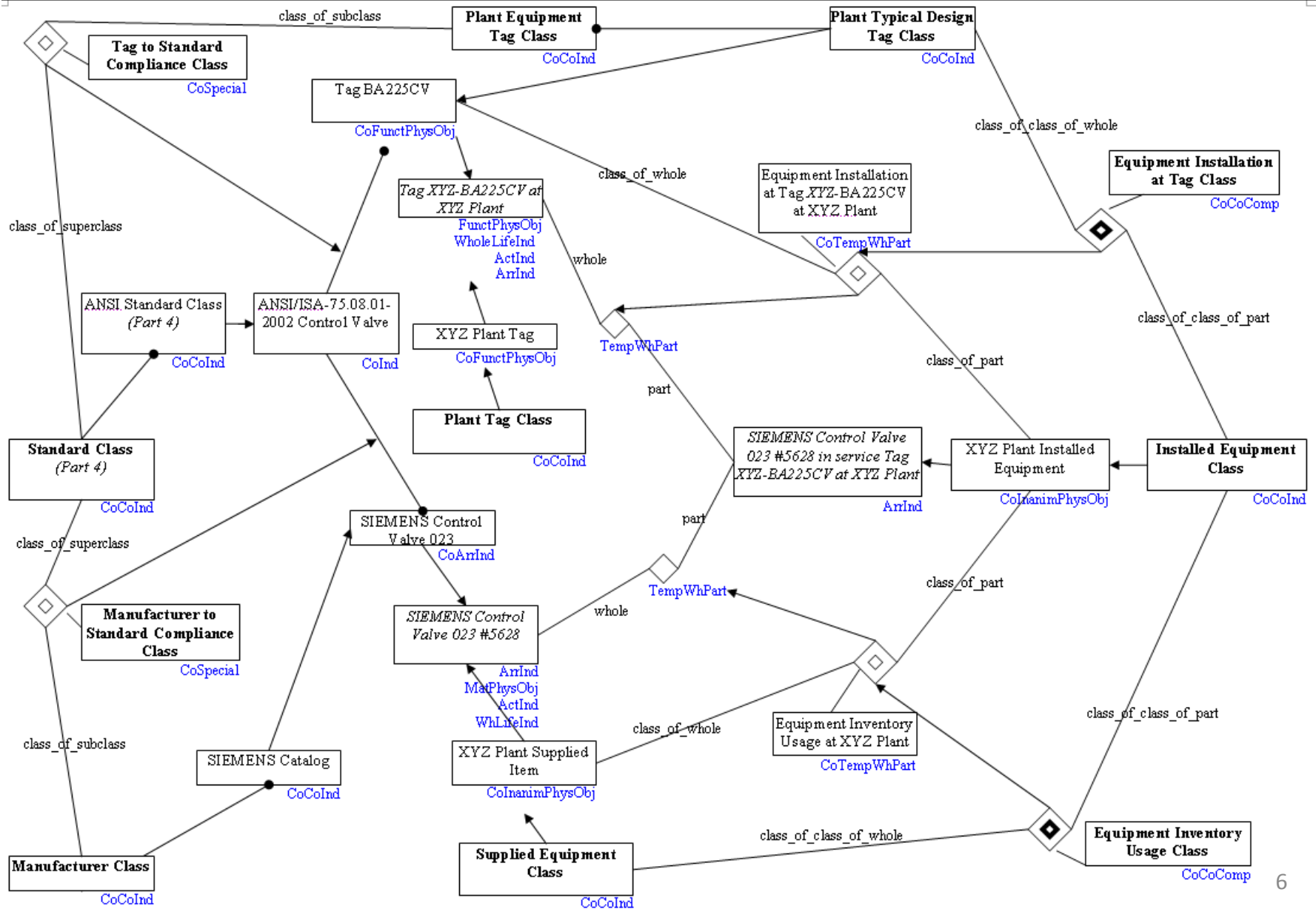- Are we prepared to work with a really complex unified model?

Life cycle of a valve

- ISO 15926-2 ontology and notation for an engineered system (upper ontology, reference data, individuals)
- Only basic objects and relationships:
  - What are the objects of design, procurement and O&M stages?
  - How are they related?
  - No idea yet what they do and how they do it!
- Simple model for understanding and communication
- Bigger model for complete machine interpretation

Equipment LC model (simplified)

Stage 2: Typical Design
- Plant Typical Design Tag (CoCoInd) → Tag P101 (CoFunctPhysObj)

Stage 3: Particular Plant Design
- XYZ Plant Tag (CoFunctPhysObj) → Tag P101 at XYZ Plant (FunctPhysObj)

Stage 4: Plant Procurement
- XYZ Plant Supplied Item (CoInanimPhysObj) → SIEMENS Control Valve 023 #5628 (ArrInd)

Stage 5: Plant Operations
- XYZ Plant Installed Equipment (CoInanimPhysObj)
- SIEMENS Control Valve 023 #5628 in service Tag P101 at XYZ Plant (ArrInd)

Stage 1: Standardization and Supplier's Catalog
- SIEMENS Catalog (CoCoInd) → SIEMENS Control Valve 023 (CoInanimPhysObj)
- Manufacturer Class (CoCoInd)
- ANSI/ISA-75.08.01-2002 Control Valve (CoArrInd)
- Standard Class (CoCoInd)

whole — TempWhPart — part

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Equipment LC model (developed)

More ontologies

- What ontologies are required beyond the one for the system of interest:
  - Rules and restrictions
    - Including Law and Regulation!
  - Design, manufacturing, O&M processes
  - Agent interactions
  - Ontology for ontology versioning
  - System of systems ontology?
  - …
- All integrated with SoI description – is single upper ontology enough?
- Is there a single language for all of the above?

Language requirements

- Reified and classified relationships
- Class_of_class – Class – Individual hierarchy (Clabjects)
- FOL
- Modal logic
- HOL?

Tools to work with ontologies

- CAD/PLM for an Ontology Engineer:
  - Natural language processing: concept extraction
  - Visual and text-based editing
  - Semantic search (pattern matching)
  - Language workbench (domain-specific language development)
  - Reasoning capabilities
- Adapters to external systems (read-write capabilities):
  - Natural language knowledge repositories (Internet and paper archives)
  - Data warehouses (legacy CAD/CAM/CAE/PDM/PLM)
  - Sensors and effectors

Questions?

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