

SOMM: Industry Oriented Model Management Tool

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Smart Factories

fully computerised, software-driven, automation of (production) processes and enterprise-wide integration of software components

Information models

- critical in enabling smart factories
- machine-readable conceptualisations / specifications
- describe assets: equipment & production processes in a plant
- address complexity of software dev. and integration process
 - raise the abstraction level

Information Models in Siemens

Many different types of models co-exist

- independently developed
- different (often incompatible) formats
- developed using different types of proprietary software
- models may not come with a well-defined semantics
- specifications of models can be ambiguous

Challenges in practice

- model development, maintenance, and integration
- data exchange and sharing

Manufacturing Model



ISA 88/95 based

manufacturing model

- Design & production
- Three layers

ISA 88/95

- 1. General guidelines for specifying
 - functionality of
 - Interface between
 - manufacturing software
- 2. Consists of
 - UML-like diagrams \bullet
 - Tables, text
 - Examples

		Α	Systems for common tas	sks	
IS	O/TS 16952	B -10	Systems of the main proces (power plants)	S	
B	Electrical auxiliary	v pow V	System for storage of materials or goods		
D	Functional allocat		Systems for administrati	ve	
Е	Fuel treatment an	supp x	or social purposes		
-	energy sources and		Communication and		
F	Handling of nicle		information systems		
н	Heat generation by a		Structure and areas for systems outside of the power plant process		
J	Sources and heat generation from natural sources				
Κ	Nuclear auxiliary	systems	MD Wind Turbine Sy	/stem	
L	Vater, steam, con	ndensate s	MDA Rotor System		
м	Systems for genero transmission of ele	ation to and ctrical ene	MDL Yaw System	n Sustam	
Ν	Medium supply sy	stem, ener	MDX Central Hydroulic	System	
Ρ	Cooling water sys	stems	MDY Control System		
Q	Auxiliary systems				
R	Flue gas exhau			A 11 11	
S	- r = 1	– Euro	grafion fast aspect	Application Main Systems, Systems	
T	- r =MDA	- 10110		Subsystems, Basic Functions	
U	=MDK	– Proc	uct Designation	Product classes	
		+ Poin	t of Installation	Cabinets, vessels	
		++ Site	of Installation	Buildina, areas	
			ntrol System		

IEC 81346

Energy Production Model

Standards

- 1. EC 81346, ISO/TS 16952-10
 - generic dictionary of codes
 - designation & classification of industrial equipment
- 2. RDS PP and KKS
 - extra codes for energy equipment

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- functionality, locations
- system for combining codes

Plant Model based on standards

 describes the structure of a plant by providing functionality & location of each equipment component using RDS PP and KKS codes.

Wind Power Plan Model



Manufacturing Process Model



Product Segments

Product

Semantic Models for Siemens

OWL 2 for information models

- rich, unambiguous, standardised & flexible modelling language
- well-suited for describing industrial information models
- a wide range of tools for, validation, integration, and reasoning
- \rightarrow automation of labor-intensive, error-prone tasks

RDF for data exchange

- unified data format for access and exchanged
- RDF triple stores for storing, highly scalable query answering
- can be effectively queried in conjunction with ontologies

SOMM: Siemens-Oxford Model Manager

Axioms & constraints (A&C)

- 1. Form based interface
- 2. A&C on the same interface
- 3. A&C encoded in Datalog

Auto-generated data forms

1. From properties assigned to classes 2. Both explicit and implicit

Extended hierarchies

1. Based on arbitrary properties

SOMM 'extended' class editor f	or 'SteamTurbine'					8 X
Property (*)	Required?	Min.	Max.	Range (*)	Value	
💼 hasState	Ø	1 •	max •	O State		×
🗖 hasld	Ø	1 -	max 🚽	xsd:string		×
💼 hasConfig	Ø	1 -	3 -	SteamTurbineConfig		×
hasProductLine		min -	max 🚽	ProductLine		×
		min 🚽	max 🚽	Enter datatype or class	Individual or literal	
			SubClass	Of(<i>ST</i> ObjectSomeVa	aluesFrom(<i>hasSta</i>	ite
			SubClass	Of(ST DataSomeValu)	esFrom(hasId xs)	d:s
<u>.</u>		Sub	$\gamma_{\rm loce} \cap f(ST)$	Chiest MinCondinali	tu(1 has Config S	יידר

🕶 🗶 🖻 Select a value turbine 987

SubClassOf(ST ObjectMaxCardinality(3 hasConfig STConfig)

SubClassOf(ST ObjectAllValuesFrom(hasProductLine ProductLine)

Ontologies in Siemens

- Have been successfully used for
 - Ontology Based Data Access
 - MES and shop-floor level diagnostics
- Developed by R&D personnel familiar with SW technologies

Project Goals:

- to widen the scope of ontologies in Siemens
- to scale onto development
- to provide industry-oriented ontology management tool

2. Generalisation of partonomies

Alignment

1. Allows to merge and import models 2. Based on LogMap

Reasoning

- 1. Schema and Instance level reasoning
- 2. Hermit for schema level reasoning
 - Ontology classification
 - Class satisfiability
- 3. Datalog engine with Stratified Negation
 - Data validation
 - Query answering

Add new value				
hasConfig (*)	SteamTurbineConfiguration	*	X	2
Add new value				
hasProductLine	Select a value	*	×	P
Add new value				



SOMM Instance Reasoning Services for <a>@@x steam_turbine_987						
Check consistency Show instance	e types					
Is consistent?: Instance viola	tes constraint					
Asserted types (classes) O SteamTurbine	SOMM Class Reasoning Services for Sources for GasTurbineModes					
Inferred types (classes)	Check satisfiability Show super classes					
	Is satisfiable?: Satisfiable					
	Asserted super classes					
	TurbineModes					
	Inferred super classes					
	O Process					