A Pattern-Based Core Ontology for Product Lifecycle Management based on DUL

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Problem Description

(a) Design and Element IDs of BRICK 2X2

(b) Product Variants

Design ID: 3003
Brick Name: BRICK 2X2

Element ID: 300323
Exact Colour: Bright blue

Element ID: 300321
Exact Colour: Bright red

Element ID: 300328
Exact Colour: Dark green

Element ID: 300301
Exact Colour: White

Engineering
Focus: Form, Fit, Function

Manufacturing
Focus: Exact part identification

Engineering
Focus: Form, Fit, Function

Manufacturing
Focus: Exact product identification

Standard version
“Blue”

Customized version for Customer A
“Red”

Customized version for Customer B
“Green”
Problem Description (2)

(a) Engineering View of LEGO Train based on Functionality

(b) Manufacturing View of LEGO Train based on Manufacturing steps
Goals and Approach

• Goals
  – Provide formal basis to express different views product (part)s
  – Integrating existing and new ontologies

• Solution Approach
  – Pattern-based Ontology Engineering
  – Based on Foundational Ontology
  – Integrated into joint semantic and software engineering process
Requirements

- Req 1: Differentiating between product concepts and product instance
- Req 2: Different views on parts depending on context
- Req 3: Distributed workflow models and workflow executions
- Req 4: Secure distributed group management and access right management
Our Solution: CO-PLM

DUL: DOLCE+DnS Ultralite
Product Part Information Entity Pattern

```
  dul:InformationObject
     ___________ 1...* dul:realizes 1...* ___________
           |                        |                    |
  ProductPartInformationObject                  ProductPartInformationRealization

  dul:InformationEntity
  ___________
     |      |    |
  dul:InformationObject
     |                        |
  ProductPartInformationEntity
```

Product Part Pattern
Product Part Pattern

Product Part Master
(Product Part Information Object)

Bill Of Materials
(Product Part Information Object)

Physical Product Part
(Product Part Information Realization)

PrintedDocument
(Product Part Information Realization)
Product Part Description Pattern
Evaluation of Practical Use

(b) Reasoning and Axioms for LEGO Example

(c) Reasoning Runs for Synthetic Data

Quadratic regression:

\[ R^2 = 0.9973 \quad p < 0.001 \quad df = 3 \]
Work in Progress / Future Work

- Elaborating our Joint Software and Semantic Engineering Process (JoSSEP) in more detail
- Integrating CO-PLM and JoSSEP into a framework for decentralized protected networks
  - Integrating CO-PLM (and/or other ontologies) into a decentralized Attribute Based Access, Flow and Usage Control infrastructure
  - Integrate decentralized semantic Group Management
Thank you for your attention!