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Model Writer

Progress on the Industrial Use Cases




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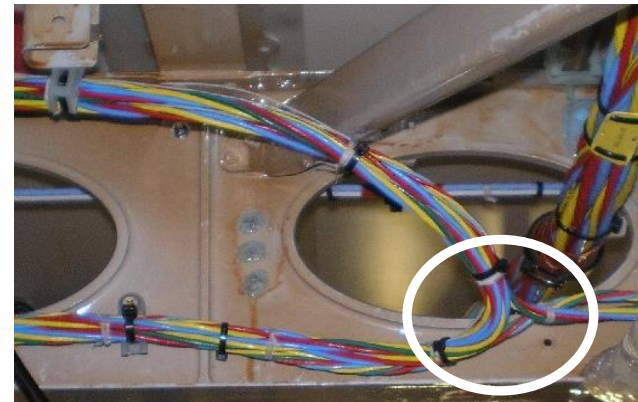
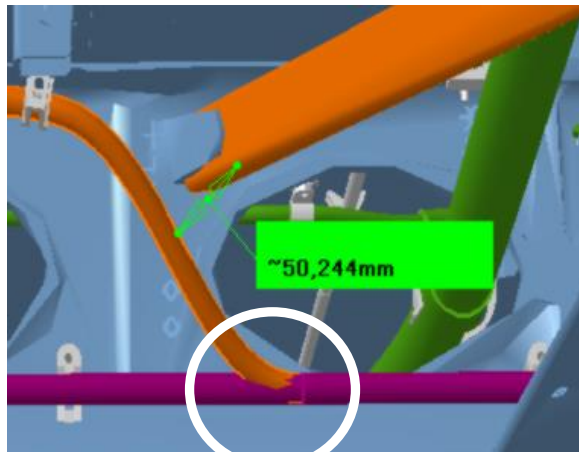
AIRBUS industrial use cases

Anne MONCEAUX

AIRBUS GROUP INNOVATIONS

Airbus use cases in ModelWriter

- We decided to concentrate on some problematics related to System Installation
- We primarily focus on Electrical, Water Waste, and Fuel Systems
- System installation:
 - obeys to some Regulations 
 - is specified by some rules/requirements/principles 
 - the design and the manufactured product are checked against these rules 



Certification Specification – CS 25 (EASA)

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Signets

- TITLE PAGE - CS-25 Amdt 5
- CONTENTS
- PREAMBLE
- CS-25 BOOK 1 - Certification Specifications for Large Aeroplanes
 - SUBPART A – GENERAL
 - SUBPART B – FLIGHT
 - SUBPART C – STRUCTURE
 - SUBPART D – DESIGN AND CONSTRUCTION
 - SUBPART E – POWERPLANT
 - SUBPART F – EQUIPMENT
 - SUBPART G – OPERATING LIMITATIONS AND INFORMATION
 - SUBPART H – ELECTRICAL WIRING INTERCONNECTION SYSTEM**
 - SUBPART J – AUXILIARY POWER UNIT INSTALLATIONS
- CS-25 BOOK 1 - APPENDICES
- CS-25 BOOK 2 - Acceptable Means of Compliance
- AMC - INTRODUCTION
- AMC – SUBPART B
- AMC – SUBPART C
- AMC – SUBPART D
- AMC – SUBPART E
- AMC – SUBPART F
- APPENDIX 1. ASSESSMENT METHODS

CS-25 BOOK 1

SUBPART H – ELECTRICAL WIRING INTERCONNECTION SYSTEM

CS 25.1701 Definition
(See AMC 25.1701)

(a) Electrical wiring interconnection system (EWIS) means any wire, wiring device, or combination of these, including termination devices, installed in any area of the aeroplane for the purpose of transmitting electrical energy, including data and signals between two or more intended termination points. Except as provided for in subparagraph (c) of this paragraph, this includes:

- (1) Wires and cables.
- (2) Bus bars.
- (3) The termination point on electronic devices, including those on relays, interrupters, switches, contactors, terminal blocks, and circuit breakers and other circuit protection devices.
- (4) Connectors, including feed-through connectors.
- (5) Connector accessories.
- (6) Electrical grounding and bonding.

(i) Appropriate for the intended function and operating environment, and

(ii) Acceptable to the Agency.

(2) Portable electrical devices that are not part of the type design of the aeroplane. This includes personal entertainment devices and laptop computers.

(3) Fibre optics.

[Amdt. No.:25/5]

CS 25.1703 Function and Installation: EWIS
(See AMC 25.1703)

(a) Each EWIS component installed in any area of the aeroplane must:

- (1) Be of a kind and design appropriate to its intended function.
- (2) Be installed according to limitations specified for the EWIS

subparagraph (b) of this paragraph, EWIS components inside the following equipment, and the external connectors that are part of that equipment, are excluded from the definition in subparagraph (a) of this paragraph:

- (1) Electrical equipment or avionics that is qualified to environmental conditions and testing procedures when those conditions and procedures are -

[Amdt. No.:25/5]

CS 25.1705 Systems and Functions: EWIS

(a) EWIS associated with systems required for type certification or by operating rules must be

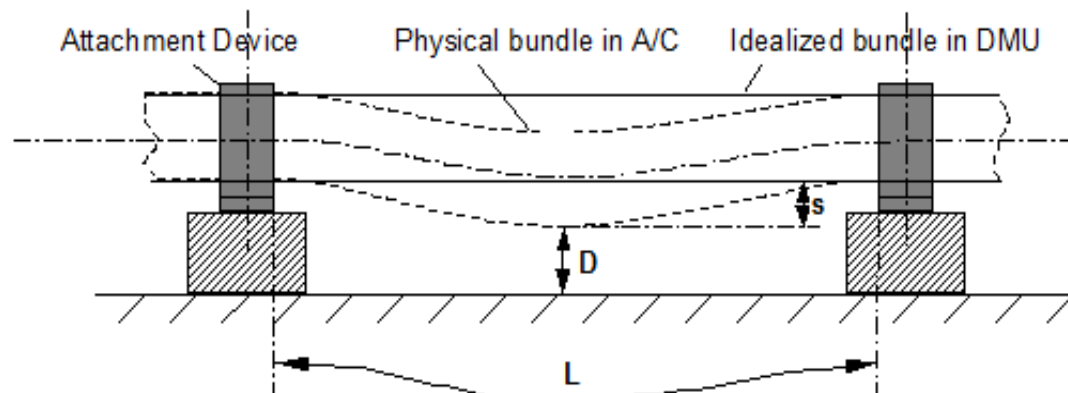
CS 25.1701 Definition

(a) Electrical wiring interconnection system (EWIS) means any wire, wiring device, or combination of these, including termination devices, installed in any area of the aeroplane for the purpose of transmitting electrical energy, including data and signals between two or more intended termination points (...)

System Installation Design Principles

SIDP92A001V-A-784

For installation of optical and electrical harnesses additional clearance for sagging (s) shall be provided as detailed below:



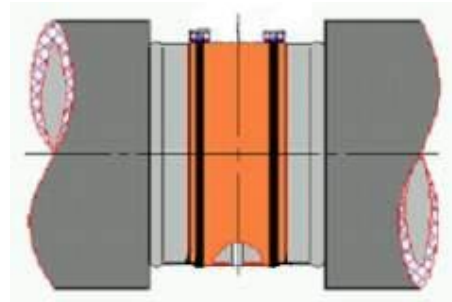
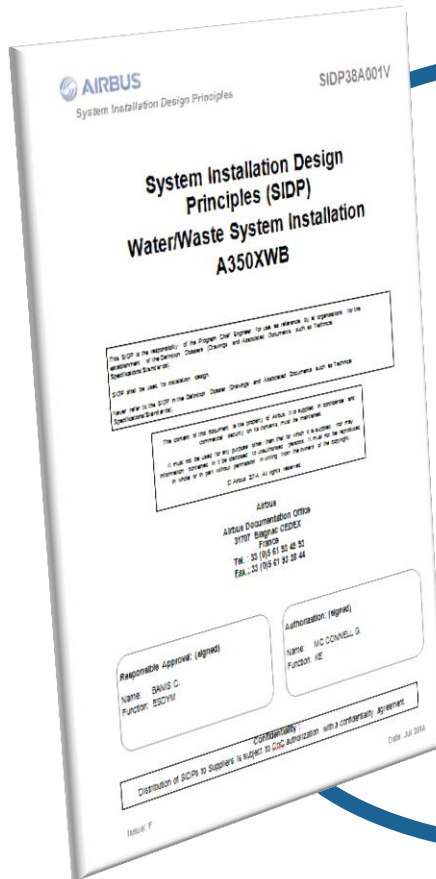
- s... Sagging of bundle (real behavior of physical bundle in A/C due to gravity, ageing, etc.)
- D... Required Distance
- L... Actual length of a bundle segment between two Attachment Points (as designed in DMU)

Figure 6: Sagging of bundles between attachment points

Note: Unless the bundle has a straight routing, L is bigger than the pitch between the Attachment Points.

Rule traceability & design check

Traceability



Check

Problem statement & objectives

1. Model and manage the design rules: since SIDP (design principles) are today's kinds of natural language requirements and explanations:
 - not all the rules can be directly formalized in a way to be used to verify the design
 - rules are spread over various products/programs
 - rules evolve
 - rules are complex artefacts made of text and picture and tables....

⇒ This problem is the one we have been considering primarily in the scope of ModelWriter, trying to define a rule model and knowledge base
2. Enable mapping between rule model and design model, in order to automate identification of conflicts between rules and design, and then automate analysis of the impact of changes in rules or in design.

⇒ This 2d objective we think cannot be reached in the frame of Modelwriter because of the challenge of mapping 3D design models to the BOM ... and because lack of skills and data in the context of the project

BUT to be consider to make the system amenable for formal analysis

Problem statement & objectives

(1) Manage rules/design principles and improve traceability

Easier search/retrieval of rules

- save costs/time by supporting DP consultation / retrieval in accordance to the needs

Easier change impact analysis at rules level

- save DP updating costs/time
- avoid non-compliance of design caused by DP updating lead time

Easier traceability between artefacts (BOM DB, design models, CAD models...)

- keep traceability from upstream regulations to requirements and to downstream design models

(2) Automate identification of design conflicts against rules

Easier consistency checking of the design (CAD) data

- Save time to retrieve applicable rules
- avoid non-compliance of design wrt rules

Solutions explored in MW

		1	2	3	4
Use a Component taxonomy (BOM) as a reference to annotate rules (rules as Text part / Taxonomy as Model part)	MW synchronization mechanism to help annotation management	+	+	-	-
Extend first approach to other artefacts/models	MW synch between several artefacts	-	-	+	+
Add semantics to BOM to enable reasoning	MW synch	+	+	+	
Model rules written in natural language by formalizing the rules in description logic / ability to dynamically update the BOM/component ontology and apply some checks on design rules	MW writer part features that LORIA developed so far in the formalization process + MW synch			+	+
Model rules written in natural language by formalizing the rules in relational logic	MW writer part + Tarsky part + Synch mech			+	+

1=Rule retrieval – 2=Rule change – 3= traceability – 4=design check

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UC-FR-03 - Synchronization of Regulation Documentation with a Design Rule Repository

Anne MONCEAUX
Airbus Group Innovation

Ex. BOM, Component taxonomy, Component ontology

Item description	
33	tank drain valves
1082	Vent system
1083	Pressure relief
1084	Carbon OPP disc
1085	flame arrestor
1086	float valve
1087	NACA duct

```

<http://airbus-group.installsys/component>
  rdf:type owl:Ontology ;
  rdfs:comment "Component definitions are given and validated by Airbus ESIR dpt"^^xsd:string ;
  owl:imports <http://qudt.org/schema/qudt> ;
  owl:imports <http://qudt.org/vocab/unit> ;
  owl:versionInfo "Ontology for System Installation Components"^^xsd:string ;

.
comp:ABS1759
  rdf:type owl:Class ;
  rdfs:label "ABS 1759 cable tie mount"^^xsd:string ;
  rdfs:label "ABS1759"^^xsd:string ;
  rdfs:label "cable tie mount ABS1759"^^xsd:string ;
  rdfs:subClassOf comp:CableTieMount ;
  skos:prefLabel "ABS 1759 cable tie mount"@en ;

.
comp:AFDXcable
  rdf:type owl:Class ;
  rdfs:label "AFDXcable"^^xsd:string ;
  rdfs:subClassOf comp:BusCable ;
  skos:prefLabel "AFDXcable"^^xsd:string ;

.
comp:Active-Fastener
  rdf:type owl:Class ;
  rdfs:label "active fastener"^^xsd:string ;
  rdfs:subClassOf comp:Fastener ;
  rdfs:subClassOf [
    rdf:type owl:Restriction ;
    owl:hasValue "true"^^xsd:boolean ;
    owl:onProperty comp:isActive ;
  ] ;
  skos:prefLabel "active fastener"@en ;

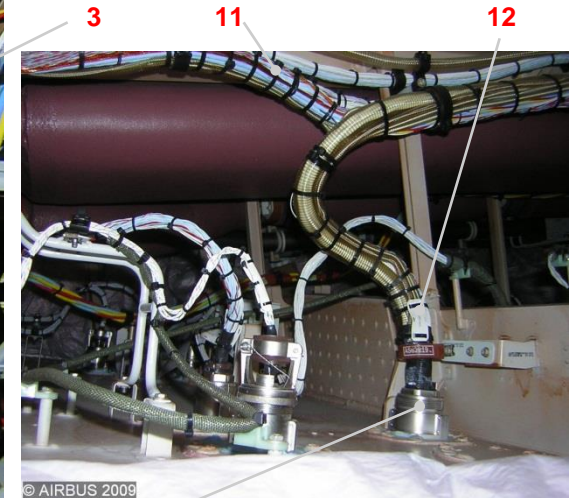
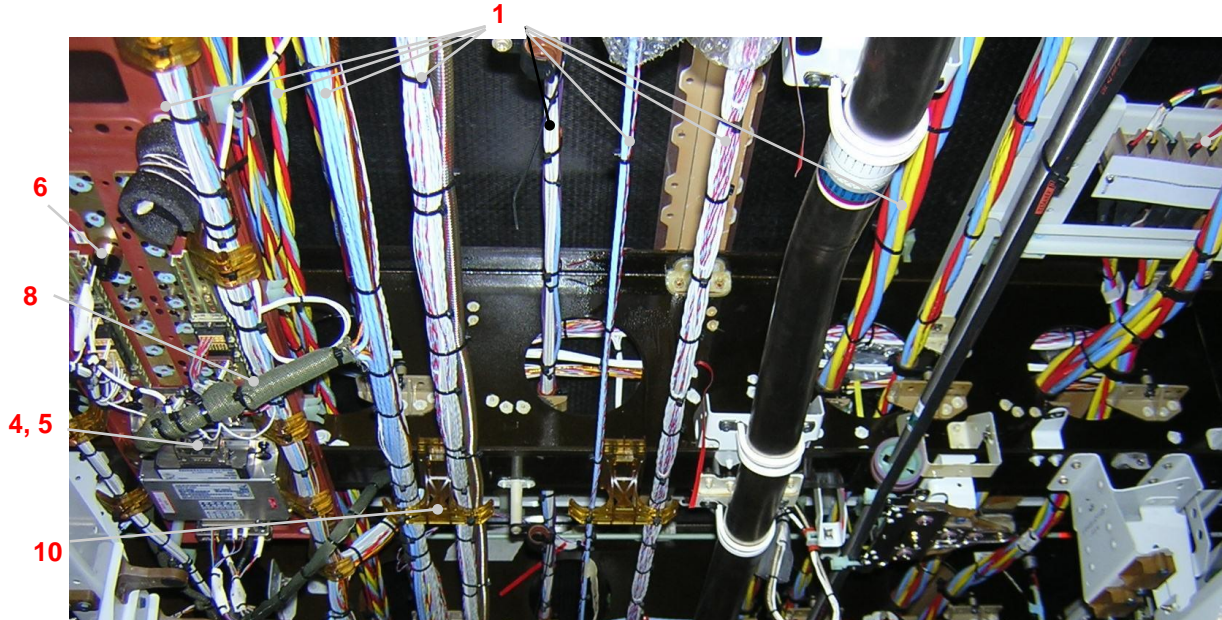
.
comp:Active_component
  rdf:type owl:Class ;
  rdfs:label "active component"@en ;
  rdfs:label "active element"@en ;
  rdfs:label "active item"@en ;

```


Electrical wiring interconnection system (EWIS)

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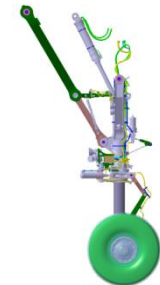
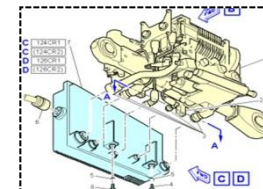
⇒ Mainly: Aircraft electrical common installation (ATA92)



⇒ But also: part of Systems equipment wiring:

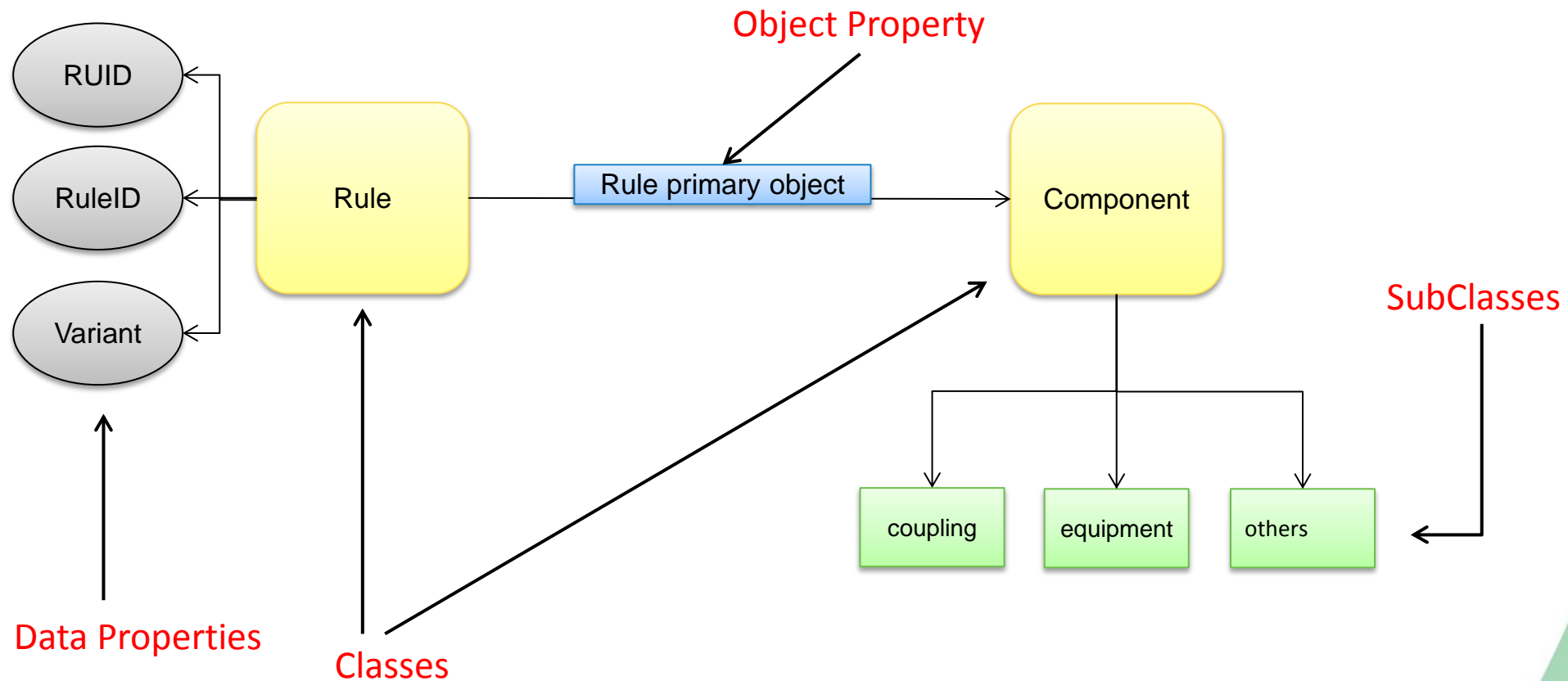
- Power distribution centers wiring
- External wiring of equipment
- Wiring of equipment not qualified to appropriate standards e.g. EUROCAE ED-14 / RTCA DO-160

cf CS 25.1701(b)&(c)



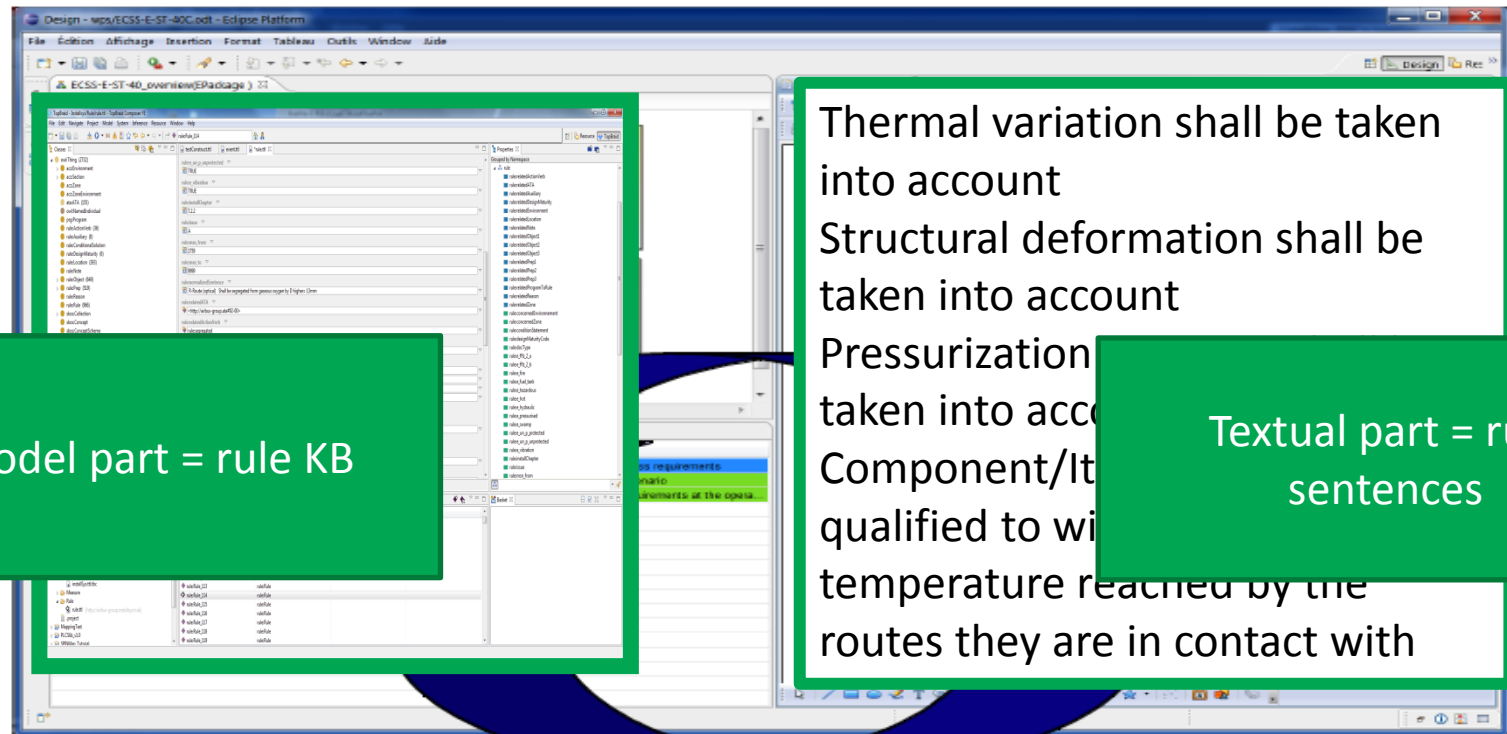
Back-up slides

Représentation des données

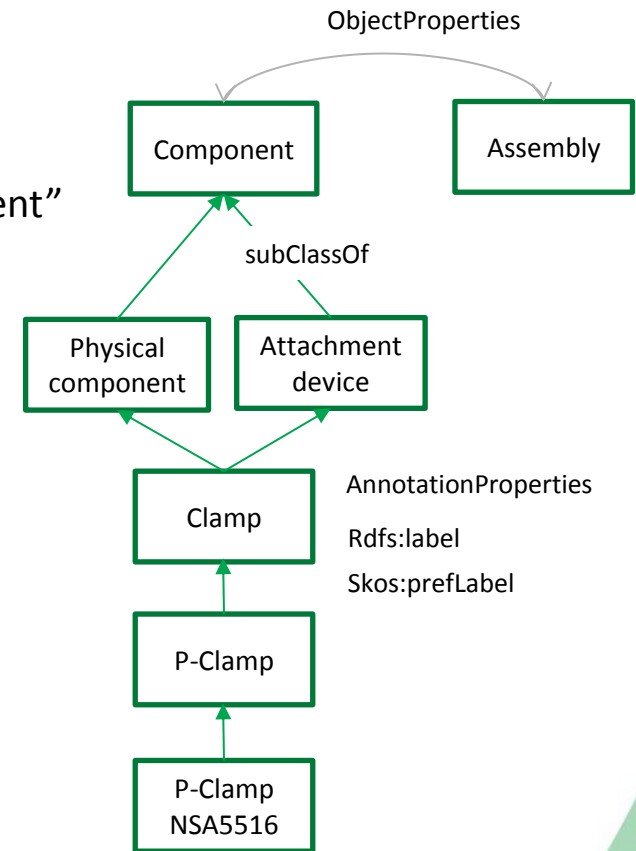
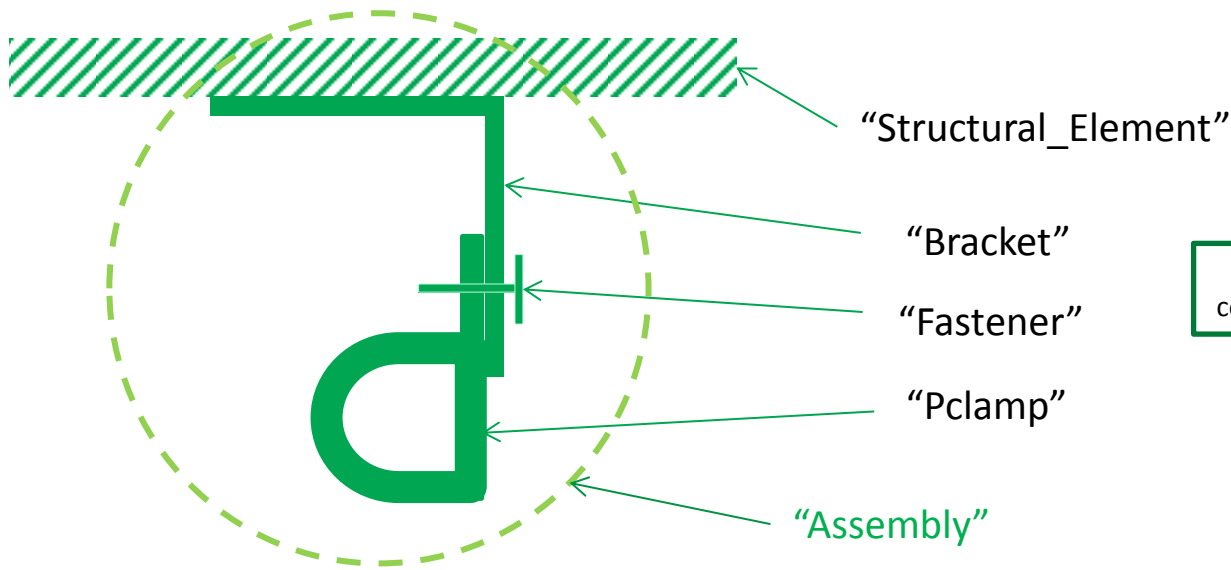


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Status 1st iteration: synchronizing the SIDP KB content and text part



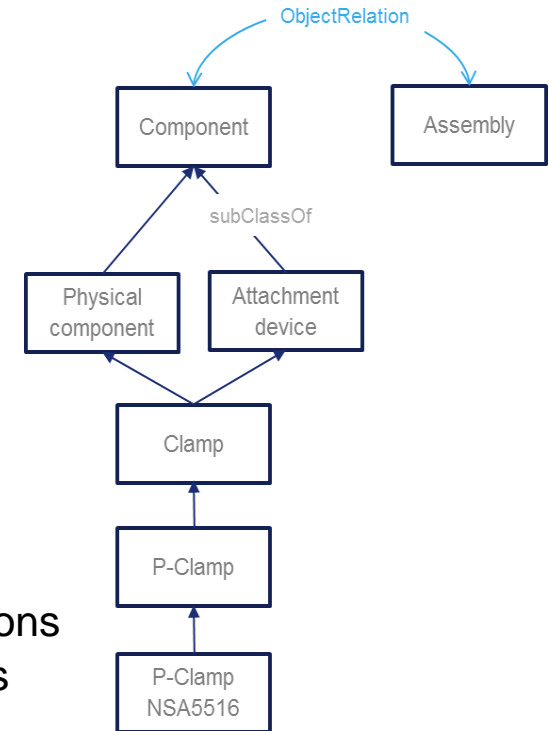
Component classes taxonomy



Component classes taxonomy

“P-clamp NSA5516 can be fixed on X with Y”

“Physical component” “Standard reference”

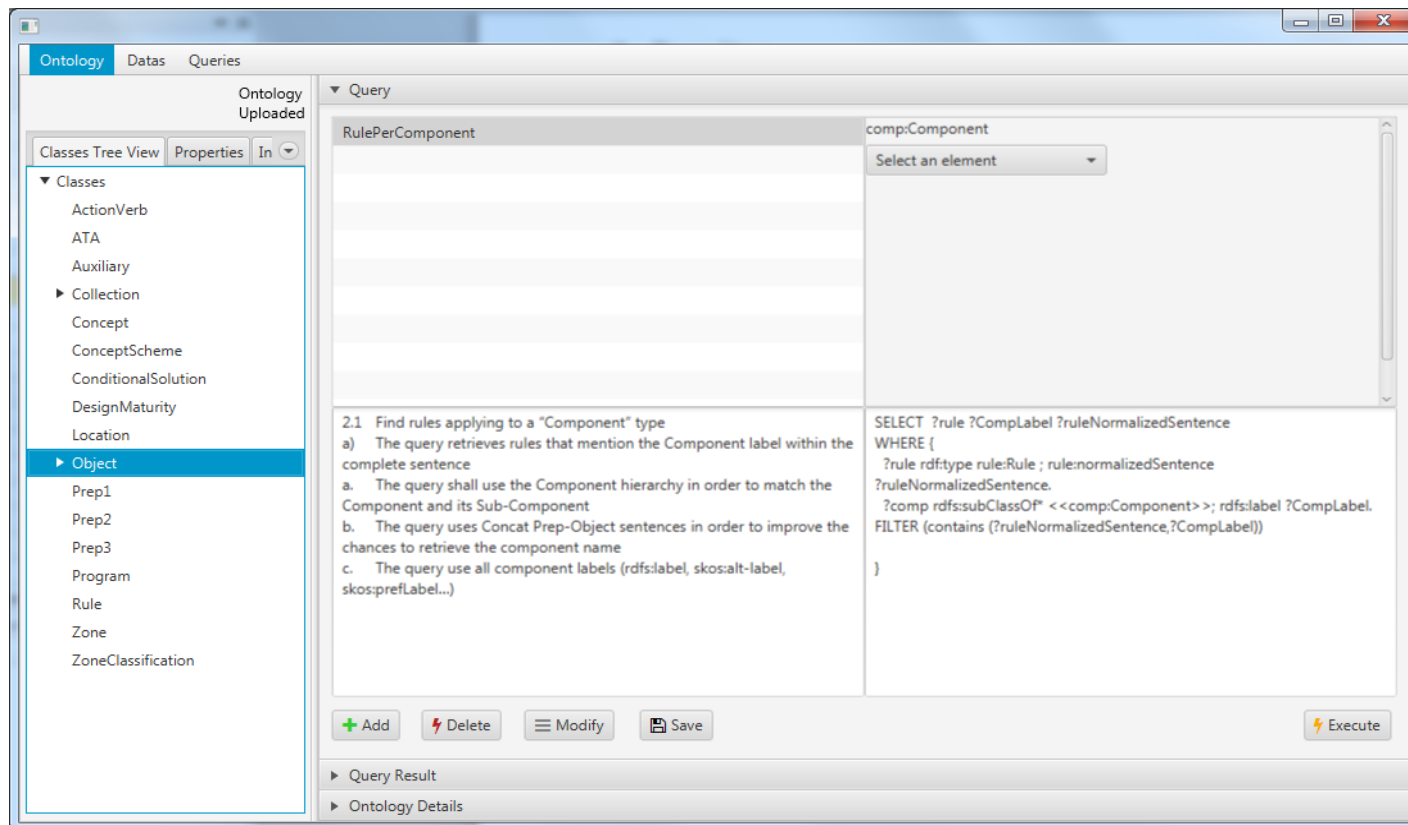


- NLP **Parsing** uses this taxonomy. Labels + assumptions such as a physical component may be referred to using its name or its reference or both concatenated
- **Inference** rule: a rule applying to a component type (Attachment device) applies to its subtypes (P-clamp)
- **Document** display : when searching rules applying to a component type (P-Camp) → retrieve and display rules applying to super-types

SPARQL queries

Status : model based queries specification

- Preliminary study with Loria (Text to RDF)
- 1 internship on RDFizer and Query management



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Thank you for your attention!
Any question ?