

# An Implementation of Multi-Level Modelling in F-Logic

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1<sup>st</sup> International Workshop on  
Multi-Level Modelling (MULTI 2014)

# Overview

- Engineering Lifecycle
- “Software Ecosystems Interoperability”
- Application of Multi-Level Modelling
- Implementation in F-Logic
- Comparison

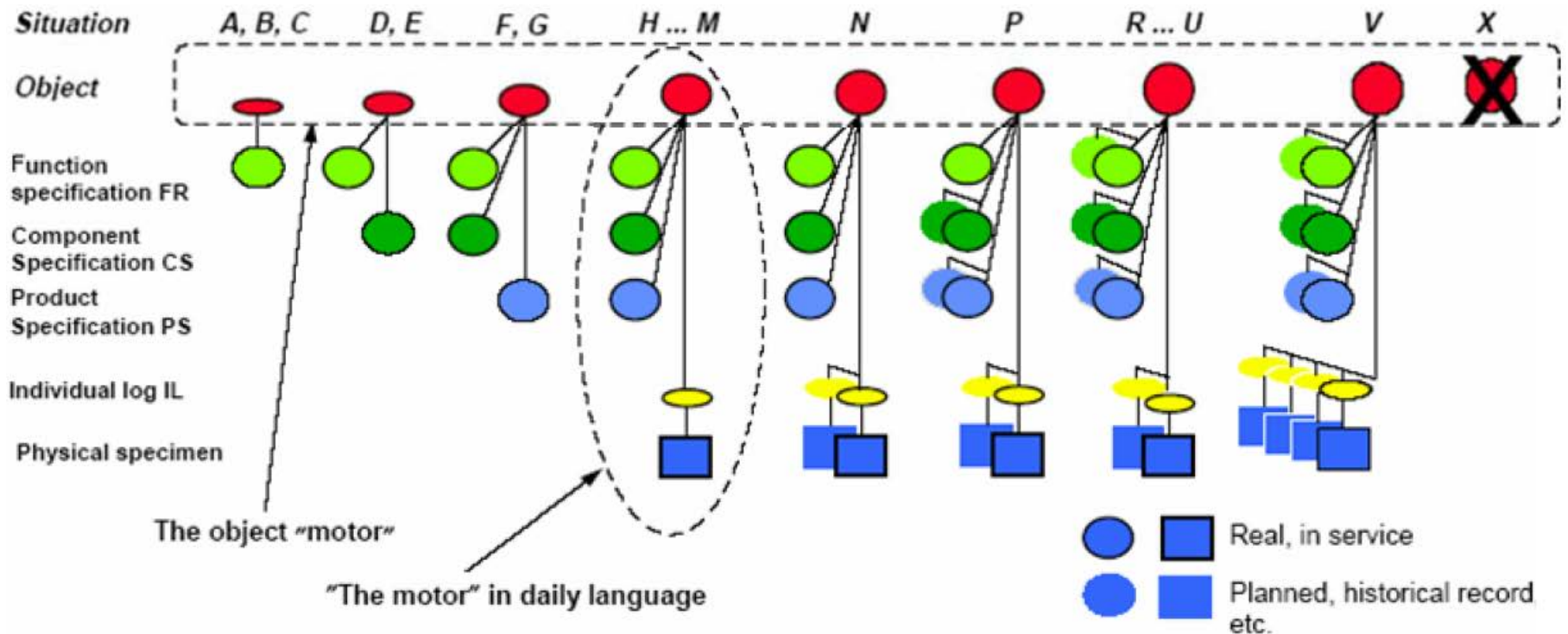


# Industrial Plants



# Engineering Lifecycle

- Plant or Component



# Engineering Conformance Checks

- Want to validate concrete systems
  - Components
  - Composed subsystems
  - Plant
- Properties of (sub)systems depend on properties of constituent parts
  - Matching pipeline/nozzle diameters
  - Pressure tolerances
- Operational behavior monitored over time
  - To do this requires passing data between the software systems in different stages of the lifecycle

# Oil & Gas Interoperability Pilot

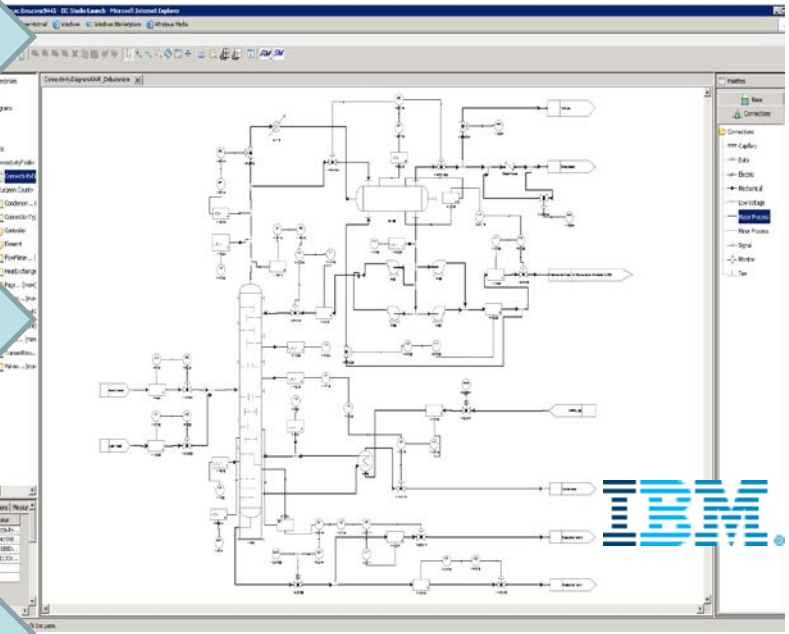
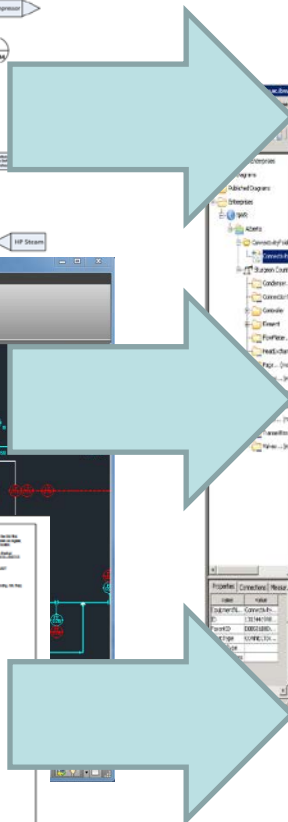
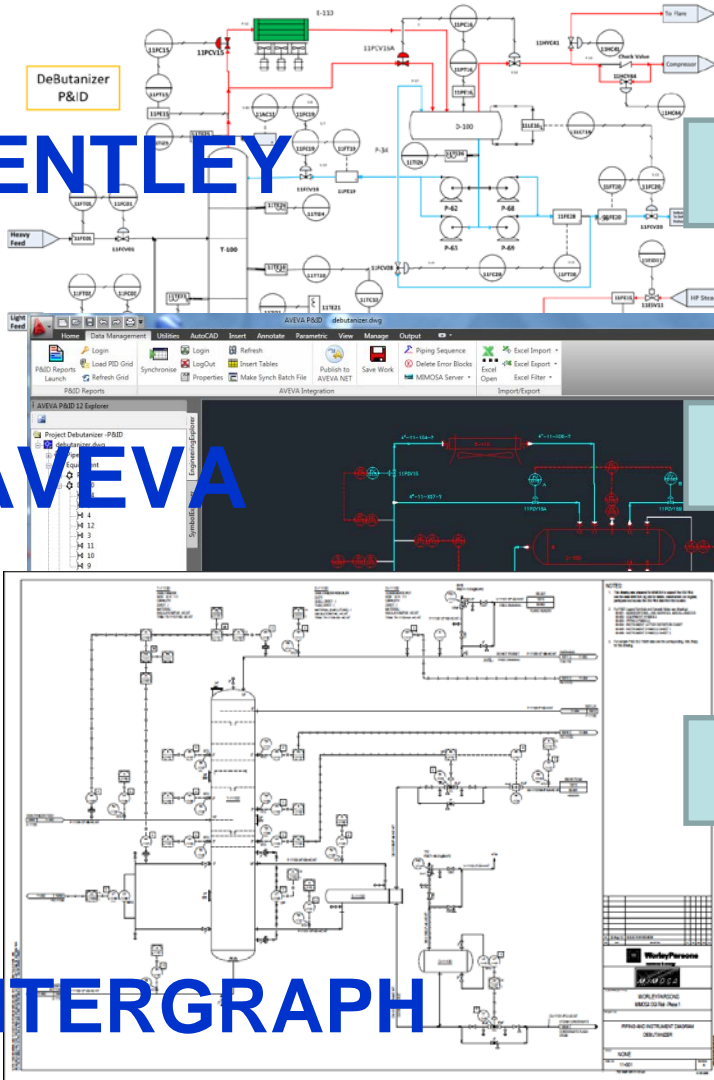
- Goal: Interoperability in the Oil & Gas Industry
- Automated Data Translation between different “software ecosystems”
- Based on the standards landscape:
  - “Reference Environment” (EPC): ISO 15926
  - “Execution Environment” (O&M): MIMOSA
- Multi-standards-organisation/multi-partner effort under ISO TC184/WG6
- Incrementally covering multiple use cases
- Youtube live demo video

# ISO15926 to CCOM Transformation

**BENTLEY**

**AVEVA**

**INTERGRAPH**

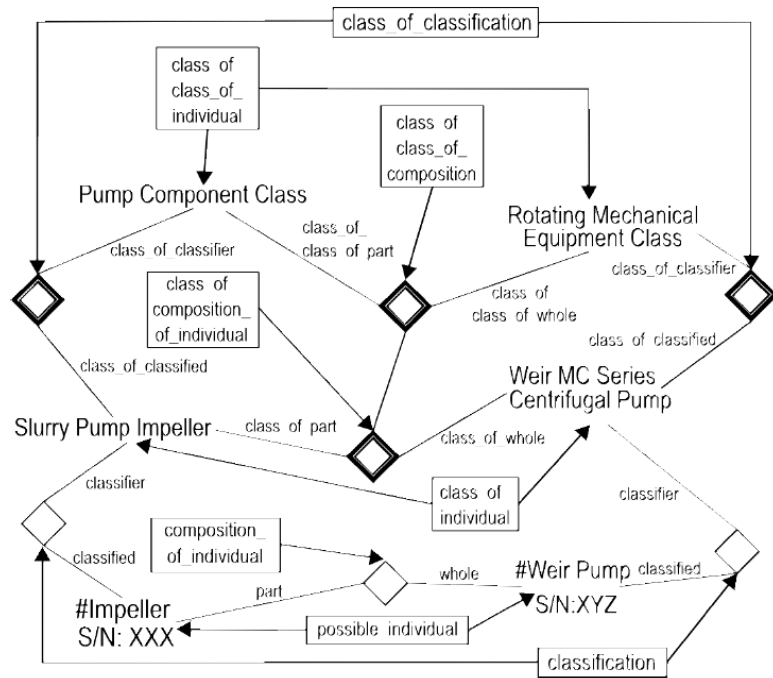


Transformations from different vendors should provide Identical outcome

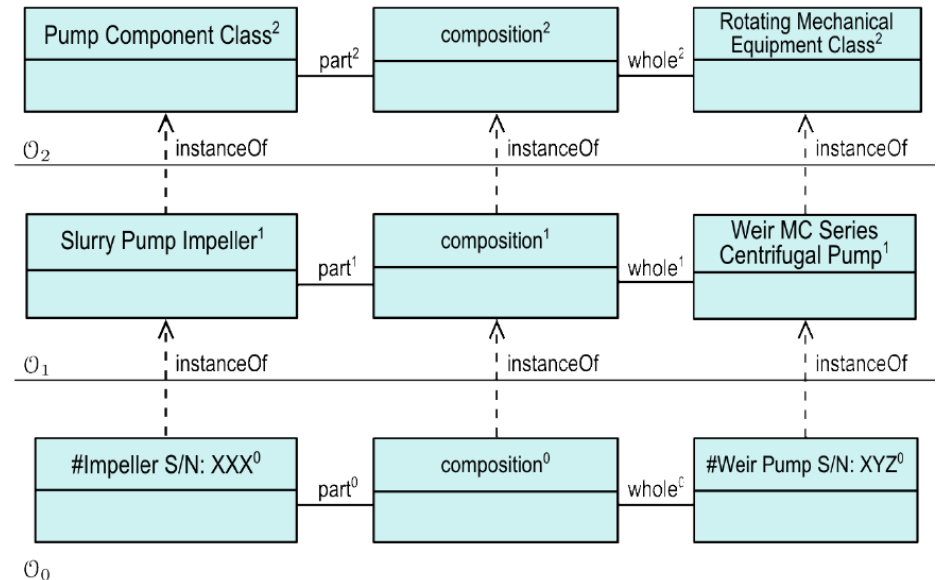




# Application of Multi-Level Modeling on ISO 15926



(a) Instance diagram



(b) Multi-level representation

Fig. 1: Two representations of the same example: relating an impeller to a pump.

# Multi-Level Modelling in F-Logic (MiF)

- F-Logic (Frame Logic)
- Based on object-oriented knowledge representation
- Ontology language
- Declarative, compact, well-defined semantics
- Widely used: Ontology and Semantic Web Community, Rule Interchange Format, and model transformation
  
- OGI Pilot: Integrated framework for formalisation, querying, validating and transformation
- Problem: F-Logic is not multi-level modelling aware

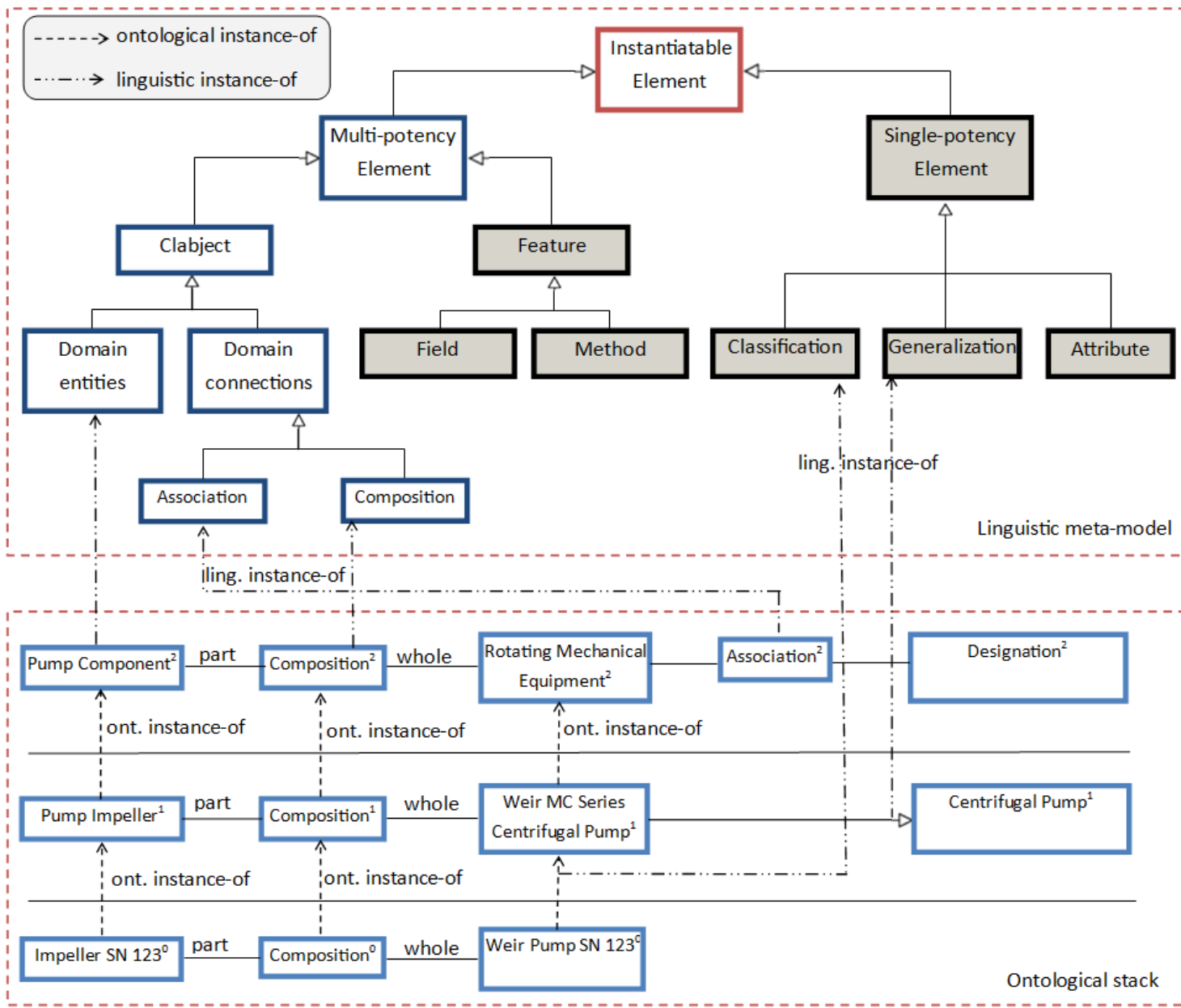
# Implementation in Flora-2

- Flora-2 is an implementation of F-Logic
- Various extension to F-Logic syntax (knowledge representation and reasoning)
- Implementation:
  - Some concepts directly supported
  - Some extensions necessary: linguistic vs. ontological instance-of relationships, multi-potency semantics, clabject, ...

# Meta Model

Field  
Supported

Clabject  
Extensions



# Comparison

Criteria/ Approaches	<u>Atkinson &amp; Kuhne</u>	Lazy Init.	<u>ConceptBase</u>	Formal DMM	F-OML	<u>MiF</u>
Linguistic extension and open semantics	-	✓	✓	✓	✓	✓
Object-oriented	✓	-	✓	-	✓	✓
Integrated framework	✓	✓	-	-	✓	✓
Relationship across levels	-	-	✓	✓	-	-
Mediation of relationship	-	-	✓	✓	-	✓
Single and multi-potency semantics	✓	-	✓	✓	✓	✓

# Conclusion & Future Work

- Implementation of a subset of OGI Pilot in Flora-2
- Integrated approach for formalising semantics, performing queries and validation
- Next steps:
  - Map Reference Data Library (RDL)
  - Performance analysis
  - Apply same principles in MIMOSA CCOM model
  - Implement transformation

Questions?