Semantic Technologies and Statoil's Integration Layer for Plant Information Systems

Jennifer Sampson

Principal Analyst Information Technology Infrastructure

Statoil is an international energy company with operations in 36 countries. Building on more than 35 years of experience from oil and gas production on the Norwegian continental shelf, Statoil is committed to accommodating the world's energy needs in a responsible manner, applying technology and creating innovative business solutions.

Open

The MapIT Project Vision

Provide enterprise-wide access to plant and equipment related data, through standardised information models combining data from different sources, to end-user applications.

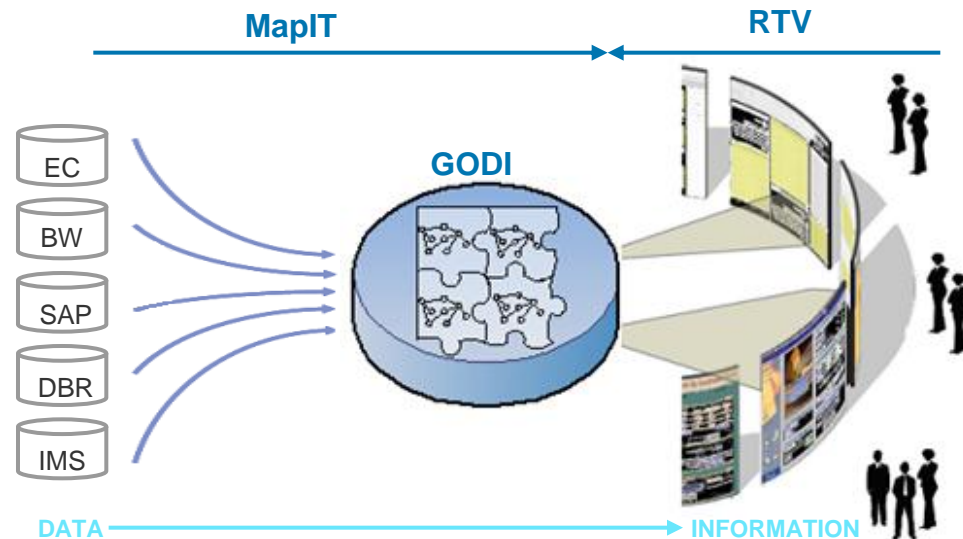Statoil

MapIT Project Goals

- Improved data management and availability

- Simplified data federation

- Reduced data integration costs

- Simplified client application replacement
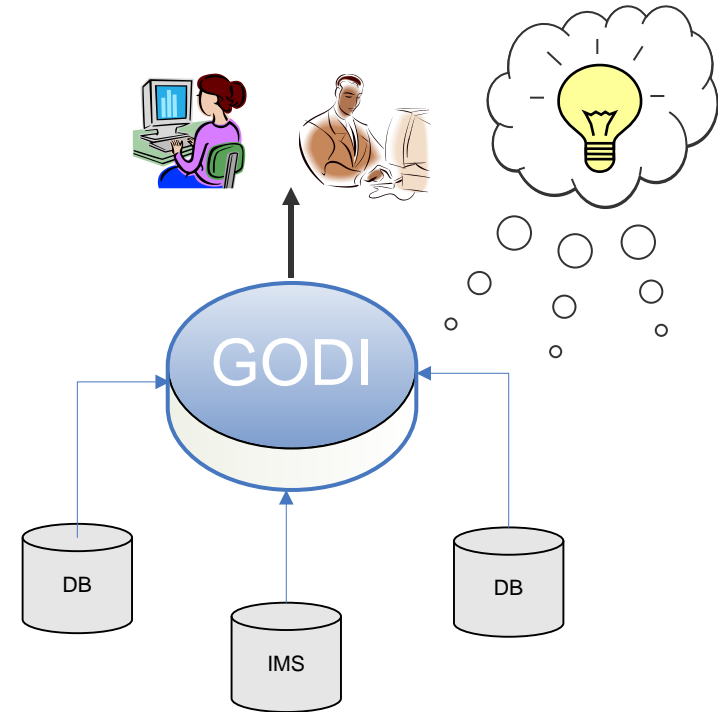
GODI – Global Operations Data Integration

Business Drivers MapIT - RTV

- The MapIT project will deliver standardised <u>data access</u> independent of data source technology to any data subscriber

- The RTV project will deliver <u>information work spaces</u> for data visualisation and collaboration to Petec and OMM

- The two projects will deliver:
    - Standardised information to support safer, better and faster decisions
    - Standard visualisation and collaboration across assets
   - Enablers for creative and innovative user IT-tools

GODI - Global Operation Data Integration
RTV   - Real Time Visualisation
MapIT- Master project IT

Statoil

Semantics = Meaning

- Using semantic technologies to support the integration of Statoil´s plant and corporate data

- It is about common formats for integration and combination of data drawn from diverse sources.

- Standards, tools, techniques, best practices, community, trust, logic, reasoning ...
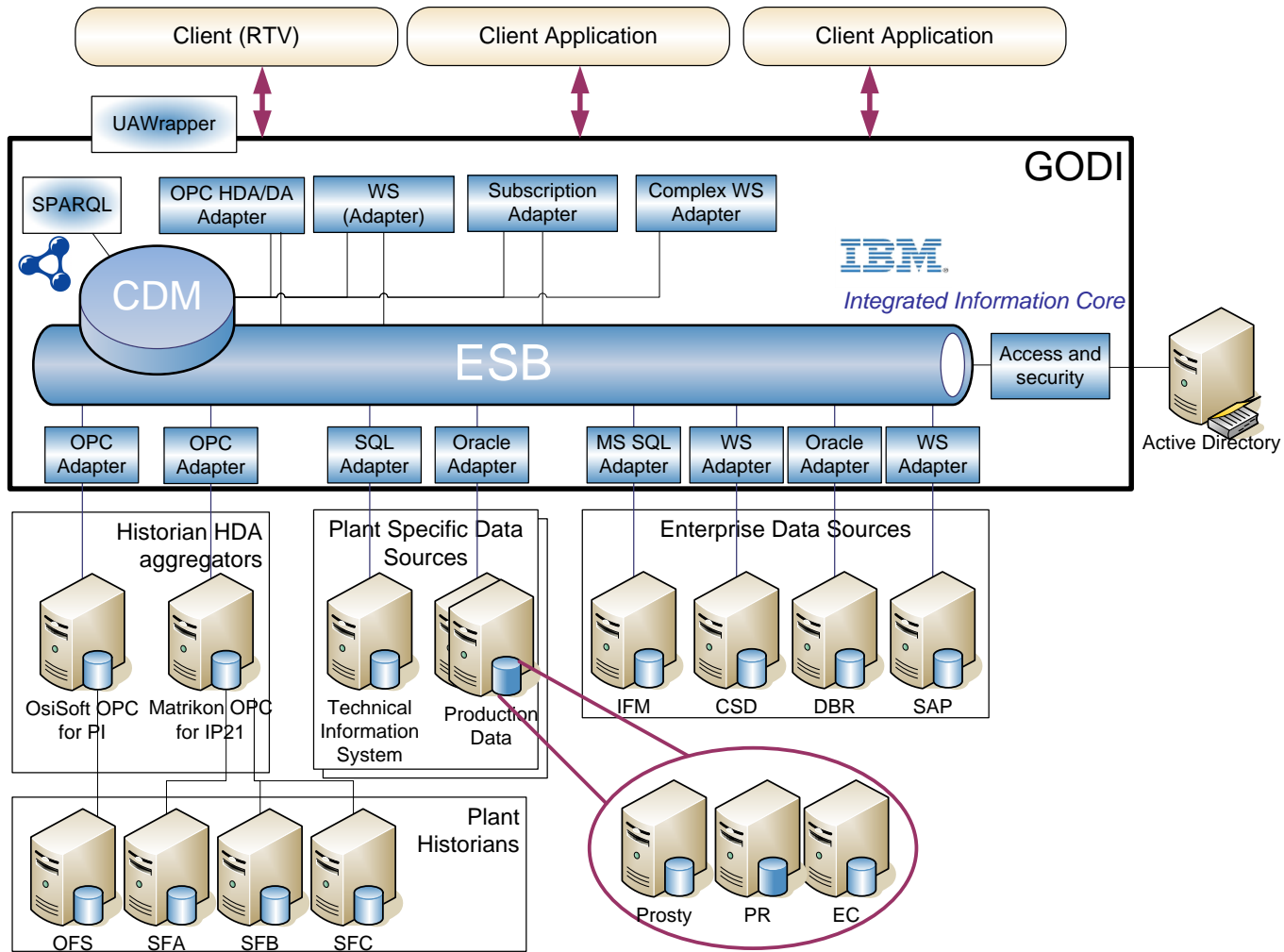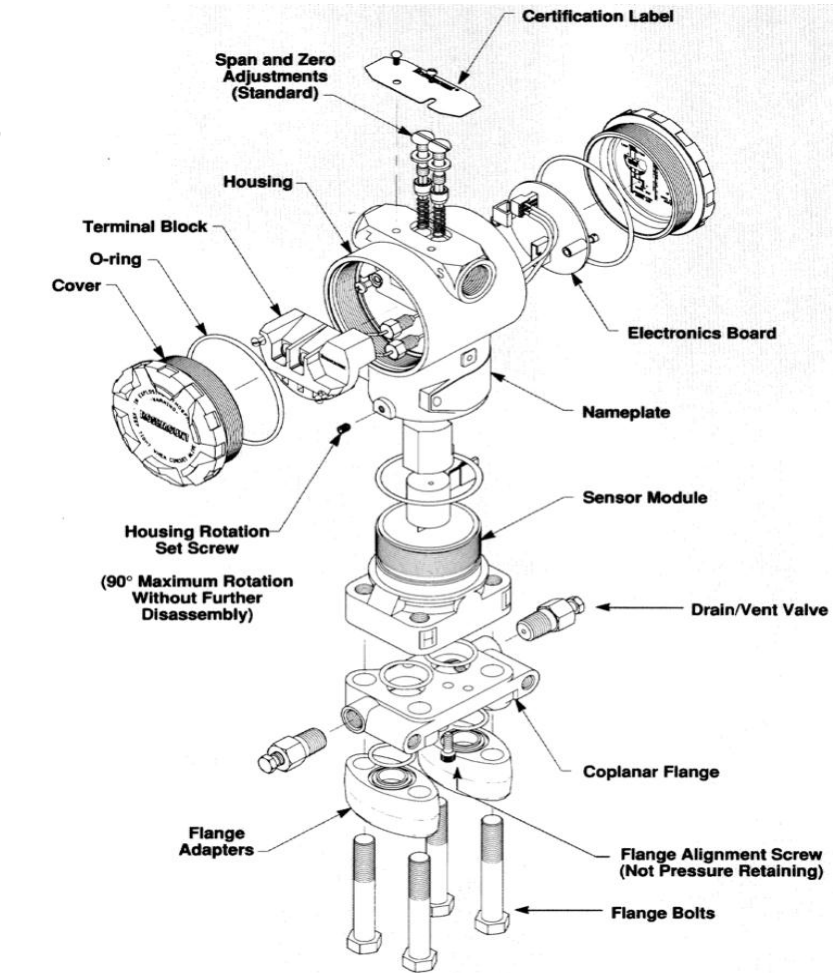
MapIT
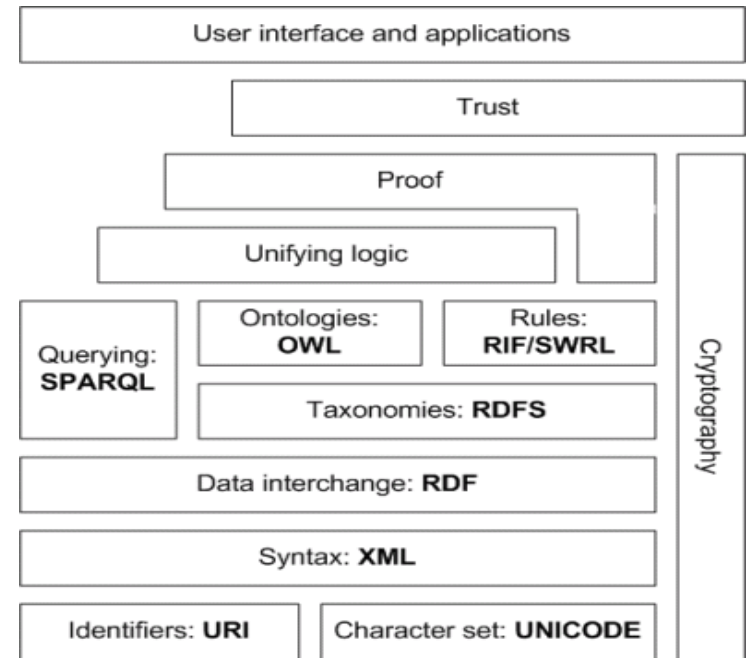
The Semantic Web Stack

GODI Architecture
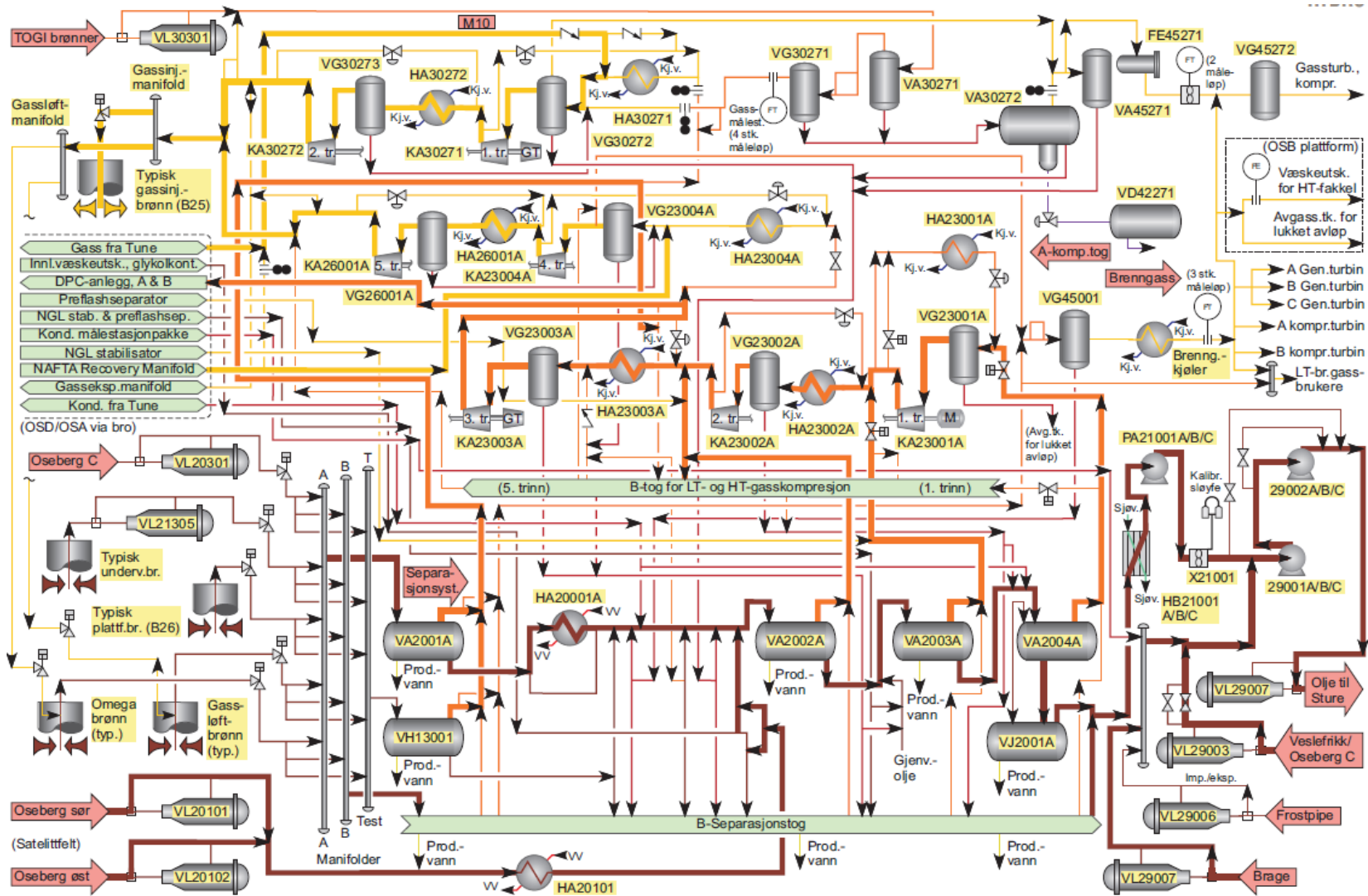
What is a semantic model?

- A model of some aspect of the world

  - Introduces vocabulary e.g. oil & gas domain

  - Specifies meaning (semantics) of terms

    - Pressure Transmitter is a Transmitter that is part of the subsea flow control module

  - Formalised using suitable logic, eg:

$$\forall x.[PressureTransmitter(x) \rightarrow Transmitter(x) \land \exists y.[isPartOf(x,y) \land SubseaControlModule(y)]]$$

Certification Label
Span and Zero Adjustments (Standard)
Housing
Terminal Block
O-ring
Cover
Electronics Board
Nameplate
Housing Rotation Set Screw
(90° Maximum Rotation Without Further Disassembly)
Sensor Module
Drain/Vent Valve
Coplanar Flange
Flange Adapters
Flange Alignment Screw (Not Pressure Retaining)
Flange Bolts

Statoil

The Challenge: Representing Reality

Data foundations

- Engineering "best practice", developed over years
- NORSOK standards, implemented on newer installations
- Engineering Numbering Systems (ENS)
- Technical Information systems (TI) and Life Cycle Management (LCI)
- Process Control Systems (SAS, SCADA, …)
- Data Historians (IMS)
- Production Reporting Systems (PROSTY, Energy Components, …)
- Operations and Maintenance system (SAP O&M)
- Expert systems (condition monitoring, process optimation, well performance, simulation, allocation, …)

Statoil

Resource Description Framework (RDF)

- We use the RDF/XML data model as the standard format for describing Statoil's asset data.

- Has a powerful query language - SPARQL

- Consists of graphs of triples – subject, predicate, object

  Resource:
  http://statoil.com/GODI/SFA/PT1121

  - A single RDF assertion: "The state of the Pressure Transmitter is Active"

  - Triple(state, pressure transmitter, active)

  predicate

  literal

- Can form complex graphs (web of data)

  - [Well] is connected to [Production Manifold]

  - [Production Manifold] is connected to [Inlet Separator]

 - [Well] is connected to [Inlet Separator] (could also be inferred?)

Reference Semantic Model by IBM

- The RSM model is the meta model model used in IBM´s IIC solution to categorise/classify Statoil's plant data in a common way

- Blend of different industry standards – S88, S95, ISA95/88, CIM (IEC 61970), MIMOSA, ISO 15926, UNCEFACT, …

- RSM contains generic business concepts for providing a coherent view of an enterprise.

- 451 classes/entities, 238 data properties, 776 associations
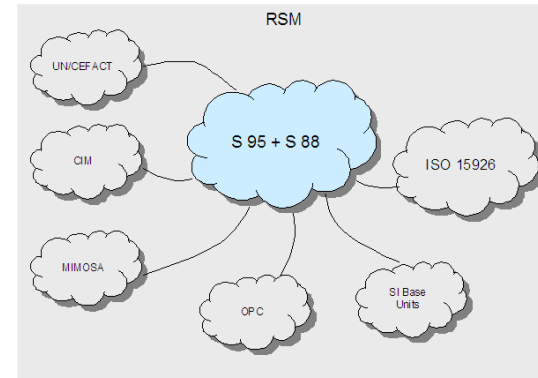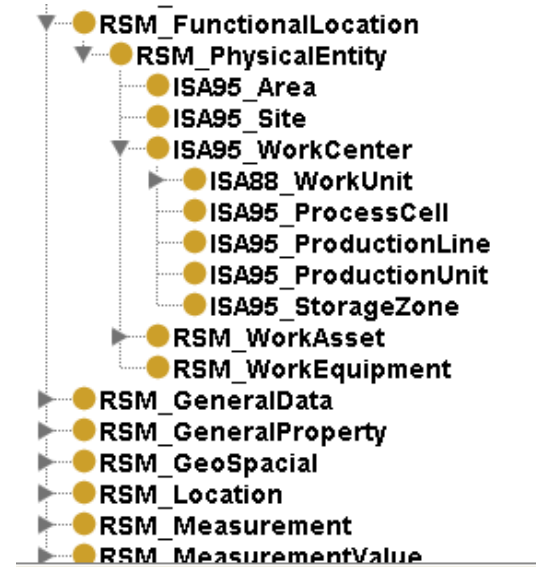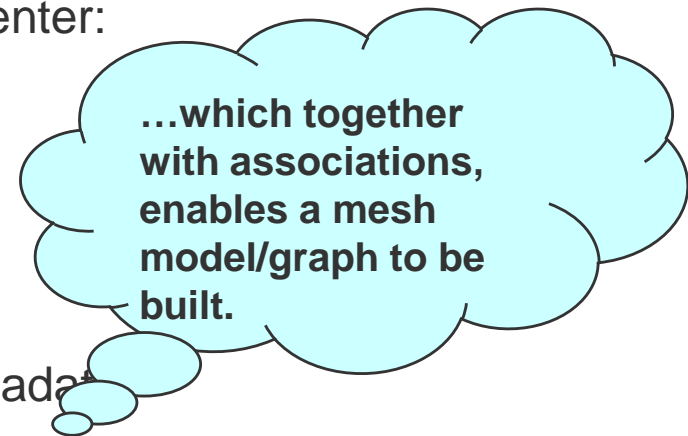
Developing the semantic data model

- IBM's RSM meta model

- Generic view of an enterprise

- Used RSM to model plant and business concepts in Statoil

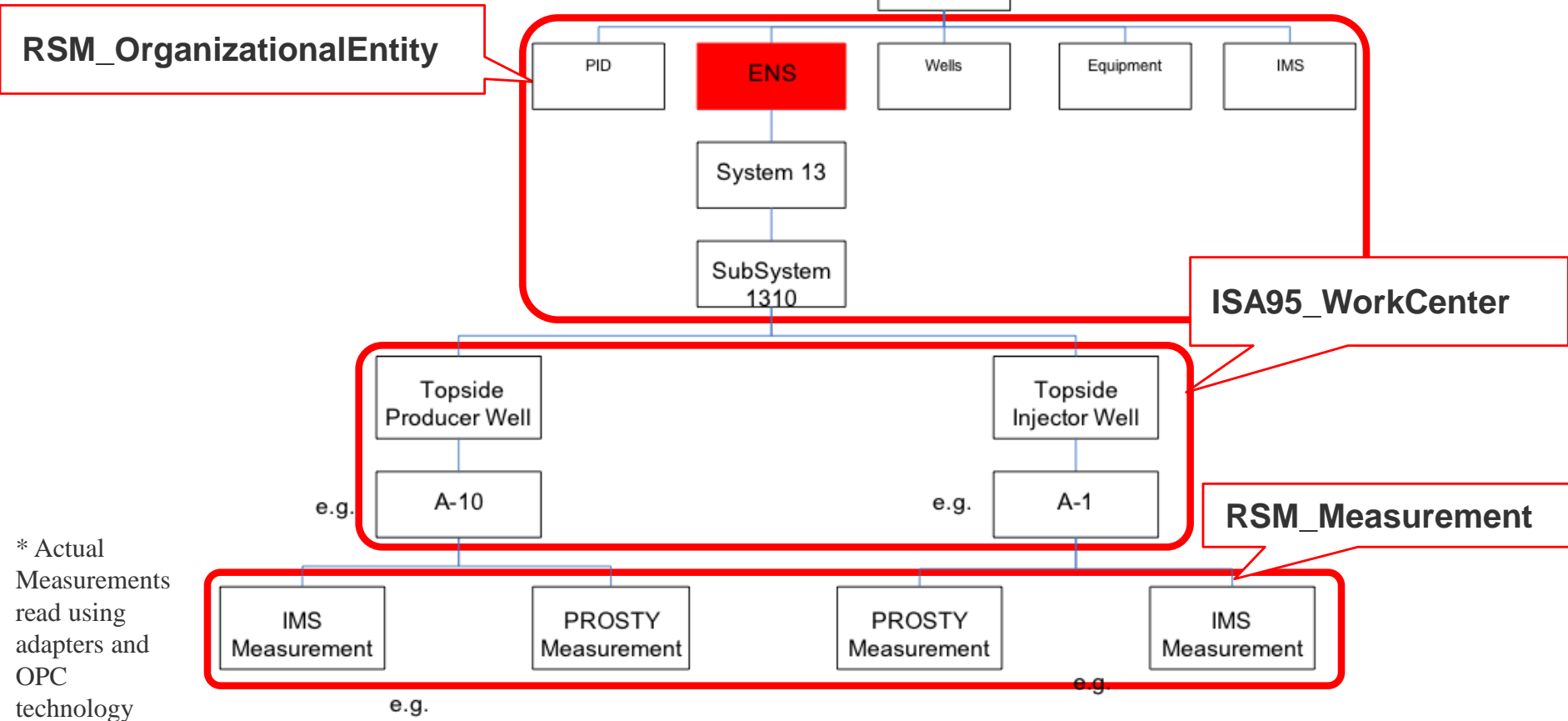- Developed templates in OWL describing RSM usage
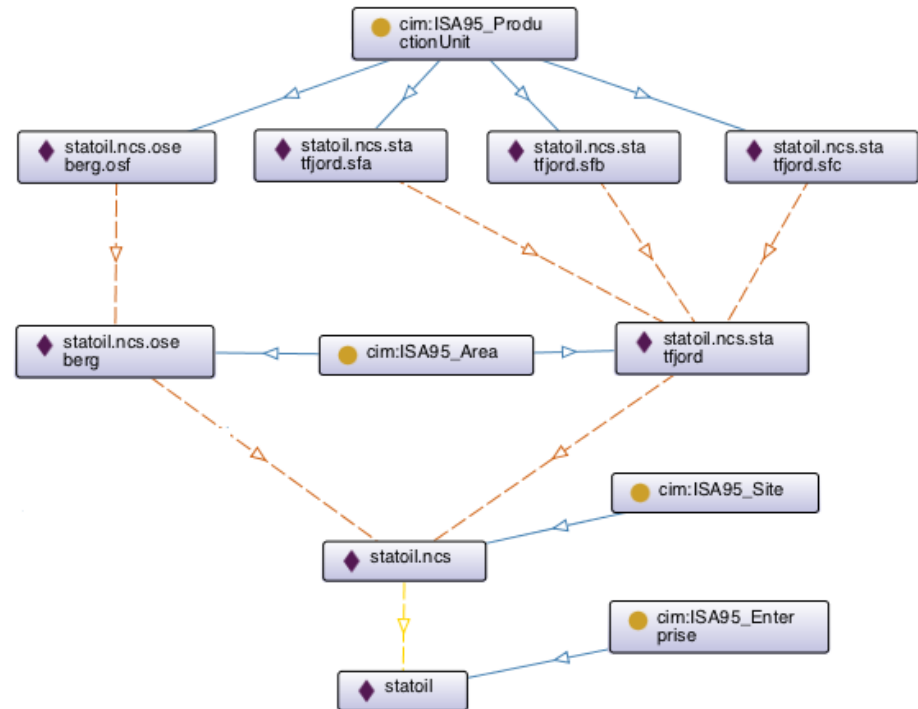
Enterprise level GODI model fragment

Statoil's CDM using the RSM

- Enterprise level:
  - ISA95_Enterprise,
  - ISA95_Site,
  - ISA95_Area,
  - ISA95_ProductionUnit
- Asset levels – pilots SFA, SFB, SFC and Oseberg Feltsenter:
  - RSM_OrganizationEntity – Statoil Views
  - ISA95_WorkCenter – Wells, Separators
  - RSM_WorkEquipment – Equipment and P&Ids
  - RSM_Measurement – Measurement metadata
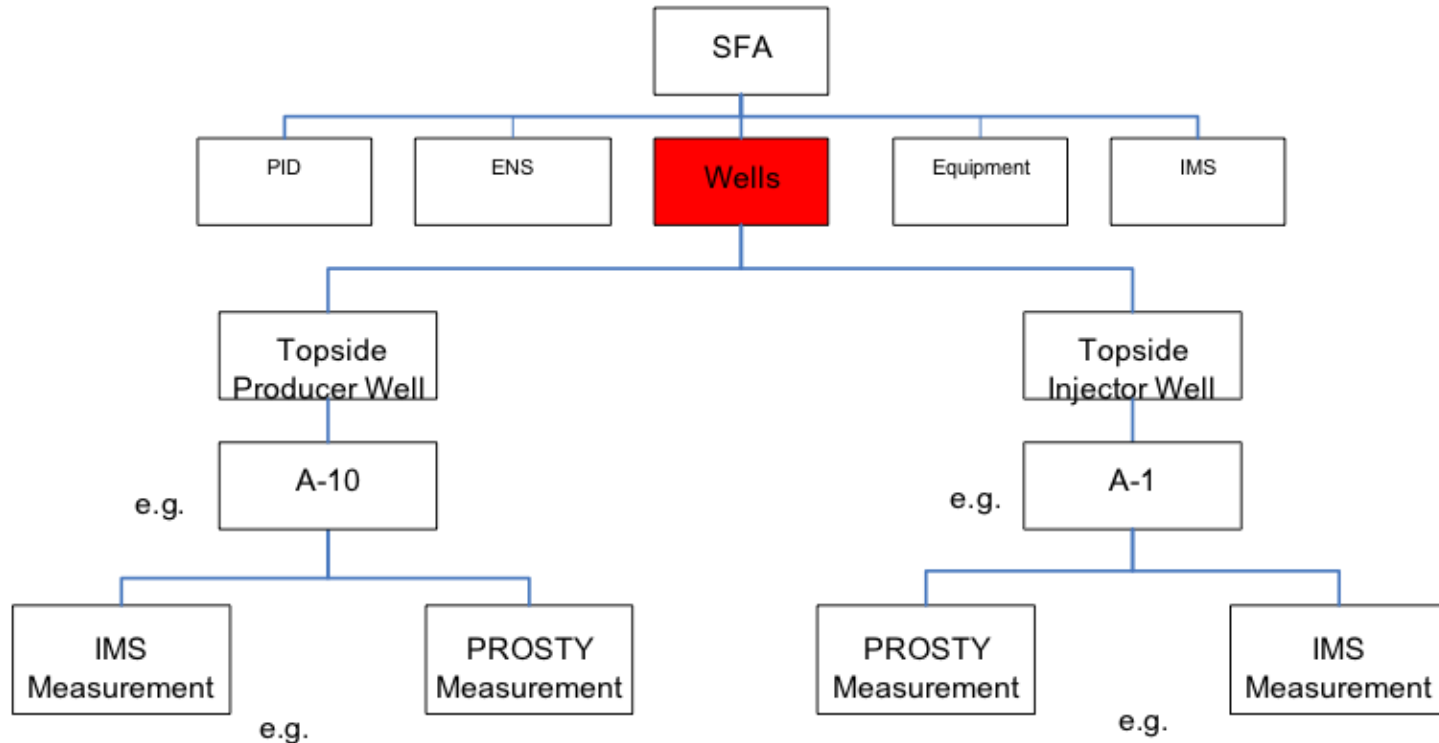 - RSM_MeasurementValue – Measurement value metada

Base entities used in GODI

…which together with associations, enables a mesh model/graph to be built.

Statoil

ENS to Measurements

Wells to Measurements

Statoil

Model Fragment – Statfjord A
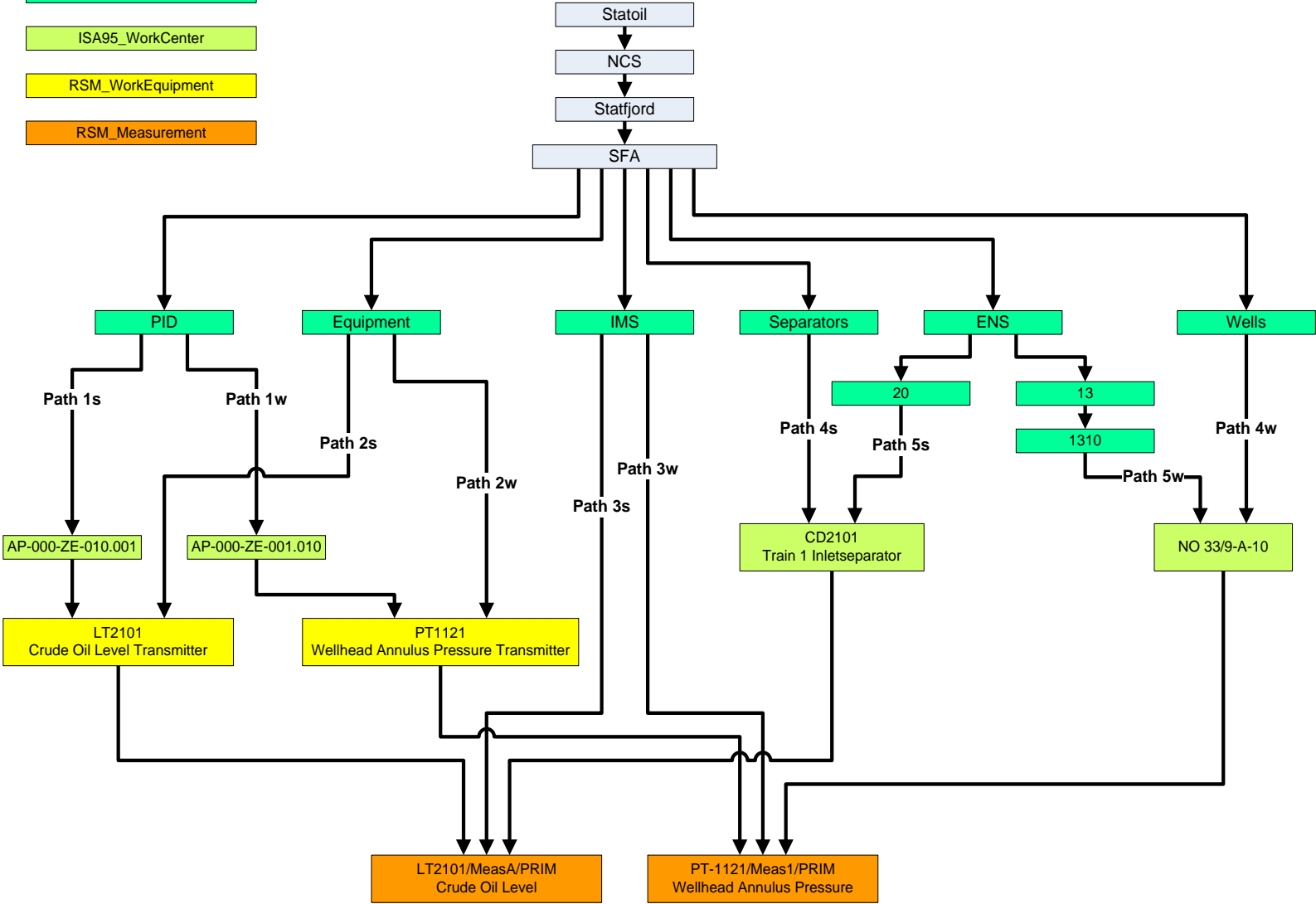
Challenges

- Lots of data! But little meta data, semantics are encoded in the applications.

- Utilizing and integrating what we know

- Ensuring the information is correct

- Ensuring the information is complete

- Mapping the data sources to a common system classification

- Equipment and measurement name standardization

Statoil

Oil and Gas ontology

- Local Equipment and System Names are not unique outside their context, and are not precise enough for use in data integration

- The ISO15926 is designed for data integration

    − standardisation of main equipment, UOM and system categories

- The reference data (ontology) is available at PCA's Reference Data System (RDS) https://www.posccaesar.org/

Statoil
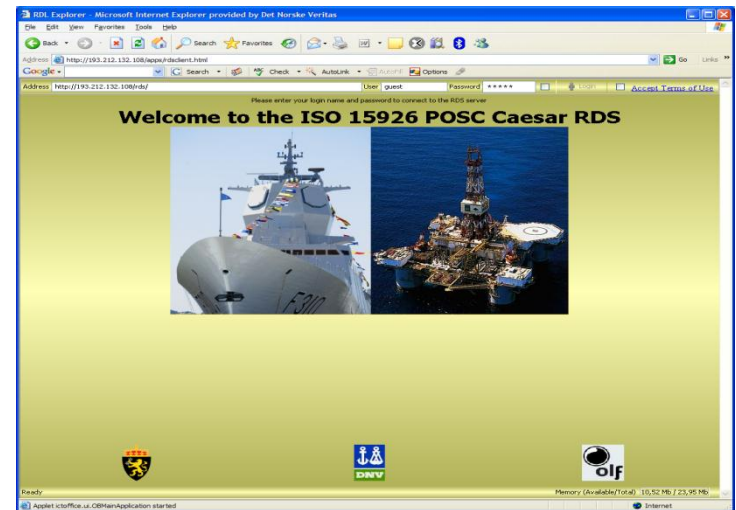
Future roadmap

- Development of new, end user applications that will interface with the data store and be new consumers of data and services delivered by GODI.

- Connect up with other datasets across the enterprise

    − e.g. environmental monitoring

- Smaller vocabularies/ontologies linked together

Thank you

Jennifer Sampson

Principal Analyst Information Technology Infrastructure

www.statoil.com