Using techniques for Ontology-based Data Access to autogenerate Daily Drilling reports

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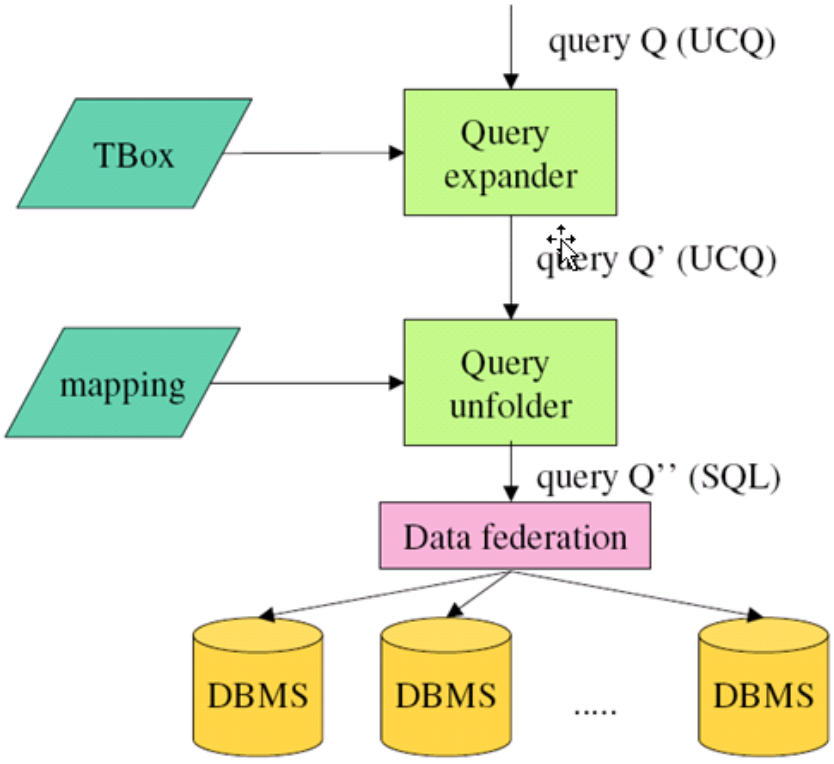
About this work

- It's a case study
- Originated in the Drilling activity of Integrated Operations in the High North in 2008
- Primarily implemented by two MSc students
- Additional funding from PCA / EPIM
- Baker Hughes provided drilling data
- Accepted for presentation at the Society of Petroleum Engineers' Intelligent Energy conference (SPE IE) 2012

Point of departure: Reporting in the O&G sector

- Reports have a clearly specified content
- The descriptions employ standards or "nearby standards"
- Report generation has an element of data integration
- The O&G industry spends significant resources on this
  - Manual processes
  - Integration not supported by the systems they use
- The amount of reporting is increasing

Virtual Ontology Based Data Access (OBDA)

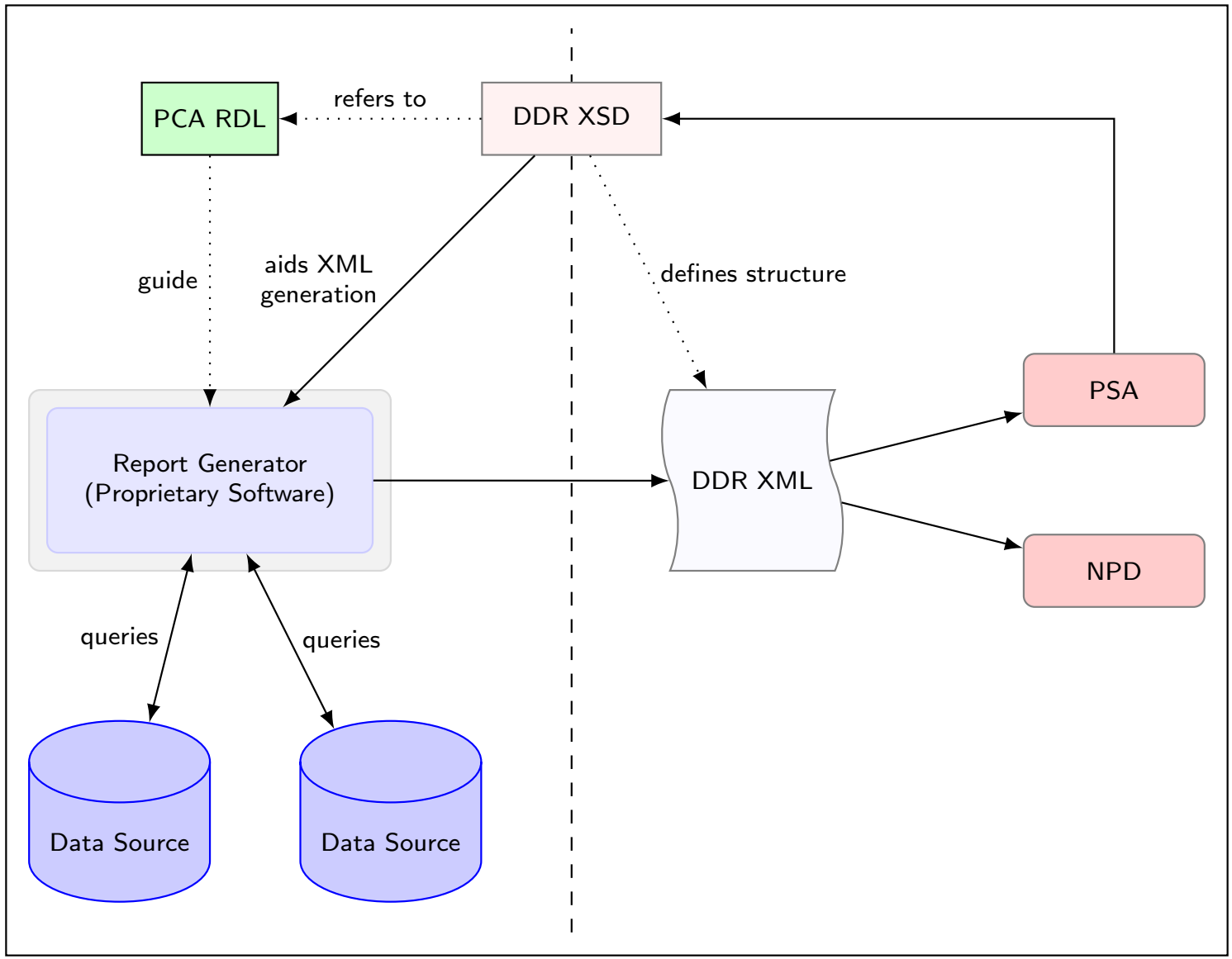


- TBox: End user vocabulary as OWL-QL ontology
- mapping: Ontology concepts map to DBMS by SQL
- Query Q in end user vocabulary
- Query rewriting generates SQL query Q"
- Prototype tools
  - QuOnto
  - Quest

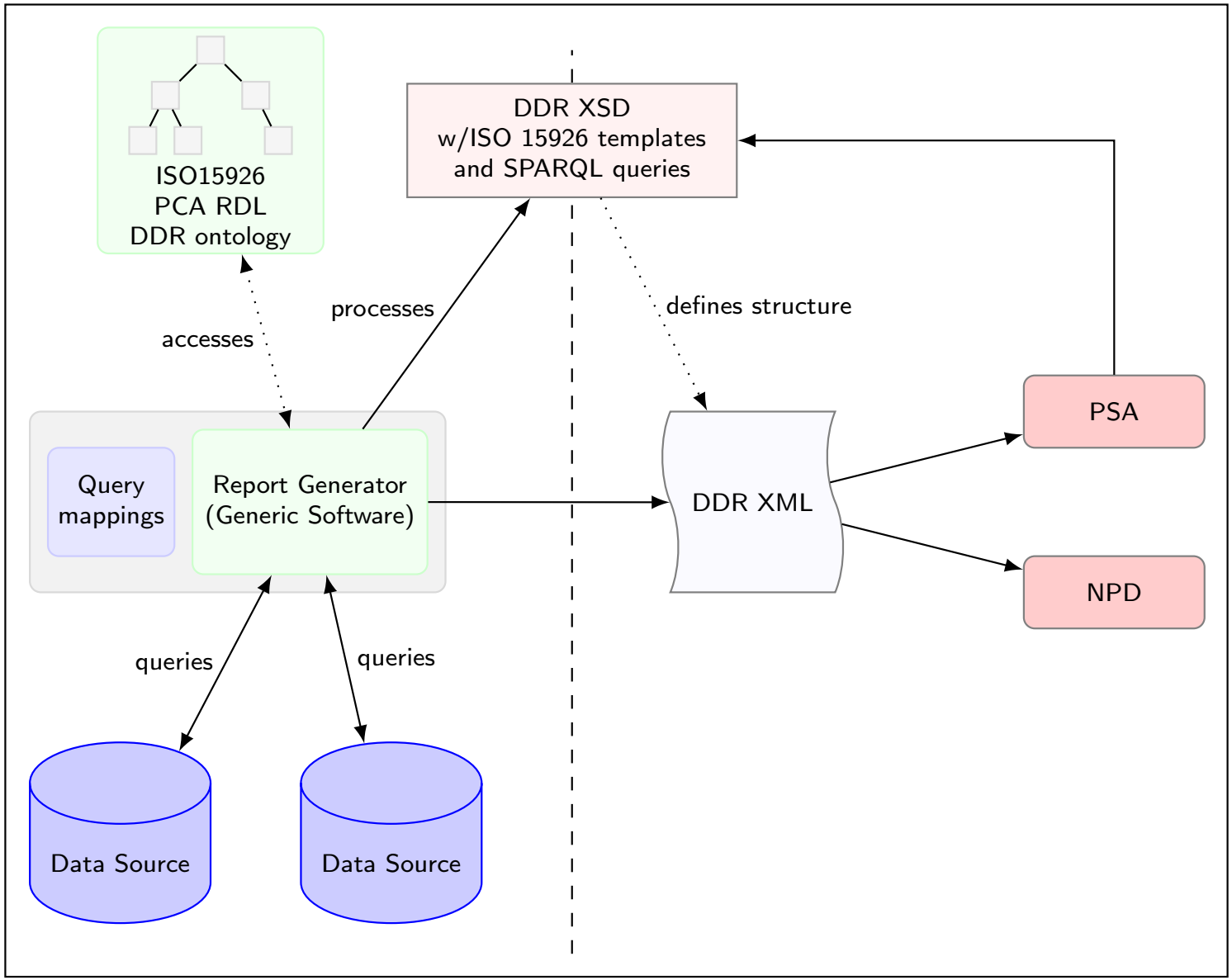
Selling points for semantic technology/declarative methods

- Information quality: What are the sources of error?
- Maintenance. How smoothly do the solutions support changes?
- Genericity: Does the report generation practice easily transfer from one type of report to another?
- Reuse: How easy is it to use the reported data in other contexts?

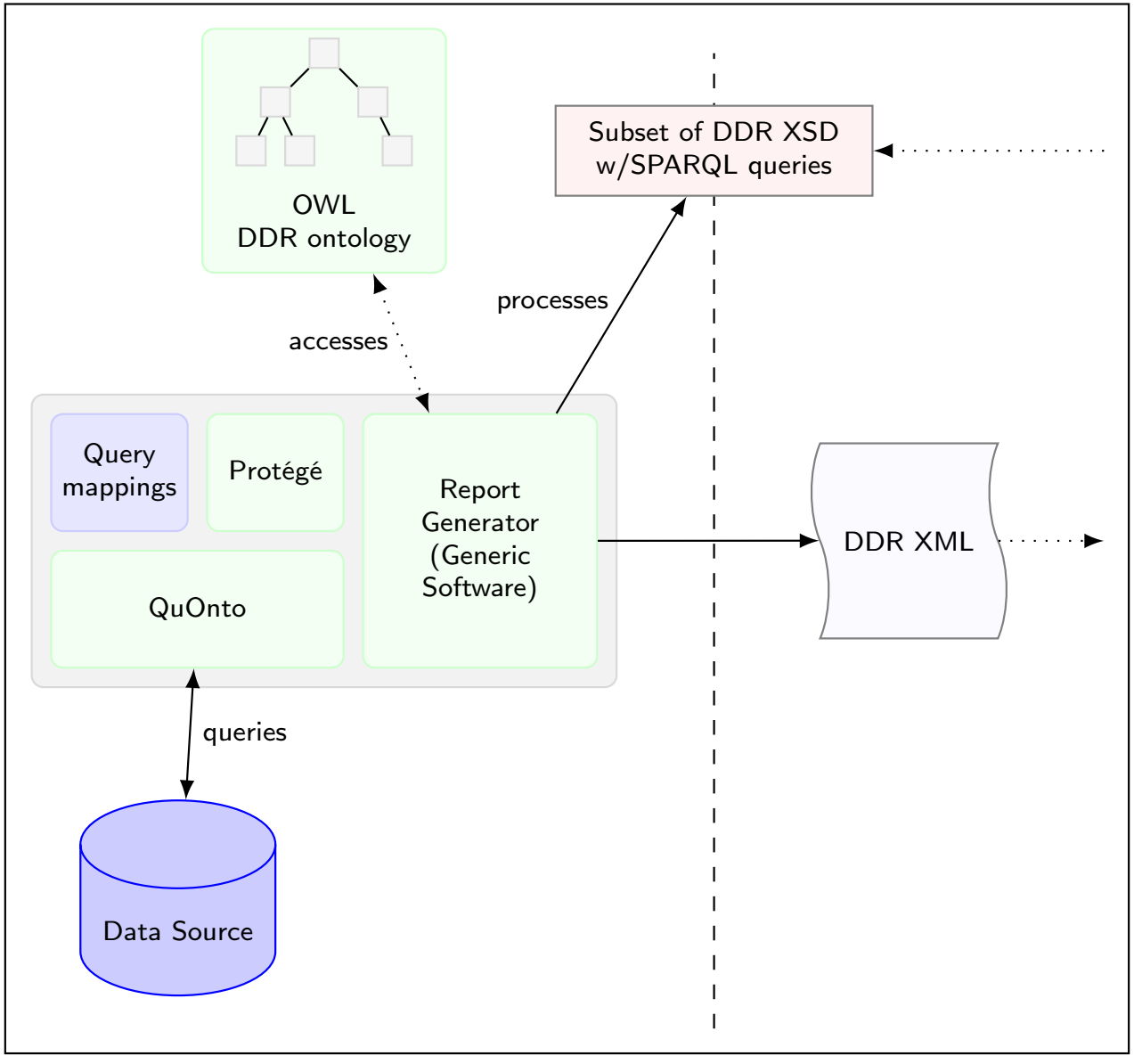
Current practice for DDR generation



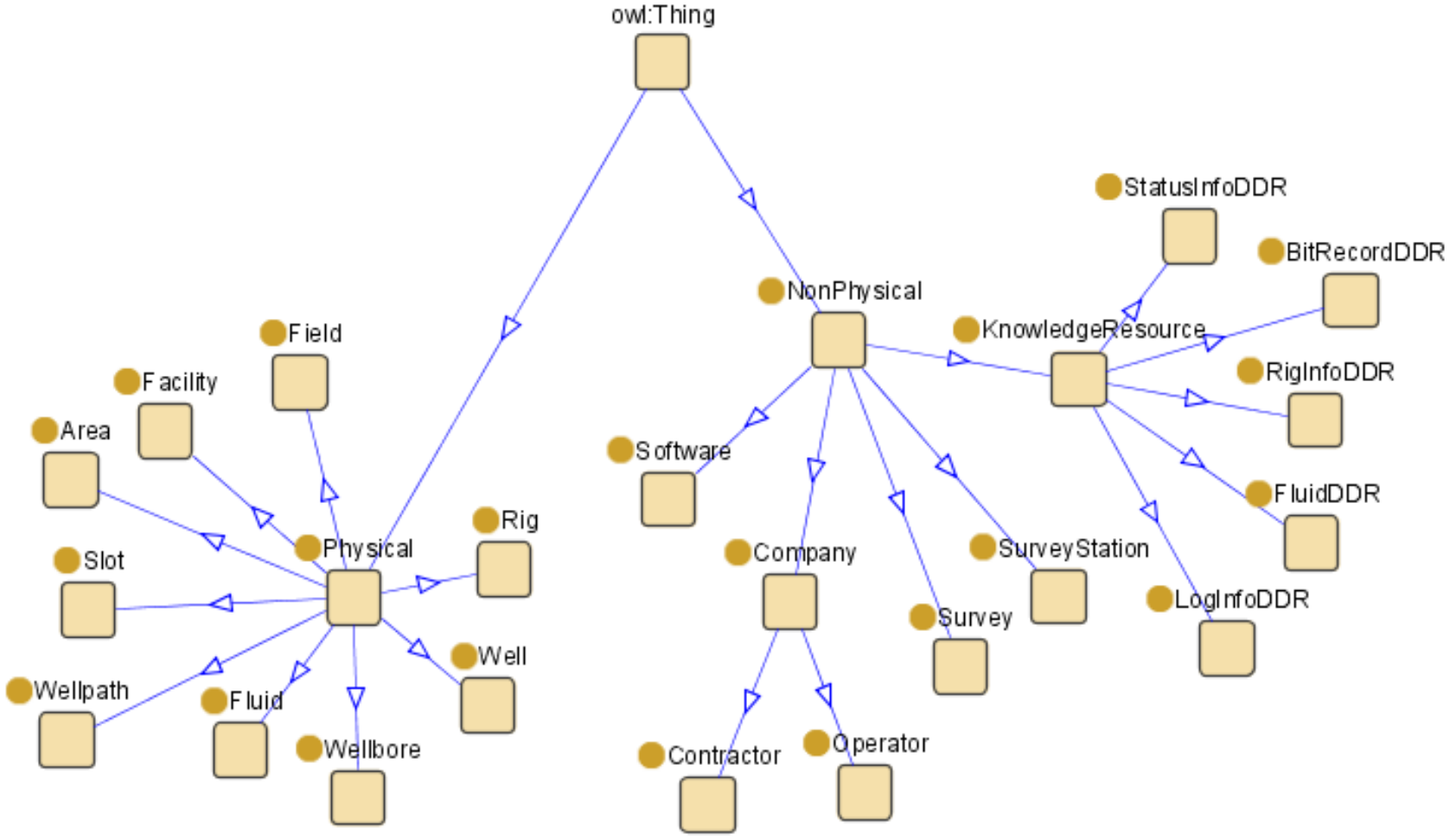
Architecture for a solution that exploits W3C technology



Implemented solution



The OWL DDR ontology



Mappings

```
<mapping id="Wellbore(Class)">
  <CQ string="Wellbore(getWellbore($ID))"/>
  <SQLQuery string="SELECT ID FROM wellbore"/>
</mapping>

<mapping id="tvd(Property)">
  <CQ string="tvd(getSurveyStation($Wellbore,$MD),$tvd)"/>
  <SQLQuery string="SELECT DISTINCT(Wellbore) AS Wellbore,
                    MD, tvd FROM trajectoryStation"/>
</mapping>
```

Annotated XSD

```
<xsd:complexType name="cs_drillReportSurveyStation">
  <xsd:annotation>
    <xsd:documentation>WITSML - Trajectory Station
    Component Schema</xsd:documentation>
    <xsd:appinfo>Modified-in-version=1.4.0,
    By-issue=1.3.1-33, Change=Added</xsd:appinfo>
    <xsd:appinfo>
    <sparql_query:quontoquery>
    SELECT $md $tvd $azimuth WHERE { $x :md $md .
$x :tvd $tvd .  $x :azimuth $azimuth }
    </sparql_query:quontoquery>
    </xsd:appinfo>
  </xsd:annotation>
  <xsd:sequence>
....
```

What did we learn?

- We managed to autogenerate a correct DDR report from realistic data
- DDR was well suited for a simple proof of concept
  - A good case for a MSc project
  - A well-structured terminology
- Extracting a useful ontology from the DDR XSD:
  - Straightforward with domain experts available
  - Time-consuming
- OWL-QL was sufficient
- The QuOnto technology was immature

How can we exploit this further?

- DDR is not an ideal case for OBDA
  - The reporting format is fixed and unlikely to change
  - There degree of integration is too low
  - All companies have implemented procedures for DDR generation
- An ideal case would be environmental data reports
  - The understanding of the domain is likely to change
  - Requires integration from many sources
  - There is a need for standardization of terminologies